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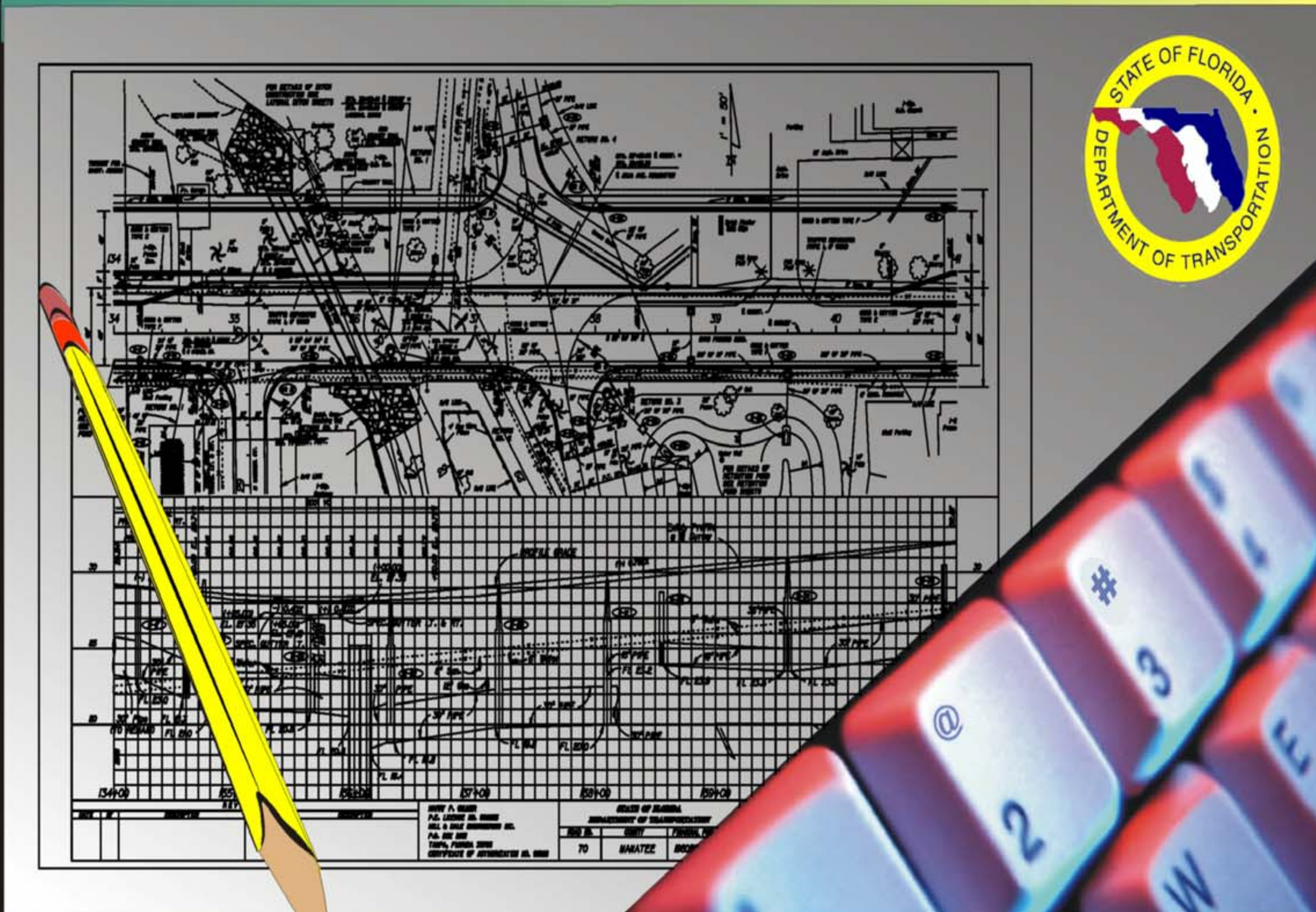
Topic #625-000-007
Plans Preparation Manual

January 2006

Revised – January 1, 2008

DESIGN CRITERIA AND PROCESS



FDOT

DESIGN

Volume

I

Plans Preparation Manual January 2006 Revised – January 1, 2008

DESIGN CRITERIA AND PROCESS I

Florida Department Of Transportation

PLANS PREPARATION MANUAL

VOLUME I

ROADWAY DESIGN OFFICE

TALLAHASSEE, FLORIDA

JANUARY 1, 2006

THIRD EDITION

REVISED – JANUARY 1, 2008

http://www.dot.state.fl.us/rddesign/PPMManual/PPM.htm

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Introduction

Plans Preparation Manual, Volume I

PURPOSE:

This ***Plans Preparation Manual, Volume 1*** sets forth geometric and other design criteria, as well as procedures, for Florida Department of Transportation (FDOT) projects. The information contained herein applies to the preparation of contract plans for roadways and structures.

AUTHORITY:

Sections 20.23(3)(a) and 334.048(3), Florida Statutes.

SCOPE:

This procedure impacts anyone preparing roadway and structures construction plans for the Department.

GENERAL INFORMATION:

Chapter 334 of the ***Florida Statutes***, as part of the ***Florida Transportation Code,*** establishes the responsibilities of the State, counties, and municipalities for the planning and development of the transportation systems serving the people of Florida, with the objective of assuring development of an integrated, balanced statewide system. The Code's purpose is to protect the safety and general welfare of the people of the State and to preserve and improve all transportation facilities in Florida. Under ***Section 334.048(3)***, the Code sets forth the powers and duties of the Department of Transportation including to adopt rules, procedures and standards for the conduct of its business operations and the implementation of any provisions of law for which the Department is responsible.

PROCEDURE:

The criteria in this manual represent requirements for the State Highway System which must be met for the design of FDOT projects unless approved exceptions or variations are obtained in accordance with procedures outlined in this manual.

Roadway and structures design is primarily a matter of sound application of acceptable engineering criteria and standards. While the criteria contained in this manual provide a basis for uniform design practice for typical roadway design situations, precise standards which would apply to individual situations must rely on good engineering practice and analyses.

Situations will exist where these criteria will not apply. The inappropriate use of and adherence to these criteria does not exempt the engineer from the professional responsibility of developing an appropriate design. The engineer is responsible for identifying those criteria which may not apply to a particular design, and for obtaining the necessary exception or variation to achieve proper design.

1. PLANS PREPARATION MANUAL, VOLUME I - MANUAL ORGANIZATION

   a. Background

      The Florida Department of Transportation ***Plans Preparation Manual (PPM)*** was published in the current format in January 1998. The criteria in the 1998 PPM were given in metric units.

   b. Organization

      The ***Plans Preparation Manual*** is a two-volume manual. ***Volume I*** contains the design criteria and process and ***Volume II*** contains material concerning plans preparation and assembly.

2. DISTRIBUTION

   This document is available electronically on the PPM web page:

   http://www.dot.state.fl.us/rddesign/PPMManual/PPM.htm

   PPM users can register to receive notification of updates and Roadway Design Bulletins online at:

   http://www2.dot.state.fl.us/contactmanagement/

   For information on updates and Design Bulletins, contact:

   Roadway Design Office, Mail Station 32
   Telephone (850) 414-4310
   FAX Number (850) 414-5261
   http://www.dot.state.fl.us/rddesign/

3. REVISIONS AND UPDATES

Plans Preparation Manual holders are encouraged to submit comments and suggestions for changes to the manual to the Roadway Design Office. When ideas or suggestions are received they will be reviewed by appropriate Roadway and/or Structures Design staff in a timely manner and will be coordinated with other offices affected by the proposed change. Items warranting immediate change will be made with the approval of the State Roadway Design Engineer in the form of a Design Bulletin.

Design Bulletins for the ***Plans Preparation Manual*** are numbered and distributed to all official ***Plans Preparation Manual*** holders. Design Bulletins have a maximum life of two hundred seventy (270) days. Within this time period either an official manual revision will be distributed or the Design Bulletin will become void.

Structures design issues, which are subject to modification and revision, will be processed in coordination with the Structures Design Office.

Proposed revisions are distributed in draft form to the District Design Engineers (DDE). The DDE coordinates the review of the proposed revisions with other affected district offices such as Structures Design. The goal is to obtain a majority opinion before revisions are made.

The Roadway Design Office will also coordinate proposed revisions or additions with affected offices within the Central Office. Substantive revisions that result in policy change will be coordinated with the Executive Committee for concurrence.

Revisions are voted on jointly by the District Design Engineers and the State Roadway Design Engineer (for Roadway Design issues) or the State Structures Design Engineer (for Structures Design issues). Each district will have one vote and the central office will have two votes; for a total of ten votes. Requirements mandated by FHWA or State Rules will not be subject to this majority vote.

All revisions and updates will be coordinated with the Forms and Procedures Office prior to distribution to ensure conformance with and incorporation into the Department's Standard Operating System.

The adopted revisions and addenda will be distributed to registered holders of the manual.

TRAINING:

None required.

FORMS ACCESS:

Documents marked as **SAMPLES** provide only a starting point allowing users to change or alter the document as needed to fit specific situations. Samples are not official forms of the Department.

GLOSSARY OF TERMS:

In the application of the criteria in this manual, the following definitions are assigned for consistency of understanding and interpretation.

1. **Arterials:** Divided or undivided, relatively continuous routes that primarily serve through traffic, high traffic volumes, and long average trip lengths. Traffic movement is of primary importance, with abutting land access of secondary importance. Arterials include expressways without full control of access, US numbered routes and principal state routes. May be classified as urban or rural.

2. **Auxiliary Lane:** The designated widths of roadway pavement marked to separate speed change, turning, passing and climbing maneuvers from through traffic. They may also provide short capacity segments.

3. **C-D Roads:** Collector-Distributor Roads are limited access roadways provided within a single interchange, or continuously through two or more interchanges on a freeway segment. They provide access to and from the freeway, and reduce and control the number of ingress and egress points on the through freeway. They are similar to continuous frontage roads except that access to abutting property is not permitted.

4. **Collectors:** Divided or undivided routes which serve to link arterial routes with local roads or major traffic generators. They serve as transition link between mobility needs and land use needs. Collectors include minor state routes, major county roads, and major urban and suburban streets.

5. **Florida Intrastate Highway System (FIHS):** An interconnected statewide system of limited access facilities and controlled access facilities developed and managed by the Department to meet standards and criteria established for the FIHS. It is part of the State Highway System, and is developed for high-speed and high-volume traffic movements. The FIHS also accommodates High-Occupancy Vehicles (HOVs), express bus transit and in some corridors, interregional and high speed intercity passenger rail service. Access to abutting land is subordinate to movement of traffic and such access must be prohibited or highly regulated.

6. **Freeways:** Divided arterial highways, with full control of access. Movement of traffic free of interference and conflicts is of primary importance. Essential elements include medians, grade separations, interchanges, and, in some cases, collector-distributor roads and frontage roads. Freeways include Interstate, toll road and expressway systems. May be classified as urban or rural.

7. **High Speed:** Descriptive term used to summarize all conditions governing the selection of Design Speeds 50 mph and greater.

8. **HOV Lane:** Special designated widths of pavement marked to provide travel lanes for high occupancy vehicles (HOV). They may be directly adjacent to other travel lanes or separated.

9. **Local Roads:** Routes which provide high access to abutting property, low average traffic volumes, short average trip lengths and on which through traffic movements are not of primary importance. Local roads include minor county roads, minor urban and suburban subdivision streets, and graded or unimproved roads.

10. **Low Speed:** Descriptive term used to summarize all conditions governing the selection of Design Speed of less than 50 mph.

11. **Low Volume and High Volume:** Descriptive terms used to describe certain operating characteristics and driver expectancy on highways. Criteria for some elements are selected according to these qualifying controls. Standards for these controls are given in the table following this section.

12. **Ramp:** A turning roadway that connects two or more legs at an interchange. The components of a ramp are a terminal at each leg and a connecting road. The geometry of the connecting road usually involves some curvature and a grade.

13. **Roadway:** The portion of a highway, including shoulders, for vehicular use. A divided highway has two or more roadways.

14. **Rural Areas:** Places outside the boundaries of concentrated populations that accommodate higher speeds, longer trip lengths and freedom of movement, and are relatively free of street and highway networks. Rural environments are surroundings of similar characteristics.

15. **Strategic Intermodal System (SIS):** A transportation system comprised of facilities and services of statewide and interregional significance, including appropriate components of all modes. The highway component includes all designated SIS Highway Corridors, Emerging SIS Highway Corridors, SIS Intermodal Connectors, and Emerging SIS Highway Intermodal Connectors.

16. **Streets:** The local system which provides direct access to residential neighborhoods and business districts, connects these areas to the higher order road systems and offers the highest access to abutting property; sometimes deliberately discouraging through-traffic movement and high speeds.

    Note: Local roads and streets are not generally a part of the State Highway System and therefore, may not be governed by the FDOT roadway design criteria, but by the ***Manual of Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways*** and/or criteria established by the local government.

17. **Traffic Lane/Traveled Way:** The designated widths of roadway pavement, exclusive of shoulders and marked bicycle lanes, marked to separate opposing traffic or vehicles traveling in the same direction. Traffic lanes include through travel lanes, auxiliary lanes, turn lanes, weaving, passing, and climbing lanes. They provide space for passenger cars, trucks, buses, recreational vehicles and, in some cases, bicycles.

18. **Travel Lane:** The designated widths of roadway pavement marked to carry through traffic and to separate it from opposing traffic or traffic occupying other traffic lanes. Generally, travel lanes equate to the basic number of lanes for a facility.

19. **Truck Traffic:** When significant, heavy, substantial, high percent, etc. truck traffic is used as a qualifying control, it shall mean 10% of the AADT or 10% of the daily count (24 hr.)

20. **Urban Areas:** Places within boundaries of concentrated populations, where density of street and highway networks, travel speeds, nature and composition of vehicles and pedestrian traffic dictate street and highway characteristics that promote lower speeds, better circulation movements, more delineation and traffic guidance devices, shorter trip lengths and provisions for pedestrians and bicycles. Urban environments are surroundings of similar characteristics.

21. **Urbanized Areas:** Transitional zones between rural and urban areas, with characteristics approaching or similar to urban areas.

STANDARDS FOR LOW AND HIGH VOLUME HIGHWAYS IN ANNUAL AVERAGE DAILY VOLUMES

HIGHWAY TYPE	LOW VOLUME AADT	HIGH VOLUME AADT
FREEWAY - URBAN		
4-LANE FACILITY	57,000	69,000
6-LANE FACILITY	86,000	103,000
8-LANE FACILITY	114,000	138,000
FREEWAY - RURAL		
4-LANE FACILITY	46,000	56,000
6-LANE FACILITY	69,000	83,000
8-LANE FACILITY	92,000	111,000
ARTERIALS - URBAN		
2-LANE FACILITY	16,000	20,000
4-LANE FACILITY	37,000	43,000
6-LANE FACILITY	55,000	64,000
8-LANE FACILITY	69,000	80,000
ARTERIALS - RURAL		
2-LANE FACILITY	9,000	14,000
4-LANE FACILITY	38,000	47,000
6-LANE FACILITY	58,000	71,000
COLLECTOR - URBAN		
2-LANE FACILITY	11,000	16,000
4-LANE FACILITY	37,000	45,000
COLLECTOR - RURAL		
2-LANE FACILITY	8,000	13,000
4-LANE FACILITY	30,000	38,000

LOW VOLUME FACILITIES ARE HIGHWAY TYPES WITH PROJECTED DESIGN YEAR **AADT** VOLUME EQUAL TO OR LESS THAN THE LOW VOLUME VALUES SHOWN.

HIGH VOLUME FACILITIES ARE HIGHWAY TYPES WITH PROJECTED DESIGN YEAR **AADT** VOLUME EQUAL TO OR GREATER THAN THE HIGH VOLUME VALUES SHOWN.

permit vehicles to enter the stream of traffic without coming to a complete stop but which, in reality, forces the vehicle to stop when a gap in the traffic stream is not immediately available.

Design inconsistencies can result in driver uncertainty, an increase in response time and an increase in the probability of inappropriate driver response.

Driver expectancy relates to the readiness of the driver to respond to events, situations, or the presentation of information. It can be defined as an inclination, based on previous experience, to respond in a set manner to a roadway or traffic situation. It should be stressed that the initial response is to the expected situation rather than the actual one.

Expectancy can affect the perception and use of information. In most circumstances, the expected and actual conditions are the same. However, when design inconsistencies occur and a driver's expectancy is incorrect, it takes longer to respond properly, there may be no response, or the response may be inappropriate to actual conditions.

There are certain elements in the design of various components of the roadway that particularly affect design consistency, driver expectancy, and vehicular operation. These components include horizontal and vertical alignment, embankments and slopes, shoulders, crown and cross slope, superelevation, bridge widths, signing and delineation, guardrail and placement of utility poles or light supports.

1.7 Transportation Design for Livable Communities (TDLC)

1.7.1 Policy Statement

Designs should consider the incorporation of TDLC features on the State Highway System when such features are desired, appropriate and feasible.

The incorporation of such features is a shared responsibility between the Department and local government. Design criteria for TDLC projects are in ***Chapter 21*** of this volume.

1.7.2 Aesthetics

Highways are built first and foremost for functional purposes, but the designer should be sensitive to how the highway will be perceived by the users. Designing aesthetic treatments is more than just providing for landscape plantings. The roadway should blend into the landscape, avoiding large cuts and fills, and round side slopes into the existing terrain. Horizontal and vertical alignment should be coordinated so that a driver has an opportunity to gain a sense of the local environment. Combinations of horizontal and crest vertical curves, and broken-back curves should be avoided. Excessively long tangent sections become monotonous. Either curvature or other features should be added to maintain drivers interest.

Application of the clear zone concept discussed in the chapter on Roadside Safety will result in a clean, uncluttered and pleasing roadside. Landscaping of the roadside should be considered early in the design process, so that plantings blend in with the geometric design. ***Chapter 9*** of this volume discusses landscape design criteria. At times extra right of way may be obtained for treatments if the need is identified early. Retention/detention ponds and other wetlands can be attractive if well designed and placed in a location where they can be viewed from the roadway.

Community Structures placed in the right of way to represent the community are discussed in ***Section 9.4*** of this volume.

Vistas of exceptional beauty should be accentuated by the roadway geometrics. Ideally, such vistas should be on the outside of horizontal curves, without excessive roadside appurtenances and signs to clutter the view.

1.9 Design Speed

Design speed is a principal design control that regulates the selection of many of the project standards and criteria used to design a roadway project. The selection of an appropriate design speed must consider many factors. The AASHTO publication, ***A Policy on Geometric Design of Highways and Streets***, has a thorough discussion on design speed and these factors.

1.9.1 Design Speed Coordination and Approvals

As a principal design control, design speed must be selected very early in the design process and must be documented in the project design file. The Engineer of Record must coordinate with the District Design Engineer (DDE), the District Traffic Operations Engineer (DTOE), and the responsible PD&E engineer to discuss the anticipated posted speed. Every effort should be made to **use as high a design speed as practical** to attain a desired degree of safety, mobility and efficiency. However, the design speed shall not be less than the project's proposed posted speed (existing posted speed if no change is proposed) or legal speed limit. On new construction and reconstruction projects, designers shall not include in their plans a posted speed higher than the design speed.

The selected design speed shall be jointly approved by the District Design Engineer and the District Traffic Operations Engineer. This includes joint approval that the expected posted speed will not exceed the selected design speed. This is to be documented on the Typical Section Package as described in ***Section 16.2.3***. When agreement between the DDE and DTOE on the Design Speed cannot be reached, the DDE and DTOE will forward the matter to the District Director of Transportation Development and District Director of Transportation Operations for final resolution. Note that in some cases it may be appropriate to select a higher design speed to match an expected posted speed and process Design Exceptions or Variations for those design elements that do not meet the criteria for the higher speed.

The modification of posted speed limits after the construction of a project has been completed is a decision made under the authority of the District Traffic Operations Engineer (***FDOT Procedure No. 750-010-011***). This is based on the 85^{th} percentile speed determined through engineering and traffic investigations described in ***Speed Zoning for Highways, Roads and Streets in Florida, (FDOT Procedure No. 750-010-002)***. The DTOE typically conducts a speed investigation within one year after a new construction or reconstruction project is completed. When it is determined from this speed study that a posted speed higher than the original design speed is warranted, the DTOE working with the DDE must process Design Exceptions or Variations for those design elements that do not meet the criteria for the higher speed. When agreement between the DDE and DTOE cannot be reached, the DDE and DTOE will forward the matter to the District Director of Transportation Development and District Director of Transportation Operations for final resolution. Further explanation on how posted speed limits are developed can also be found on the State Traffic Operations web page:

http://www.dot.state.fl.us/TrafficOperations/FAQs/SpeedLimitFAQ.htm

While the selected design speed will establish minimum geometric requirements (e.g., minimum horizontal curve radius and sight distance), this does not preclude the use of improved geometry (flatter curves or greater sight distances) where such improvements can be provided as a part of economic design. The Engineer of Record is required to document, in a design speed matrix, any design features that were designed to speeds other than the project design speed. Increments of 5 mph should be used when selecting design speeds.

Table 1.9.1 provides a recommended range of design speeds for new construction and reconstruction projects on the State Highway System except for facilities on the Florida Intrastate Highway System (FIHS)/Strategic Intermodal System (SIS). Design Speed for facilities on the FIHS/SIS (including SIS Highway Corridors, Emerging SIS Highway Corridors, SIS Highway Intermodal Connectors and Emerging SIS Highway Intermodal Connectors) shall meet or exceed the values in ***Table 1.9.2***.

For design speed on RRR projects on the State Highway System, see ***Chapter 25*** of this volume. ***Chapter 25*** may be used for RRR projects on the FIHS/SIS. However, the minimum design speed in ***Table 1.9.2*** should be used when practicable, consistent with proposed improvements defined for the facility in the ***Corridor Management Plan***. See ***Topic Number 525-030-250, Procedure for the Development of the Florida Intrastate Highway System,*** for requirements.

Chapter 2

Design Geometrics and Criteria

Tables

Chapter 2

Design Geometrics and Criteria

2.0 General

The implementation of design criteria is outlined in the following text.

1. **Design Criteria:** The design criteria presented in this manual are intended as the principal source of criteria for the design of new construction or major reconstruction projects on the Florida State Highway System.

   These criteria are presented by subject for major design elements as fixed values or a range of acceptable values as defined by qualifiers.

   Where design criteria appear in the ***Design Standards***, they will be consistent with the criteria in this manual. In addition, some criteria will remain in the other chapters of this manual. When conflicts are discovered, they should be brought to the attention of the State Roadway Design Engineer or State Structures Design Engineer, as applicable, for resolution.

   On reconstruction projects, existing project features which were constructed to meet minimum metric design criteria, but are mathematically slightly less than equivalent minimum English design criteria, do not require design exceptions or variations to remain.

   Design criteria for Resurfacing, Restoration, and Rehabilitation (RRR) are presented in ***Chapter 25*** of this volume and are applicable only on programmed RRR projects.

   Facilities on the Florida Intrastate Highway System (FIHS) and the Strategic Intermodal System (SIS) are subject to special standards and criteria for number of lanes, design speed, access, level of service, and other requirements. These are identified in ***Topic No. 525-030-250, Procedure for the Development of the Florida Intrastate Highway System.***

   SIS and Emerging SIS Highway Intermodal Connectors on the State Highway System (SHS) shall be designed in accordance with the FIHS/SIS criteria contained in this manual. SIS and Emerging SIS Highway Intermodal Connectors on the local system (non-SHS) should also be designed in accordance with the FIHS/SIS criteria contained in this manual, but the District may allow the use of the ***Manual of Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways*** (commonly known as the ***"Florida Greenbook"***), ***Topic No. 625-000-015*** depending on project specifics.

Design Criteria for roads that are not part of the State Highway System should be obtained from the ***Florida Greenbook***.

2. **Design Controls:** Design controls are characteristics and conditions that influence or regulate the selection of the criteria for project standards. It is the designer's responsibility to recognize and apply those controls applicable to the project.

3. **Design Standards:** The specific values selected from the design criteria become the design standards for a design project. These standards will be identified and documented by the designer.

4. **Project Parameters:** The properties or specific conditions with limits which require modification of design standards within these limits. The designer is responsible for establishing and documenting any project parameters and their limits, as part of the justification for deviations from project standards.

Many design standard considerations are related directly to the design speed, including vertical and horizontal geometry and required sight distances. The minimum design values are very closely related to traffic safety and cannot be compromised without an approved design exception or design variation. See ***Chapter 23*** of this volume.

Public facilities constructed or funded by FDOT (parking garages, weigh stations, operation centers, park & ride facilities, etc.) shall comply with the criteria in this manual, ***FDOT Design Standards***, and other applicable Department manuals. Roads not on the State Highway System which are impacted by the construction of these public facilities should also be designed in accordance with Department criteria and standards, but the District may allow the use of the ***Florida Greenbook*** depending on project specifics.

Roadway and bridge typical sections developed for projects must reflect the values and properties outlined in Items 1 - 4 of this section. These typical sections shall include the location and limits of such features as lanes, medians, shoulders, curbs, sidewalks, barriers, railings, etc.. ***Section 16.2.3*** of this volume gives the requirements for approval and concurrence of typical section packages.

Coordination is of primary importance on projects that contain both roadway and bridge typical sections. The Roadway and Structures Offices must address the compatibility of the typical section features mentioned above, and provide for an integrated design and review process for the project.

Example roadway typical sections are included in the exhibits in ***Volume 2, Chapter 6***. Partial bridge sections, ***Figures 2.0.1 - 2.0.4***, provide criteria regarding lanes, medians, and shoulders for various facilities. Subsequent sections of this chapter contain specific information and criteria regarding these and other typical section elements, as well as geometric features of both roadways and bridges.

Figure 2.0.3 Partial Bridge Sections *

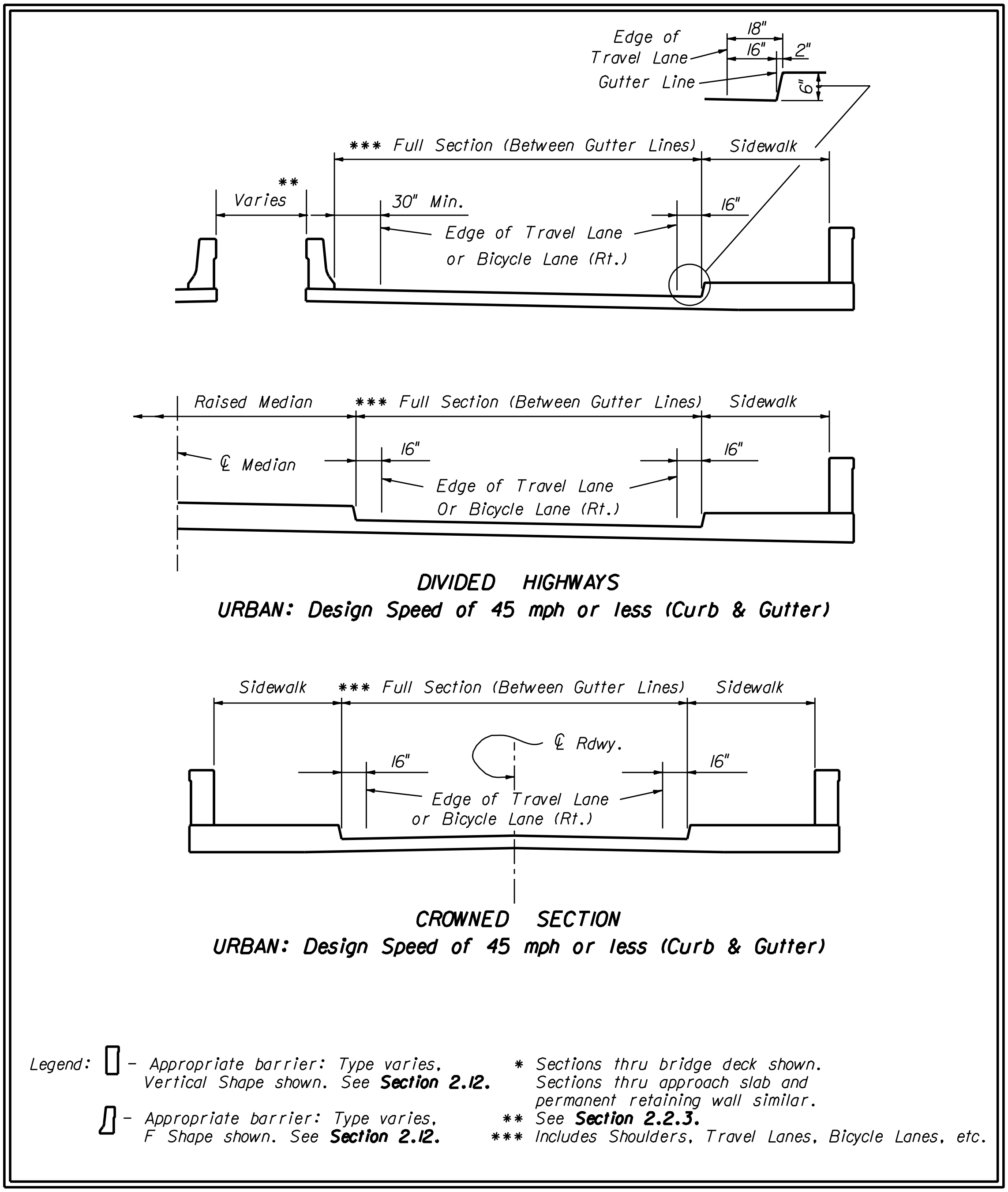
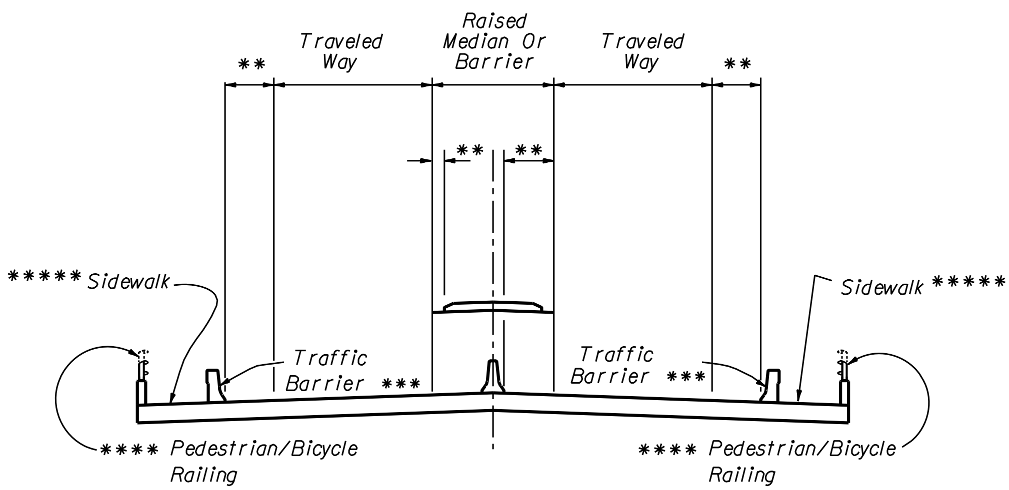


Figure 2.0.4 Bridge Section *



DIVIDED ARTERIALS AND COLLECTORS - URBAN

* *Sections thru bridge deck shown. Sections thru approach slab and permanent retaining wall similar.*

** *Outside shoulders:*
- *Standard curb and gutter on approach roadway:*
  - *Use 2.5' minimum, 5.5' (with 4' bike lane), 8' minimum for long bridges (500' or greater) and/or high level bridges.*
- *Flush shoulder on approach roadway:*
  - *Use 10' minimum.*

Median shoulders:
- *Raised median on bridge:*
  - *Use same offset to median as used on the approach roadway.*
- *Median barrier on bridge:*
  - *Raised median on approach roadway:*
    - *Use 2.5' minimum, and for long bridges (500' or greater) and/or high level bridges use 6' minimum for 2 lanes and 8' minimum for 3 or more lanes.*
  - *Flush shoulder on approach roadway:*
    - *Use 6' minimum for 2 lanes and 10' minimum for 3 or more lanes.*

*** *Use traffic barrier between traveled way and sidewalk and separate pedestrian railing at back of sidewalk if heavy pedestrian traffic is anticipated or facility is near a school, or design speeds on the bridge are 50 mph or greater.*

**** *Provide either a 42" or 54" pedestrian/bicycle railing as required per Section 8.8.*

***** *Sidewalks shall be a minimum of 5' in clear width and may be located along one side of the bridge only.*

2.1.5 Cross Slopes

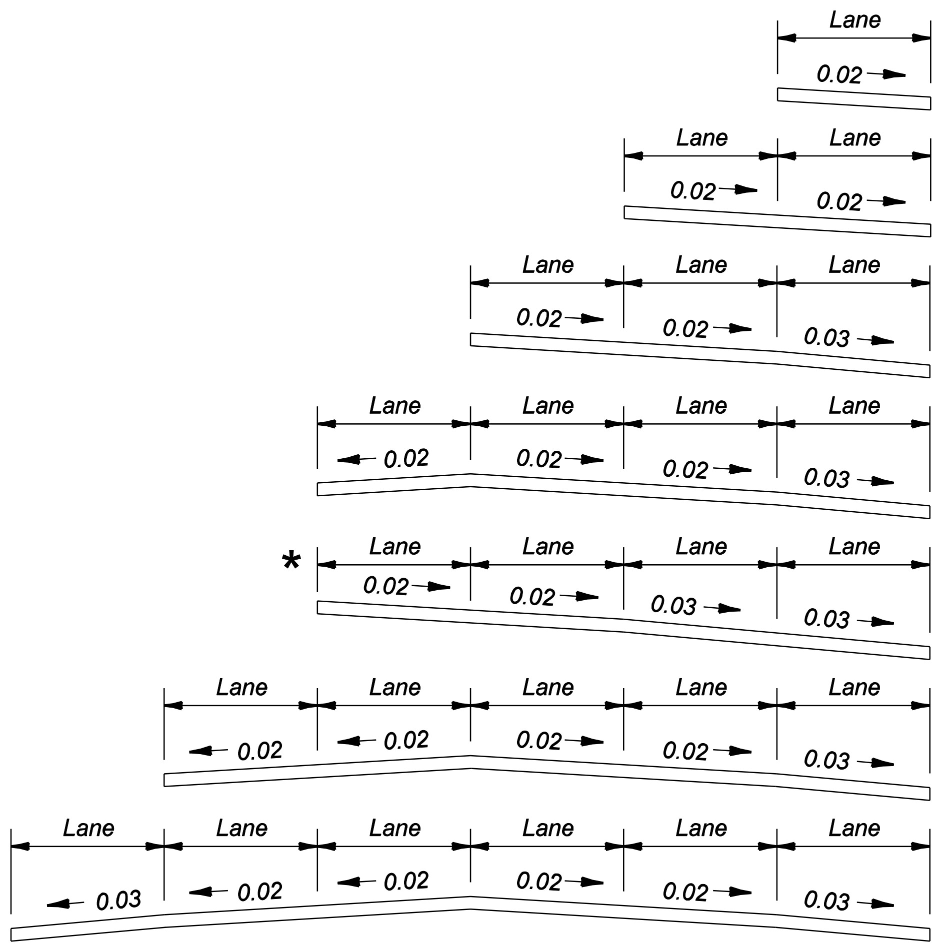
For roadways, the maximum number of travel lanes with cross slope in one direction is three lanes. This maximum may be increased to four lanes for curb and gutter roadways with four travel lanes in the same direction. See ***Figure 2.1.1*** for standard pavement cross slopes. The algebraic difference in cross slope between adjacent through lanes should not exceed 0.04. The maximum algebraic difference in cross slope between a through lane and an auxiliary lane at a turning roadway terminal is given in ***Table 2.1.4***. ***Chapter 4*** on ***Roadside Safety*** and ***Chapter 8*** on ***Pedestrian, Bicycle and Public Transit Facilities*** (this volume) contain additional procedures and guidelines on slope design.

Cross slopes on bridges shall be on a uniform, straight-line rate, typically 0.02, in each traffic direction, with no break in slope. The straight-line slope shall be applied uniformly over all travel lanes and required shoulders in each direction of travel. Bridges with one-way traffic shall have one, uniform cross slope, while bridges with two-way traffic may be designed with a crowned bridge deck section.

This cross slope criteria applies to all bridge decks whether of cast-in-place concrete, precast concrete, or open steel decking.

Transitions shall be used to adjust for differences in cross slope between the approach roadway section and the required straight-line slope for bridge decks. Whenever possible the transition should be accomplished on the roadway section, outside the limits of the bridge and approach slabs. This will require detailing of the transition(s) in the roadway plans. Coordination between the Roadway, Drainage and Structures designers in the development of transitions is required to ensure compatibility and harmonizing at bridge approaches.

Figure 2.1.1 Standard Pavement Cross Slopes



All Travel Lanes One Direction

These sections show only the standard slopes for adjoining travel lanes; they do not prescribe needed lanes, lane usage or typical section requirements other than lane slope. These slopes are not applicable to parabolic crowns.

Maximum pavement cross slopes on tangent sections are:
- 0.04 for design speeds of 45 mph or less.
- 0.03 for design speeds greater than 45 mph.

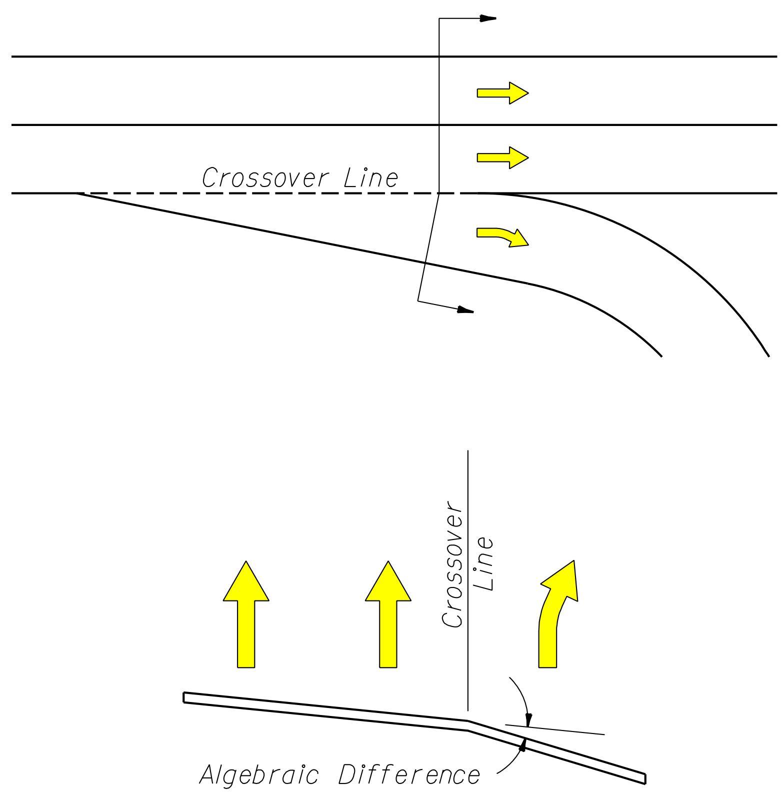
The change in cross slope between adjacent through lanes shall not exceed 0.04.

Slopes on multi-purpose lanes may be 0.03 to 0.05. Portions of multi-purpose lanes that are reserved for parking and access isles for the physically disabled shall have cross slopes not exceeding 1:50 (0.02) in all directions.

*NOTE: Four travel lanes may be sloped in one direction for curb and gutter sections only.

Table 2.1.4 Maximum Algebraic Difference in Cross Slope at Turning Roadway Terminals

Design Speed of Exit or Entrance Curve (mph)	Maximum Algebraic Difference in Cross Slope at Crossover Line (%)
Less than 35	6.0
35 and over	5.0



2.1.6 Roadway Pavement

The type of pavement usually is determined by analysis of the volume and composition of traffic, the soil conditions, the availability of materials, the initial cost and the estimated cost of maintenance.

Criteria and procedures for selecting the type of pavement and the structural design of the various surfacing courses are discussed in the Department's pavement design manuals.

2.1.6.1 Alternative Roadway Paving Treatments

When requested by a local community, alternative paving treatments such as patterned/textured pavement and architectural pavers meeting FDOT Specifications may be used for enhancing aesthetics and appearance. Use of either of these paving treatments involves additional construction and maintenance costs not associated with typical roadway pavement. Therefore, when used, appropriate agreements with the local community should be obtained. Maintenance agreements for installations on the State Highway System must include provisions that performance requirements for friction and wear shall be maintained for the duration of the installation. The following restrictions apply:

Architectural Pavers:

1. Shall not be used on the traveled way of the State Highway System.
2. May be used on local side streets (with a design speed of 35 mph or less), non-traffic medians and islands, curb extensions, sidewalks, borders, and other areas not subject to vehicle traffic.
3. ADA requirements must be met in areas subject to pedestrian traffic.

Patterned/textured Pavement:

1. Use on the traveled way of the State Highway System is restricted to areas within marked pedestrian crosswalks where the design speed is 45 mph or less. However, patterned/textured pavement shall not be used on pedestrian crosswalks across limited access roadway ramps. Use on pedestrian crosswalks with heavy truck traffic turning movements (≥ 10% trucks) should be avoided.
2. May be used on local side streets, non-traffic medians and islands, curb extensions, sidewalks, borders, and other areas not subject to vehicle traffic.

3. ADA requirements must be met in areas subject to pedestrian traffic.

Architectural pavers consist of brick pavers or concrete pavers placed on specially prepared bedding material and are covered under ***Section 526 of the Standard Specifications***. When used, the plans shall identify the location, type, pattern, shape and color, along with details and requirements for edge restraints, bedding material thickness, and base and subbase materials and thicknesses, as appropriate.

Patterned/textured pavement treatments may be applied to asphalt or concrete pavements and are covered under ***Section 523 of the Standard Specifications***. Patterns are defined as visible surface markings while imprinted textures are defined as palpable surface markings. When used, the plans shall identify the location, pattern/texture type (brick, stone, etc.), and coating color.

2.1.7 Transitions of Pavement Widths

When new pavement widths are not substantially greater than the joining pavement, grade differentials are slight and future widening is expected, striped transitions may be considered. An alternative approach is an abrupt change in width, with appropriate pavement markings, reflectors and rumble strips. The ***Design Standards*** contain additional criteria and details.

2.1.8 Number of Lanes on the State Highway System

For the number of lanes to be provided on the State Highway System, see the ***Florida Intrastate Highway System Program Development Procedure*** (***Topic No. 525-030-255***), and ***Section 335.02(3)*** of the ***Florida Statutes***.

Nothing in ***s. 335.02(3), F.S***., precludes a number of lanes in excess of ten lanes. However, before the Department may determine the number of lanes should be more than that, the availability of right of way and the capacity to accommodate other modes of transportation within existing rights of way must be considered.

Exceptions to this Procedure (***Topic No.: 525-030-255; s. 335.02(3), F.S.***) will be addressed on a case-by-case basis, with final approval resting with the Secretary of Transportation.

2.3.1 Limits of Friction Course on Paved Shoulders

Friction courses on limited access facilities shall be extended 8 inches onto both the median and outside paved shoulders of roadways.

Friction courses shall be extended the full width of the paved shoulder on non-limited access highways to accommodate bicyclist usage.

2.3.2 Shoulder Warning Devices (Rumble Strips)

The safety of freeways and other limited access facilities on the State highway system is to be enhanced by the installation of shoulder warning devices in the form of rumble strips. Projects on limited access facilities shall include the construction of ground-in rumble strips. Several types of applications have been tested. The ground-in strips provide the desired warning to the driver and consistency in application has been possible using this construction process.

These ground-in strips are installed using two patterns. The skip array is the standard array. These are used on both inside and outside shoulders on divided highway sections. The continuous array shall be constructed in advance of bridge ends for a distance of 1000 ft. or back to the gore recovery area for mainline interchange bridges. Other areas may be specified in plans.

Methods and types of application other than described above and in the ***Design Standards, Index 518***, shall not be used unless concurred in by the State Roadway Design Engineer. Approval will be considered only with sufficient documented justification for deviation from the standard.

The ***Design Standards, Index 518***, has been prepared to provide all needed details. This index also gives standards for raised rumble strips for use at structures where the bridge shoulder width is less than the width of the useable shoulder on the approach roadway. Notes for locations of raised rumble strip applications are also included on the index.

2.3.3 Use of Curb on High Speed Roadways

Curbs shall not be used on high speed roadways (Design Speed > 45 mph) except as follows:

1. FDOT Suburban Section
2. FDOT High Speed Urban Section
3. Directional Median Openings
4. Transit Stops

Curbs used on high speed roadways shall be FDOT Type E with the face of the curb placed no closer to the edge of the traveled way than the outside edge of the shoulder. For the Suburban and High Speed Urban Section, special offset widths to curb have been established. See ***Section 2.16*** for Suburban Section requirements and ***Section 2.17*** for High Speed Urban Section requirements. For directional median openings, see ***Index 527***. For transit stops, the curb face shall be no closer to the edge of the traveled way than the outside edge of the approach shoulder.

2.4 Roadside Slopes

Criteria and details for roadside slopes are included in ***Table 2.4.1***. Clear zone criteria are included in ***Section 2.11*** and ***Chapter 4*** of this volume.

Table 2.4.1 Roadside Slopes

TYPE OF FACILITY	**RURAL & URBAN FREEWAYS, RURAL ARTERIALS AND COLLECTORS, WITH PROJECTED 20 YEAR AADT OF 1500 OR GREATER DESIGN SPEED 45 mph OR GREATER**		**RURAL ARTERIALS AND COLLECTORS WITH PROJECTED 20 YR. AADT LESS THAN 1500 AND RURAL LOCALS, URBAN ARTERIALS AND COLLECTORS WITHOUT CURB & GUTTER ALL SPEEDS**		**URBAN ARTERIALS AND COLLECTORS WITH CURB & GUTTER DESIGN SPEED 45 mph OR LESS**	
	Height of Fill (feet) *	Rate	Height of Fill (feet) *	Rate	Height of Fill (feet) *	Rate
Front Slope	0.0 - 5 5 - 10 10 - 20 >20	1:6 1:6 to edge of CZ then 1:4 1:6 to edge of CZ then 1:3 1:2 (with guardrail)	0.0 - 5 5 - 20	1:6 Where R/W is insufficient, 1:6 to edge of CZ then 1:3 1:6 to edge of CZ then 1:3. Where, R/W is insufficient, 1:6 to edge of CZ then 1:2.	All	1:2 or to suit property owner, not flatter than 1:6. R/W cost must be considered for high fill sections in urban areas
Back Slope	All	1:4 or 1:3 with a standard width trapezoidal ditch and 1:6 front slope	All	1:4 when R/W permits or 1:3	All	1:2 or to suit property owner. Not flatter than 1:6.
Transverse Slopes	All	1:10 or flatter (freeways) 1:4 (others)	All	1:4	All	1:4

* Height of Fill is the vertical distance from the edge of the outside travel lane to the toe of front slope.

2.5 Borders

Border widths for new construction or major reconstruction where R/W acquisition is required are as follows:

On highways with flush shoulders, the border is measured from the shoulder point to the right of way line. This border width accommodates (1) roadside design components such as signing, drainage features, guardrail, fencing and clear zone, (2) the construction and maintenance of the facility and (3) permitted public utilities. See ***Table 2.5.1***.

On highways with curb or curb and gutter where clear zone is being provided, border width is to be based on flush shoulder requirements, but is measured from the lip of the gutter (or face of curb when there is not a gutter) to the right of way line. This border width accommodates (1) roadside design components such as signing, drainage features, guardrail, fencing and clear zone, (2) the construction and maintenance of the facility and (3) permitted public utilities. See ***Table 2.5.1***.

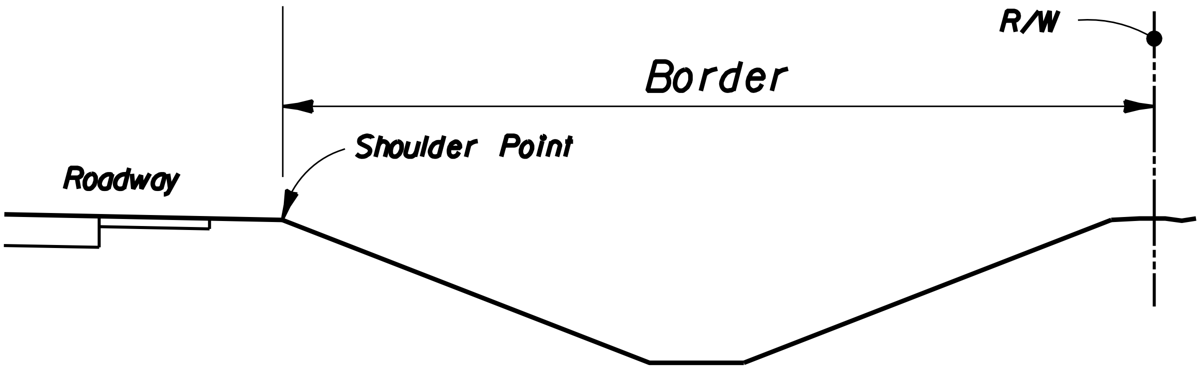
On highways with curb or curb and gutter in urban areas, the border is measured from the lip of the gutter (or face of curb when there is not a gutter) to the right of way line. This border provides space for a buffer between vehicles and pedestrians, sidewalks with ADA provisions, traffic control devices, fire hydrants, storm drainage features, bus and transit features, permitted public utilities and space for aesthetic features such as sod and other landscape items. See ***Table 2.5.2***.

On limited access facilities, the border width criteria are provided in ***Section 2.5.1***.

Projects involving bridges will require coordination to match the features of the roadway with those of the bridge.

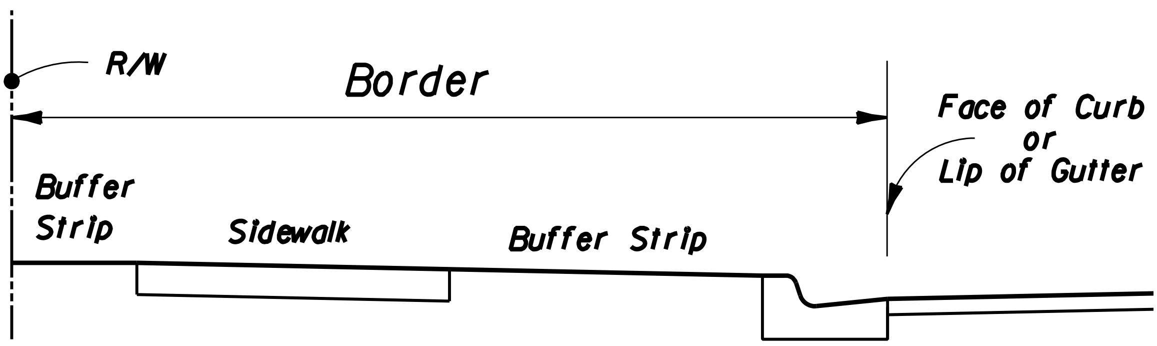
On existing streets and highways where R/W cannot be acquired or where the decision has been made to simply maintain and preserve the facility, the border area must be reserved for the functional and safety needs of the facility. Extraordinary design effort will be required to meet ADA requirements, driveway construction and the other essential features. Spot R/W acquisitions may be required along the corridor to accommodate these essential components. The absolute minimum border under these conditions is 8 feet.

Table 2.5.1 Highways with Flush Shoulders



BORDER	
TYPE FACILITY	**WIDTH (FEET)**
ARTERIALS COLLECTORS Design Speed > 45 mph	40
ARTERIALS COLLECTORS Design Speed ≤ 45 mph	33

Table 2.5.2 Highways with Curb or Curb and Gutter in Urban Areas



** Border width measured from lip of gutter (shown) or from face of curb when there is not a gutter.*

BORDER

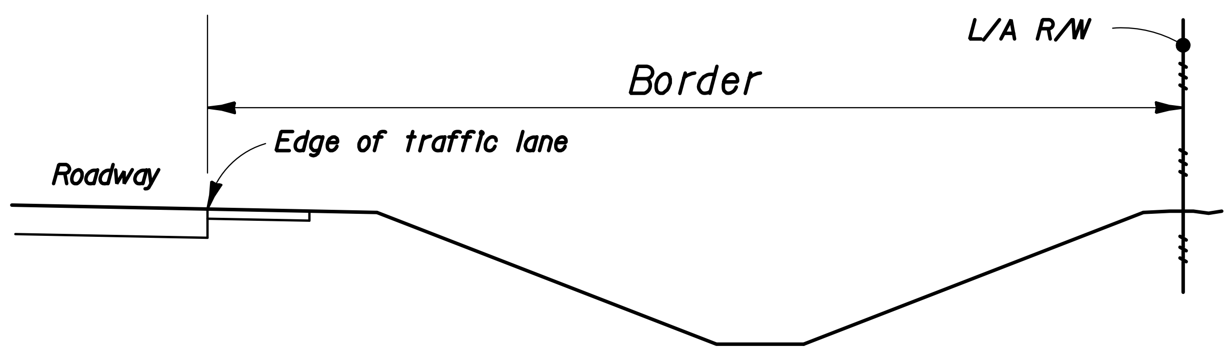
TYPE FACILITY	MINIMUM WIDTH (FEET)	
	TRAVEL LANES AT CURB OR CURB AND GUTTER	BIKE LANES OR OTHER AUXILIARY LANES AT CURB OR CURB AND GUTTER
ARTERIALS COLLECTORS Design Speed = 45 mph	14	12
ARTERIALS COLLECTORS Design Speed ≤ 40 mph	12	10
URBAN COLLECTOR STREETS Design Speed ≤ 30 mph	10	8

2.5.1 Limited Access Facilities

On limited access facilities, the border is measured from the edge of the outside traffic lane to the right of way line. This width may be reduced in the area of a crossroad terminal, as long as the design meets the requirements for clear zone, horizontal clearance, drainage, maintenance access, etc.

Limited access facilities shall be contained by fencing, or in special cases, walls or barriers. These treatments shall be continuous and appropriate for each location. Treatment height and type may vary under special conditions. The treatment is typically placed at or near the limited access right of way line, but location may be adjusted based on site-specific conditions (i.e., ponds, trees, bridges, etc.). Placement information and additional data is included in the ***Design Standards, Indexes 800, 801, and 802***.

Table 2.5.3 Limited Access Facilities



BORDER

TYPE FACILITY	WIDTH (FEET)
FREEWAYS (INCLUDING INTERCHANGE RAMPS)	94

2.6 Grades

The profile grade line defines the vertical alignment for roadway and bridge construction. As with other design elements, the characteristics of vertical alignment are influenced greatly by basic controls related to design speed, traffic volumes, functional classification, drainage and terrain conditions. Within these basic controls, several general criteria must be considered. See ***Tables 2.6.1 – 2.6.4***.

Minimum clearances for structures over railroads are given in ***Table 2.10.1***. Additional information, including at-grade crossings, is given in ***Chapter 6*** of this volume.

The Department's minimum for structure clearance over all highways is given in the criteria tables and figures. Exceptions to this policy shall be permitted only when justified by extenuating circumstances and approved as a variation or exception.

The clearance required for the roadway base course above the Base Clearance Water Elevation is given in the criteria tables and figures.

The relationship between the pavement elevation and the Design Flood Elevation is discussed in ***Section 4.4 (3)*** of the ***FDOT Drainage Manual (Topic No. 625-040-002)***.

Grades for structures over water shall be designed to provide the desirable vertical clearance as stipulated in ***Section 2.10*** of this chapter.

The ***Design Standards*** lists utility clearances and minimum covers and maximum fill heights for all types of culverts.

Table 2.6.1 Maximum Grades

MAXIMUM GRADES IN PERCENT													
TYPE OF HIGHWAY	**AREA**	**DESIGN SPEED (mph)**											
		FLAT TERRAIN						**ROLLING TERRAIN**					
		30	**40**	**45**	**50**	**60**	**70**	**30**	**40**	**45**	**50**	**60**	**70**
FREEWAYS [1]	Rural Urban	----	----	4	4	3	3	----	----	----	5	4	4
ARTERIALS [3]	Rural	----	5	5	4	3	3	----	6	6	5	4	4
	Urban	8	7	6	6	5	----	9	8	7	7	6	----
COLLECTORS [3]	Rural	7	7	7	6	5	4	9	8	8	7	6	5
	Urban	9	9	8	7	6	5	11	10	9	8	7	6
	Industrial [2]	4	4	4	3	3	----	5	5	5	4	4	----
FRONTAGE ROADS	Require same criteria as Collectors.												

RAMPS				
DESIGN SPEED (mph)	< 20	25 to 30	35 to 40	45 to 50
GRADES (%)	6 to 8	5 to 7	4 to 6	3 to 5

One-way descending grades on Ramps may be 2% greater, in special cases.

1. Interstate designed to 70 mph will be restricted to 3% maximum grade.
2. Areas with significant (10% or more) heavy truck traffic.
3. On 2-lane highways critical length of upgrades shall not be exceeded. Critical lengths are those which reduce the speeds of 200 lb/hp trucks by more than 10 mph.

Table 2.6.2 Maximum Change in Grade Without Vertical Curves

DESIGN SPEED (mph)	**20**	**30**	**40**	**45**	**50**	**60**	**65**	**70**
MAXIMUM CHANGE IN GRADE IN PERCENT	1.20	1.00	0.80	0.70	0.60	0.40	0.30	0.20

Table 2.6.3 Criteria for Grade Datum

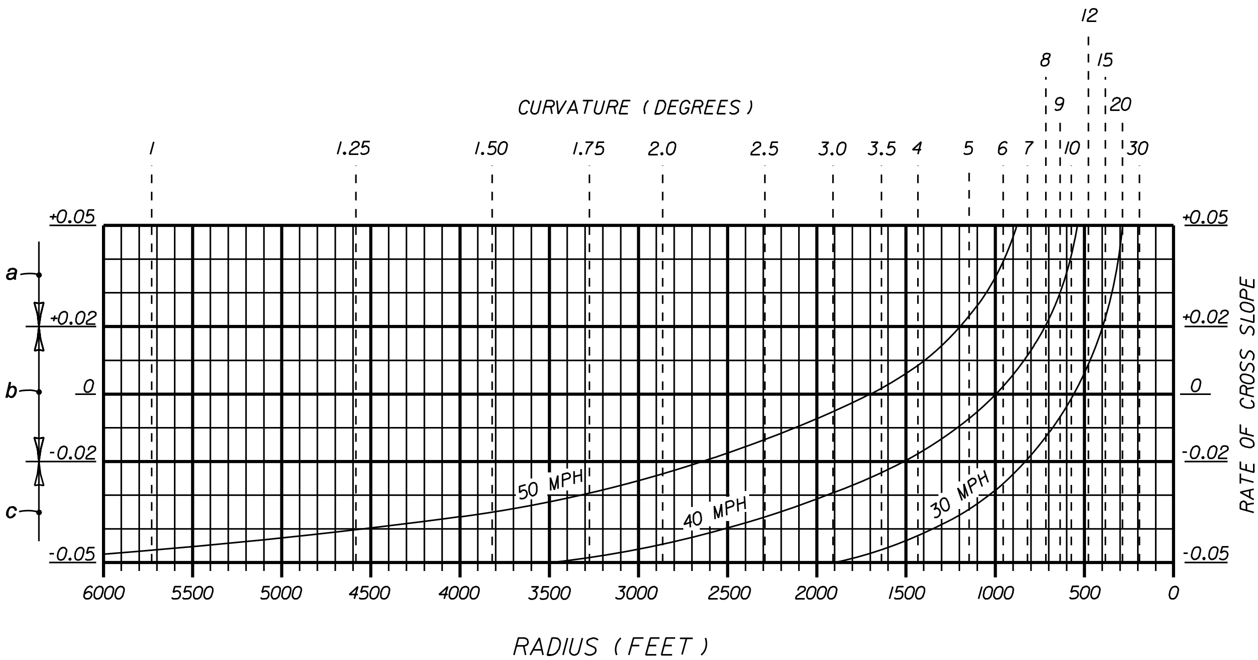
CLEARANCE FOR THE ROADWAY BASE COURSE ABOVE THE BASE CLEARANCE WATER ELEVATION	
TYPE FACILITY	**REQUIRED CLEARANCE**
Freeways and Rural Multilane Mainline	3 ft.
Ramps (proper)	2 ft.
Low Point on Ramps at Cross Roads	1 ft.
Rural Two-lane with Design Year ADT Greater than 1500 VPD	2 ft.
All Other Facilities Including Urban	1 ft.

Table 2.6.4 Grade Criteria for Curb and Gutter Sections

GRADES ON CURB AND GUTTER SECTIONS	
Minimum Distance Required between VPI's	250 ft.
Minimum Grade (%)	0.3 %

(See ***Table 2.6.1*** for Maximum Grades)

Figure 2.9.2 Superelevation Rates for Urban Highways and High Speed Urban Streets (e_{max} = 0.05)



a. When the speed curves and the degree of curve lines intersect above this line, the pavement is to be superelevated (positive slope) at the rates indicated at the lines intersecting points.

b. When the speed curves and the degree of curve lines intersect between these limits, the pavement is to be superelevated at the rate of 0.02 (positive slope).

c. When the speed curves and the degree of curve lines intersect below this line, the pavement is to have normal crown (typically 0.02 and 0.03 downward slopes).

Table 2.9.3 Superelevation Transition Slope Rates for Rural Highways, Urban Freeways and High Speed Urban Highways

SLOPE RATES FOR STRAIGHT LINE SUPERELEVATION TRANSITIONS				
SECTION	**Design Speed (mph)**			
	35-40	**45-50**	**55-60**	**65-70**
	SLOPE RATES			
2 Lane & 4 Lane	1:175	1:200	1:225	1:250
6 Lane	---	1:160	1:180	1:200
8 Lane	---	1:150	1:170	1:190

The length of superelevation transition is to be determined by the relative slope rate between the travel way edge of pavement and the profile grade, except that the minimum length of transition shall be 100 feet.

For additional information on transitions, see the ***Design Standards, Index 510***.

Table 2.9.4 Superelevation Transition Slope Rates for Urban Highways and High Speed Urban Streets

SLOPE RATES FOR STRAIGHT LINE SUPERELEVATION TRANSITIONS	
30 mph	1:100
40 mph	1:125
45-50 mph[1]	1:150

1. A slope rate of 1:125 may be used for 45 mph under restricted conditions.

The length of superelevation transition is to be determined by the relative slope rate between the travel way edge of pavement and the profile grade, except that the minimum length of transition shall be 50 ft. for design speeds under 40 mph and 75 ft. for design speeds of 40 mph or greater. For additional information on transitions, see the ***Design Standards, Index 511***.

2.11 Horizontal Clearance

Horizontal clearance is the lateral distance from a specified point on the roadway such as the edge of travel lane or face of curb, to a roadside feature or object. Horizontal clearance applies to all highways. Horizontal clearance requirements vary depending on design speed, whether rural or urban with curb, traffic volumes, lane type, and the object or feature.

Rural highways with flush shoulders and highways with curb or curb and gutter where right of way is not restricted have roadsides of sufficient widths to provide clear zones; therefore, horizontal clearance requirements for certain features and objects are based on maintaining a clear zone wide enough to provide the recoverable terrain in ***Table 2.11.11***. The procedure for determining required clear zone widths is described in ***Chapter 4*** of this volume.

In urban areas, horizontal clearance based on clear zone requirements for rural highways should be provided wherever practical. However, urban areas are typically characterized with lower speed, more dense abutting development, closer spaced intersections and accesses to property, higher traffic volumes, more bicyclists and pedestrians, and restricted right of way. In these areas, curb with closed drainage systems are often used to minimize the amount of right of way needed. Highways with curb or curb and gutter in urban areas where right of way is restricted do not have roadsides of sufficient widths to provide clear zones; therefore, while there are specific horizontal clearance requirements for these highways, they are based on clearances for normal operation and not based on maintaining a clear roadside for errant vehicles. It should be noted that curb has no redirectional capabilities except at speeds less than the lowest design speeds used on the State Highway System. Therefore curb should not be considered effective in shielding a hazard. Curb is not to be used to reduce horizontal clearance requirements.

Crashworthy objects shall meet or exceed the offset listed in ***Tables 2.11.1*** through ***2.11.10*** and objects that are not crashworthy are to be as close to the right of way as practical and no closer than the requirements listed in ***Tables 2.11.1*** through ***2.11.10.***

For horizontal clearances where roadways overpass railroads refer to ***Chapter 6*** of this volume.

Table 2.11.1 Horizontal Clearance for Traffic Control Signs

PLACEMENT	Placement shall be in accordance with the ***Design Standards***. Placement within sidewalks shall be such that an unobstructed sidewalk width of 4 ft. or more (not including the width of curb) is provided.
SUPPORTS	Supports, except overhead sign supports, shall be breakaway. When practicable, sign supports should be located behind barriers that are justified for other reasons. Overhead sign supports shall be located outside the clear zone unless shielded.

Table 2.11.2 Horizontal Clearance for Light Poles

CONVENTIONAL LIGHTING	Not in the median except in conjunction with barriers that are justified for other reasons. Rural and Urban Flush Shoulders: 20 ft. from the travel lane, 14 ft. from auxiliary lane (may be clear zone width when clear zone is less than 20 ft.). Urban Curb or Curb and Gutter: From right of way line to 4 ft. back of face of curb (may be 2.5 ft. back of face of curb when all other alternatives are deemed impractical). Placement within sidewalks shall be such that an unobstructed sidewalk width of 4 ft. or more (not including the width of curb) is provided.
HIGHMAST LIGHTING	Outside of the clear zone unless shielded.

Table 2.11.3 Horizontal Clearance for Utility Installations

ABOVE GROUND FIXED OBJECTS (Such as Poles)	Shall not be located within the limited access right of way, except as allowed by the ***Policy No. 000-625-025, Telecommunications Facilities on Limited Access Rights of Way***. Shall not be located in the median. Rural and Urban Flush Shoulders: Not within the clear zone. Install as close as practical to the right of way without aerial encroachments onto private property. Urban Curb or Curb and Gutter: At the R/W line or as close to the R/W line as practical. Must maintain 4 ft. clear from face of curb. Placement within sidewalks shall be such that an unobstructed sidewalk width of 4 ft. or more (not including the width of the curb) is provided. See the ***Utility Accommodation Manual, (Topic No. 710-020-001)*** for additional information. Note: may be located behind barriers that are justified for other reasons.
BREAKAWAY OBJECTS (Such as Fire Hydrants)	Rural and Urban Flush Shoulders: Locate as close to the right of way as practical. Urban Curb or Curb and Gutter: Locate no less than 1.5 feet from face of curb.

Table 2.11.4 Horizontal Clearance to Signal Poles and Controller Cabinets for Signals

Shall not be located in medians Rural and Urban Flush Shoulders: Outside the clear zone. Urban Curb or Curb and Gutter: 4 ft. from face of outside curbs and outside the sidewalk. However, when necessary, the Signal Poles may be located within sidewalks such that an unobstructed sidewalk width of 4 ft. or more (not including the width of curb) is provided.

Table 2.11.5 Horizontal Clearance to Trees

Minimum Horizontal Clearance to trees where the diameter is or is expected to be greater than 4 inches measured 6 inches above the ground shall be outside the clear zone except as follows: Urban Curb or Curb and Gutter where speeds are ≤ 45 mph and where right of way is restricted: 4 ft. from face of outside curbs. 6 ft. from edge of inside traffic lane.

Table 2.11.6 Horizontal Clearance to Bridge Piers and Abutments

Minimum Horizontal Clearance to Bridge Piers and Abutments: Rural and Urban Flush Shoulders: Outside the clear zone. Urban Curb or Curb and Gutter: 16 ft. from the edge of the travel lane.
Note: Pier protection and design shall comply with the requirements provided in ***Structures Design Guidelines, Section 2.6.***

Table 2.11.7 Horizontal Clearance to Railroad Grade Crossing Traffic Control Devices

Placement shall be in accordance with the ***Design Standards***.

Table 2.11.8 Horizontal Clearance to Drop-off and Canal Hazards

Canals: (See also ***Chapter 4*** of this Volume.)

Rural and Urban Flush Shoulders:

Design Speeds ≥ 50 mph:	60 ft. from the travel lane.
Design Speeds < 50 mph:	50 ft. from the travel lane.

Urban Curb or Curb and Gutter:

40 ft. from the edge of the travel lane.

Drop-offs: (See also ***Chapter 4*** of this Volume.)

Rural and Urban Flush Shoulders:

Treat as roadside slopes in accordance with ***Design Standards, Index 700.***

Urban Curb or Curb and Gutter:

22 ft. from traveled way to the point that is 6 ft. below the hinge point.

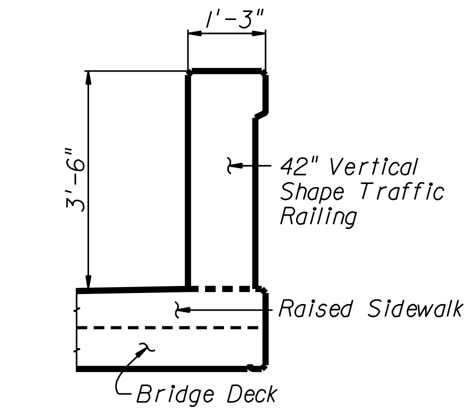
Table 2.11.9 Horizontal Clearance to Other Roadside Obstacles

Minimum Horizontal Clearance to other roadside obstacles: Rural and Urban Flush Shoulders: Outside the clear zone. Urban Curb or Curb and Gutter: 4 ft. back of face of curb. May be 2.5 ft. back of face of curb when all other alternatives are deemed impractical.	
Note:	Horizontal Clearance to mailboxes is specified in the construction details contained in the ***Design Standards, Index No. 532.***
Note:	Transit and school bus shelters shall be placed in accordance with ***Rule Chapter 14-20.003, Florida Administrative Code***. Transit bus benches shall be placed in accordance with ***Rule Chapter 14-20.0032, F.A.C.***.

Table 2.11.10 Horizontal Clearance for ITS Poles and Related Items

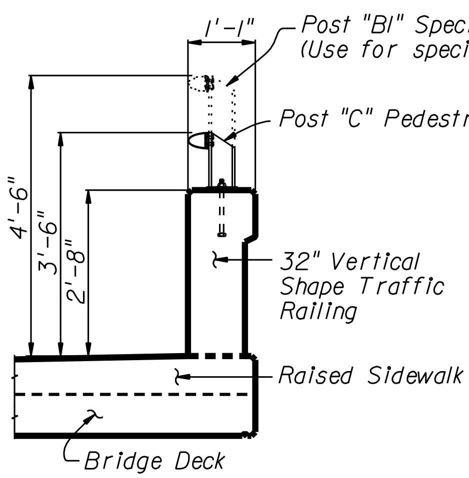
POLES AND OTHER ABOVE-GROUND FIXED OBJECTS	Shall not be located in the median except in conjunction with barriers that are justified for other reasons. Rural and Urban Flush Shoulders: Outside the clear zone. Install as close as practical to the right of way without aerial encroachments onto private property. Urban Curb or Curb and Gutter: At the right of way line or as close to the right of way line as practical. Maintain 4 feet of clearance from the face of the curb. Placement within sidewalks is allowed only where an unobstructed sidewalk width of 4 feet or more (not including the curb width) is provided. May be located behind barriers that are justified for other reasons.
EQUIPMENT SHELTERS AND TOWERS	Shall not be located within the limited-access right of way, except as allowed by ***Policy No. 000-625-025, Telecommunications Facilities on Limited Access Rights of Way***.
BREAKAWAY OBJECTS	Rural and Urban Flush Shoulders: Locate as close to the right of way as practical. Urban Curb or Curb and Gutter: Locate no less than 4 feet from the face of the curb (a 2.5-foot setback from the face of the curb is allowed when all other alternatives are deemed impractical).

Figure 2.12.2 Bridge Traffic Railings – Vertical Shapes



- TL-4 Traffic Railing.
- Typical application is a Traffic Railing at the back of a raised sidewalk (bridge deck edge) or as a pedestrian railing behind a Traffic Railing (without a raised sidewalk).
- No additional pedestrian rails permitted.
- Section thru Railing on Bridge Deck Shown, Section thru Railing on Approach Slab and Permanent Retaining Wall Similar.

SECTIONAL VIEW NO. 3 - 42" VERTICAL SHAPE TRAFFIC RAILING - DESIGN STANDARDS, INDEX NO. 422



- TL-4 Traffic Railing.
- Typical application is a Traffic Railing at the back of a raised sidewalk (bridge deck edge) or as a pederstrian railing behind a Traffic Railing (without a raised sidewalk).
- Section thru Railing on Bridge Deck Shown, Section thru Railing on Approach Slab and Permanent Retaining Wall Similar.

SECTIONAL VIEW NO. 4 - 32" VERTICAL SHAPE TRAFFIC RAILING - DESIGN STANDARDS, INDEX NOS. 423 & 820

VERTICAL SHAPE TRAFFIC RAILINGS

Figure 2.12.3 Bridge Traffic Railings – Other Shapes

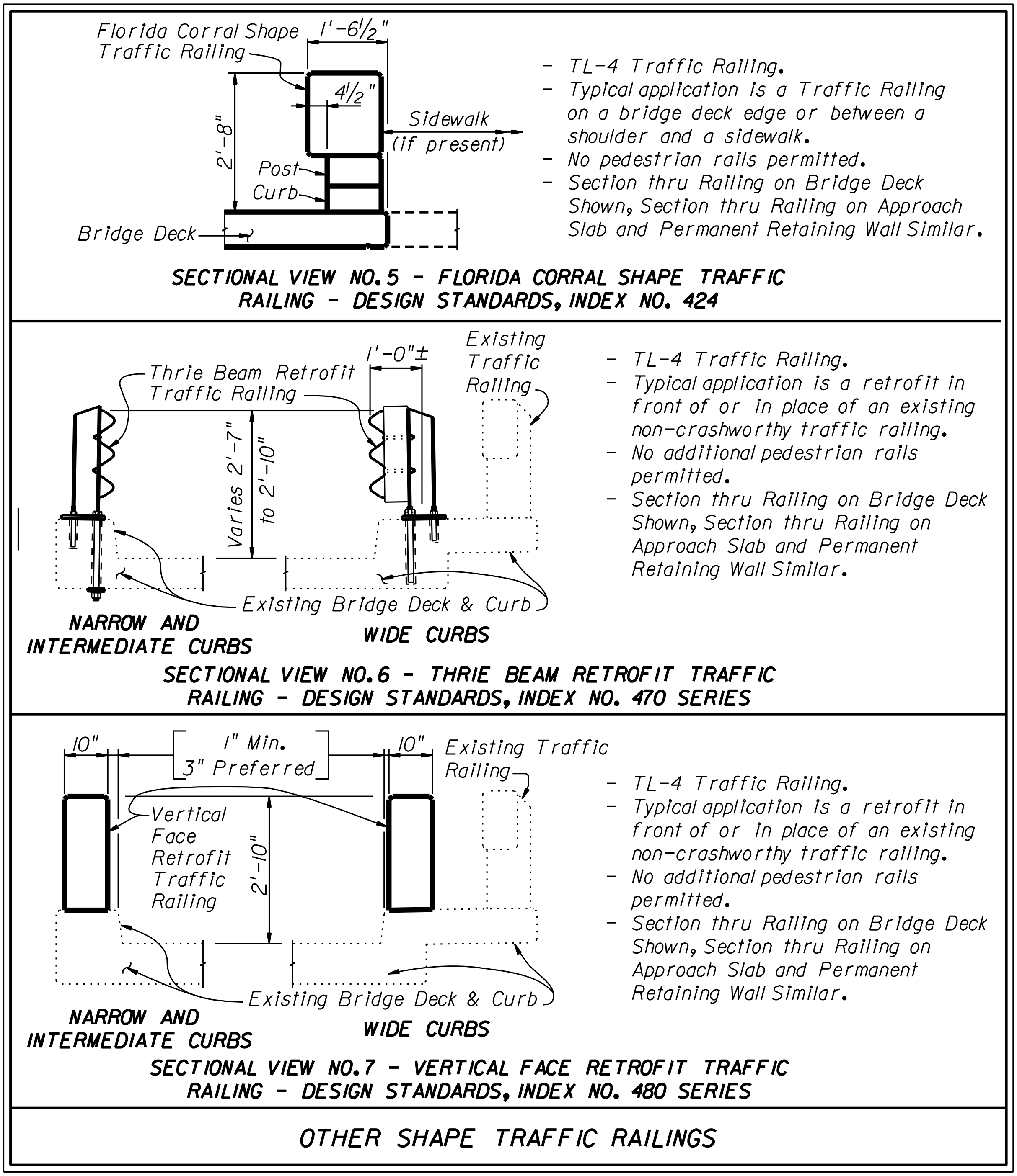
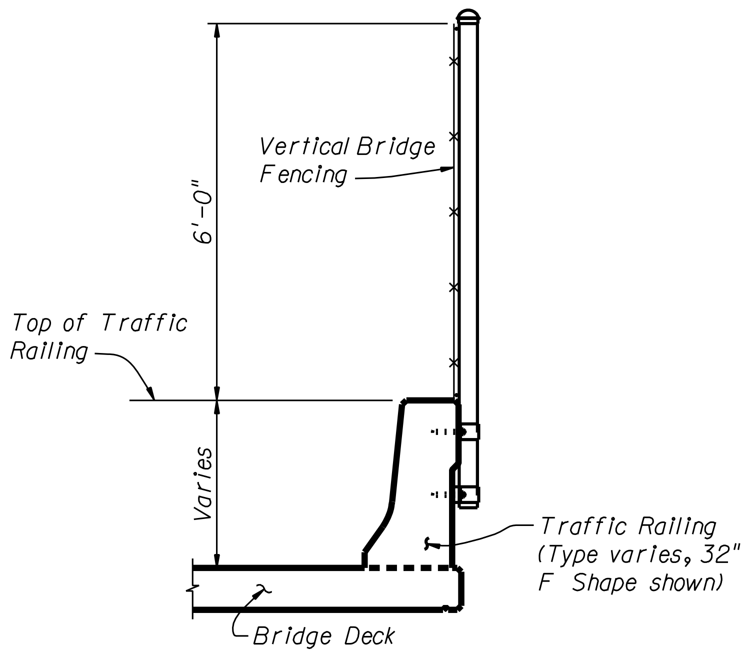


Figure 2.12.6 Bridge Fencing for Traffic Railings

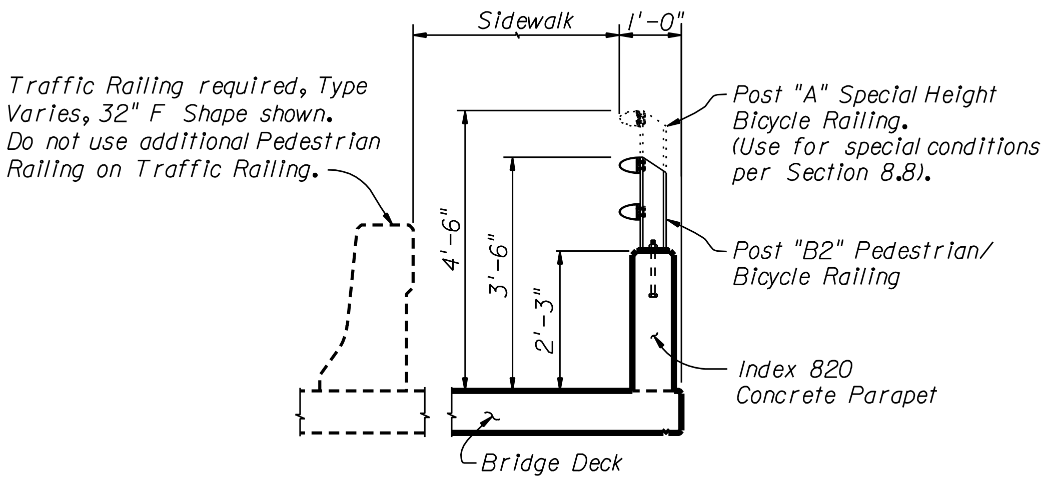


- Test Level - Based on a TL-3 crash tested design.
- Typical application is on a Traffic Railing where it is required or desirable to limit the potential for objects to fall or be dropped or thrown from bridge.
- Section thru Fence and Railing on Bridge Deck shown, Section thru Fence and Railing on Approach Slab and Permanent Retaining Wall similar.

SECTIONAL VIEW NO. 12
VERTICAL BRIDGE FENCING
DESIGN STANDARDS, INDEX NO. 810

BRIDGE FENCING FOR TRAFFIC RAILINGS

Figure 2.12.7 Bridge Railing – Pedestrian / Bicycle Railing



- Test Level – N.A.
- Typical application is with a sidewalk behind a Traffic Railing.
- Standard aluminum railing shown, project specific railings permitted.
- Section thru Railing on Bridge Deck Shown, Section thru Railing on Approach Slab and Permanent Retaining Wall Similar.

SECTIONAL VIEW NO. 13
PEDESTRIAN/BICYCLE RAILING - DESIGN STANDARDS,
INDEX NOS. 820 & 822

PEDESTRIAN / BICYCLE RAILING

2.13 Intersections

Design guides and criteria presented heretofore are also applicable to the proper design of intersections.

2.13.1 Circular Intersections (Roundabouts)

The circular intersection with all yield control is another design concept for the designer to consider. Two critical elements of the small circular traffic pattern with a central island are as follows:

1. Entry is by gap acceptance by having a yield condition at all entry legs.
2. Speeds through the intersection are 25 mph or less.

The use of this design is best for low speed facilities. Its use should be documented by a complete intersection analysis and study, including alternate types of design.

The ***Florida Roundabout Guide*** (available through FDOT Maps and Publications Sales) presents a methodology for identifying appropriate roundabout sites and estimating roundabout capacity and delay. It describes the design principles and standards to which roundabouts installed on state roadways must conform and offers guidelines for operational features such as signing, marking, lighting, landscaping, etc.. Additional guidance is available in the ***FDOT Traffic Engineering Manual***.

All roundabout designs must be approved by the State Roadway Design Engineer.

2.13.2 Queue Length for Unsignalized Intersections

Turn lanes should comply with the ***Design Standards, Index 301*** to the extent practical. The available queue length provided should be based on a traffic study.

For low volume intersections where a traffic study is not justified, a minimum queue length of 50 ft. (2 vehicles) should be provided for rural areas and small urban areas; for other urban areas, a minimum queue length of 100 ft. (4 vehicles) should be provided.

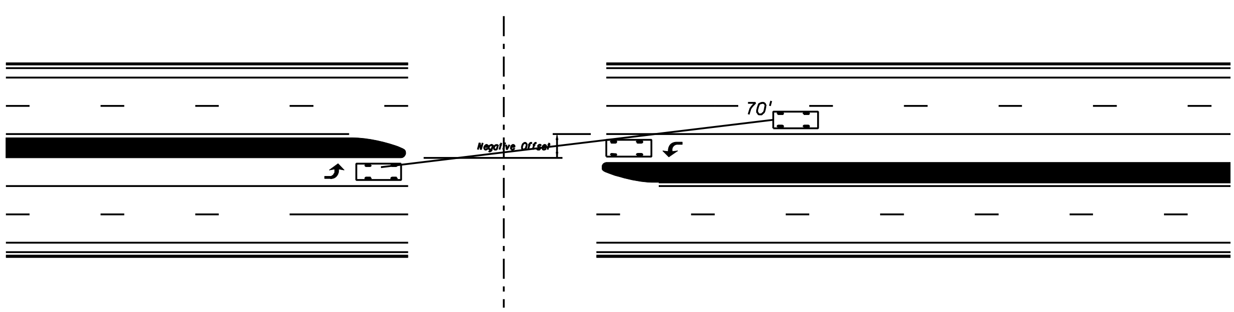
2.13.3 Offset Left Turn Lanes

The alignment of opposing left-turn lanes and the horizontal and vertical curvature on the approaches are the principal geometric design elements that determine how much sight distance is available to a left-turning driver. Operationally, vehicles in the opposing left-turn lane waiting to turn left can also restrict the left-turning driver's view of oncoming traffic in the through lanes. The level of blockage depends on how the opposing left-turn lanes are aligned with respect to each other, as well as the type/size of vehicles in the opposing queue and their position in the opposing lane.

The offset distance is defined as the distance between the left edge of the turn lane and the right edge of the opposing turn lane. If the offset distance is to the left of the turn lane it is considered a negative offset, and if it is to the right of turn lane it is considered a positive offset.

The conventional method of designing left turn lanes is to place the left turn lanes adjacent to the through lanes. This design creates a negative offset which severely restricts the sight distance of the left-turning driver's view of oncoming traffic when another vehicle is in the opposing turn lane. ***Figure 2.13.1*** indicates the negative offset when the conventional design is used.

Figure 2.13.1 Typical Opposing Left Turns (22' Median with Negative 10' Offset)



On all urban designs offset left-turn lanes should be used with median widths greater than 18 feet. A four foot traffic separator should be used when possible to channelize the left turn and provide separation from opposing traffic. On rural intersections where high turning movements are involved, offset left-turn lanes should also be considered. On median widths 30 feet or less, an offset turn lane parallel to the through lane should be used and the area between the left turn and traffic lane where vehicles are moving in the same direction should be striped out. On medians greater than 30 feet, a tapered offset should be considered. ***AASHTO Exhibit 9-98*** illustrates the design of parallel and tapered left turn lanes. ***Figure 2.13.2*** indicates an offset left turn.

Chapter 4

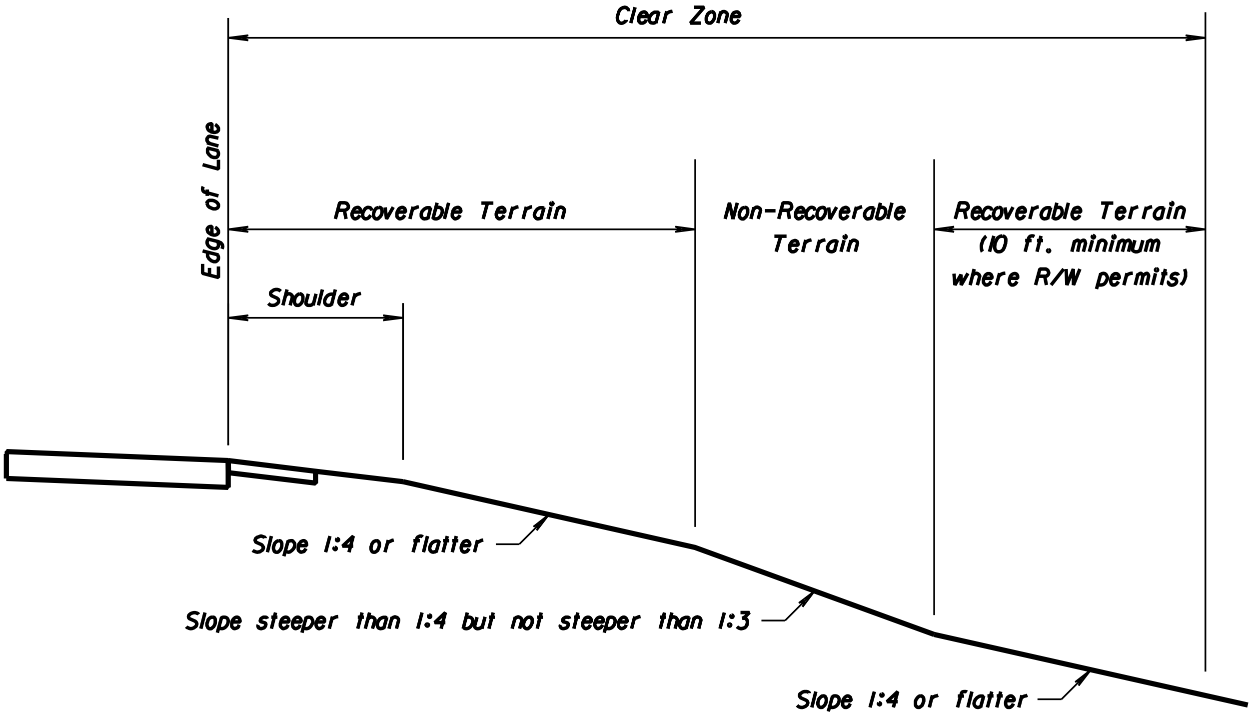
Roadside Safety

Tables

Figures

Exhibits

Figure 4.1.2.2 Clear Zone Cross Section



Note: See ***Chapter 2, Table 2.4.1*** for new construction slope criteria.

See ***Chapter 25, Section 25.4.9*** for RRR slope criteria.

Roadside Terrain includes all surfaces along the roadway other than Travel Lanes, Auxiliary Lanes, and Ramps. For the purpose of establishing Clear Zones, Roadside Terrain is defined as recoverable, non-recoverable, non-traversable, and hazardous as follows:

1. Recoverable when it is safely traversable and on a slope that is 1:4 or flatter.
2. Non-recoverable when it is safely traversable and on a slope that is steeper than 1:4 but not steeper than 1:3.
3. Non-traversable when it is not safely traversable or on a slope that is steeper than 1:3.
4. Hazardous when a slope is steeper than 1:3 and deeper than 6 feet.

4.2 Hazard Standards

4.2.1 Canal Hazards

A canal is defined as an open ditch parallel to the roadway for a minimum distance of 1000 ft. and with a seasonal water depth in excess of 3 ft. for extended periods of time (24 hours or more).

For rural and urban flush shoulder highways, the distance from the outside edge of the through travel lane to the top of the canal side slope nearest the road will be no less than 60 ft. for highways with design speeds of 50 mph or greater. For highways with design speeds less than 50 mph this minimum distance may be reduced to 50 ft. for rural and urban flush shoulder highways or 40 ft. for urban curb or curb and gutter highways. When new canal or roadway alignment is required, distances greater than those above should be provided, if possible, to accommodate possible future improvements to the roadway (widening, etc.).

On fill sections, a flat berm (maximum 1:10 slope) of width no less than 20 ft. will be provided between the toe of the roadway front slope and the top of the canal side slope nearest the roadway. This minimum berm width applies to all types of highways, both rural and urban construction. (See ***Exhibits 4-A & 4-B***)

When the slope between the roadway and the "extended period of time" water surface is 1:6 or flatter, the minimum distance can be measured from the edge of the through lane to the "extended period of time" water surface and a berm is not required.

In sections with ditch cuts, 20 ft. will be provided between the toe of the front slope and the top of the canal.

Guardrail or other protective devices shall be installed 5 ft. from the canal front slope where it is not possible to meet the above minimum criteria. The design is complicated when clear zone and slope criteria are combined with canal hazard criteria. Extreme caution must be taken to ensure that all criteria are met.

If the minimum standards for canal hazards cannot be met, then the standard guardrail treatments as provided in the ***Design Standards*** should be used.

4.6 Roadside Appurtenances

4.6.1 Sign Supports

All sign supports, except overhead cantilever, truss type or bridge or barrier wall mounted, shall be breakaway as defined in the ***AASHTO Standard Specifications for Structural Supports for Highway Signs*, *Luminaires and Traffic Signals*** and the ***AASHTO Roadside Design Guide***. Sign supports shall be of an acceptable and crashworthy design as described in the ***Design Standards***. Supports not meeting the breakaway criteria should not be installed within the clear zone. Sign supports not meeting these requirements, that must be installed within the clear zone, shall be protected by a barrier or crash cushion.

4.6.2 Mailbox Supports

Mailbox supports shall be of an acceptable crashworthy design, as described in the ***Design Standards***.

4.6.3 Other Appurtenances

The ***Design Standards*** contains design criteria for numerous other roadside appurtenances.

4.6.4 Location Criteria

Most breakaway mechanisms are designed to be impacted at bumper height, typically about 20 inches above the ground. If impacted at a significantly higher point, the bending moment in the breakaway base may be sufficient to bind the mechanism, resulting in non-activation of the breakaway device. For this reason, it is important that breakaway supports not be located in ditches or on steep slopes where a vehicle is likely to be partially in sprung suspension at the time of impact.

4.6.5 Bus Benches and Transit Shelters

Refer to ***Table 2.11.9*** for criteria on the placement of shelters and benches.

4.7 Non-Standard Roadside Safety Devices

The Qualified Products List (QPL) includes proprietary devices and products that have been evaluated against implemented FDOT Specifications and Standards, and found to meet those Specifications and/or Standards. The majority of proprietary roadside safety devices needed for use on the State Highway System are identified on the QPL. However, just as FDOT Specifications and Standards do not address every potential highway need, the QPL does not cover every type of roadside safety device that may be available on the market. Unique situations will sometimes require unique devices. Examples of available devices that are not covered by FDOT Specifications and Standards include barrier wall gates, aesthetic guard rails, temporary steel barriers, crashworthy stop gates, and others. When the need arises for a unique crashworthy device not covered on the QPL, the designer must carefully investigate the applicability of the device for the situation, as well as the crash performance characteristics of the device. For some of these devices, the State Roadway Design Office may have information and be of assistance in establishing the appropriateness of the device for a given situation.

The designer must document the following:

1. FHWA Acceptance Letter
2. Crash Test Reports, including review of all test results. All performance characteristics must be reviewed, including post impact vehicle behavior and post impact test article deflection, debris scatter, etc.
3. Compatibility with adjacent and/or connecting standard roadside safety devices.
4. Maintenance requirements and characteristics, including coordination with the District Maintenance Office.
5. For devices such as barrier gates, operational plans and training as appropriate.

The designer will also be responsible for providing special plan details, technical specifications, and method of pay as appropriate.

Chapter 5

Utilities

5.1 General

The Department has the responsibility to maintain state highways as necessary to preserve the integrity, operational safety and function of the highway facility. Since the manner in which utilities cross or otherwise occupy highway right of way can materially affect the safe operation, maintenance and appearance of the highway, it is necessary that such use of the right of way be authorized and reasonably regulated. By Florida Statutes, utilities, whether public or privately owned, aerial or underground are permitted by the Department to be accommodated within the right of way on the State Highway System. For limited access highways, parallel utilities within the right of way are not allowed except for utilities serving facilities required for operating the transportation system or by approved utility exception (for Limited Access R/W Use). Lateral crossings on limited access facilities are allowed by permit only. (See ***Utility Accommodation Manual, Topic No. 710-020-001****)*.

The designer should make every reasonable effort to design a project that will accommodate all existing utilities and new utilities to be constructed concurrently with the project. The selection of typical section features, horizontal alignment and location of storm drain lines are areas that can sometimes be varied without violating safety standards and design criteria. Design features that reduce or avoid utility conflicts may involve increased cost; however, those costs may be offset by savings in construction time and the total associated cost savings for the FDOT project and the utilities. The use of Subsurface Utility Engineering is promoted to best facilitate utility related cost savings.

Selection of the methods to be employed within the Subsurface Utility Engineering (SUE) discipline should be considered in the scoping process. Relying totally on designating and selectively exposing utility facilities will seldom prevent all utility related delays in construction nor will it prevent the need for redesign. Consulting a state of the art SUE provider early on is the best way to determine the most cost effective approach. Determining the location of utilities when they are great in number or are in intersections is the most problematic and risk prone area within a project. These areas especially lend themselves to being candidates for newer technology locating services because they can reflect changes in shape and alignment not seen with traditional methods. The data gathering process can be less disruptive to the facility user and is non-destructive. A knowledge of potentially limiting environmental conditions is essential to the process. No single method is cost effective when risk versus benefit is measured.

The ***Utility Accommodation Manual (UAM)*** shall be used for all detailed requirements of utility issues. The ***UAM*** is the controlling legal document for criteria and standards to be applied to utilities. The ***UAM*** may not be updated on the same frequency as the ***PPM***. Where differences occur between the ***UAM*** and the ***PPM***, the ***UAM*** controls. New Utility installations shall comply with the latest UAM requirements. When evaluating Utility compliance, the date of the permit establishes which UAM requirements must be met. The Designer/Project Manager should always determine which criteria are appropriate before directing a Utility/Agency Owner (UAO).

5.2 Utility Accommodation Manual

UAOs are required to obtain utility permits for the installation and maintenance of utility facilities within the right of way of any State Highway System. These permits will be issued and approved by FDOT in conformity with the ***Utility Accommodation Manual***. This includes utility work required by FDOT projects. The designer may be involved in the coordination of this process.

The Department's ***Utility Accommodation Manual*** is established to regulate the location, manner, installation and adjustment of utility facilities along, across, under or on right of way under the jurisdiction of the FDOT. This manual also establishes the process for issuing permits for such work which is in the interest of safety, protection, utilization and future development of the highways with due consideration given to public service afforded by adequate and economical utility installations as authorized under ***Section 337.403, Florida Statutes*** and ***Florida Administrative Code Rule 14-46.001***. Adherence shall be required under the circumstances set forth in the ***Utility Accommodation Manual***.

Additional guidance for accommodating utilities within the highway rights of way are given in the AASHTO publications ***A Guide for Accommodating Utilities within Highway Right of Way*** and ***A Policy on Geometric Design of Highways and Streets*** and in the TRB publication ***Policies for Accommodation of Utilities on Highway Rights-of-Way***.

Chapter 7

Traffic and ITS Design

Tables

Chapter 7

Traffic and ITS Design

7.1 General

Traffic control devices and intelligent transportation system (ITS) deployments are necessary to help ensure highway safety by providing the orderly and predictable movement of all traffic, motorized and nonmotorized, throughout the highway transportation system, and to provide such guidance and warnings as are needed to ensure the safe and informed operation of individual elements of the traffic stream. The design and layout of signs, signals, pavement marking and lighting should complement the basic highway design.

7.2 Signing and/or Pavement Marking

The designer responsible for a signing and/or pavement marking project should be aware that the design must comply with various standards. In addition to Department Standard Specifications, the following standards should be consulted:

Manual on Uniform Traffic Control Devices (MUTCD) - The ***MUTCD*** was adopted by the Department as the uniform system of traffic control for use on the streets and highways of the State. This action was in compliance with ***Chapter 316.0745*** of the ***Florida Statutes***. The ***MUTCD*** is therefore the basic guide for signing and marking. The requirements of the ***MUTCD*** must be met, as a minimum, on all roads in the State.

Standard Highway Signs, FHWA - This manual contains detailed drawings of all standard highway signs. Each sign is identified by a unique designation. Signs not included in this manual or in the ***Design Standards*** must be detailed in the plans.

AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and ***FDOT*** **Structures Manual** - These documents provide structural design criteria.

Design Standards - These standards are composed of a number of standard drawings or indexes that address specific situations that occur on a large majority of construction projects.

Manual on Uniform Traffic Studies (MUTS) - This is a Department publication containing documentation for several types of traffic studies. This manual provides a systematic data collection procedure for the studies described.

Traffic Engineering Manual - This Department publication provides traffic engineering standards and guidelines to be used on the State Highway System.

7.2.1 Design Criteria

The ***MUTCD*** and the ***Design Standards*** should be consulted for sign location. All signs not bridge or barrier wall mounted and installed within the clear recovery zone, must be breakaway or protected by an approved barrier. ***Chapter 4, Roadside Safety*** of this volume, contains detailed instructions on safety design.

Post sizes for single column signs are covered in the ***Design Standards***. The supports for multipost signs are not in that reference and must be included in the plans. The designer must provide post sizes and length for each multipost sign. The Structures Design Office has written a program for personal computers that calculates post sizes and length for multipost signs. This program may be used for these calculations.

The design for all overhead sign structures and foundations shall be included in the plans. Refer to ***Section 7.6***, ***Foundation Design***, and ***Chapter 29*** of this volume for more information.

The type lamp for signs shall be specified in the plans. The following table gives the number of luminaires for various sign widths for 175 watt mercury vapor deluxe white lamps. See the ***Design Standards, Index 17505*** for spacing details and mounting location.

Table 7.2.1 Number of Luminaires for Various Sign Widths

Sign Width (ft.)	To 10	To 21	To 32	To 43
Luminaires	1	2	3	4

7.2.2 Wind Loading Criteria - Signs

The wind loadings given below are based on the ***AASHTO Standard Specification For Structural Supports for Highway Signs, Luminaires and Traffic Signals*** and ***FDOT Structures Manual.*** The Counties are listed by wind loading for the appropriate sign type.

110 mph Alachua, Baker, Bradford, Clay, Columbia, Gadsden, Gilchrist, Hamilton, Hardee, Jackson, Jefferson, Lafayette, Lake, Leon, Madison, Marion, Polk, Putnam, Sumter, Suwannee, and Union

130 mph Bay, Brevard, Calhoun, Charlotte, Citrus, DeSoto, Dixie, Duval, Flagler, Franklin, Glades, Gulf, Hendry, Hernando, Highlands, Hillsborough, Holmes, Lee, Levy, Liberty, Manatee, Nassau, Okaloosa, Okeechobee, Orange, Osceola, Pasco, Pinellas, Sarasota, Seminole, St. Johns, Taylor, Volusia, Wakulla, Walton, and Washington.

150 mph Broward, Collier, Miami-Dade, Escambia, Indian River, Martin, Monroe, Palm Beach, Santa Rosa, and St. Lucie

7.2.3 No-passing Zones

The procedures required by the Department for determining the limits of no-passing zones are contained in the ***Manual on Uniform Traffic Studies, (MUTS).*** The requirements of this manual must be followed.

Limits of pavement markings for no-passing zones shall be established by one of the following methods:

1. On projects where existing roadway conditions (vertical and horizontal alignments) are to remain unaltered by construction, the no-passing zones study shall be accomplished as part of the design phase. This will be either by in-house staff or included in design consultant contracts.

   The limits of the no-passing zones shall be included in the contract documents, and a note to this effect shown on the plans.

2. On projects with new or altered vertical and horizontal alignments, limits for no-passing zones shall be established during construction. The required traffic study and field determination of limits shall be performed through the design consultant as a post design service, or as part of a districtwide consultant contract for such services.

   When this service is included as part of post design services, sufficient time shall be included to accomplish the required field operations without delaying or interfering with the construction process.

7.2.4 Use of Local Street Names on Guide Signs

The normal practice is to use route numbers on guide signs to designate roadways. In some areas, the local names for certain roadways are more familiar than the route number. For this situation, the local street name may be used. However, some roadways are known by more than one name as well as the route number. In many instances, the existing sign panel is not large enough to accommodate the street name and would require a new panel.

For these reasons, the decision to use local names on guide signs must be evaluated on a case-by-case basis. It is recommended that the District Traffic Operations Engineer be contacted for input in these decisions.

7.2.5 Signing and Pavement Marking Project Coordination

Coordination with other offices and other agencies is a very important aspect of project design. The offices discussed in this section are not intended to be an all inclusive list with which the designer should coordinate, but are those that are typically involved in a signing and marking project.

Roadway Design - The designer of a signing and pavement marking project receives the base sheets for design from the roadway designer, who can also provide any required cross sections. If the signing project is not an active roadway design project, base sheets may be obtained from existing plans.

Utilities - The District Utilities Engineer provides the coordination between the designer and the various utilities involved in the project. The Utilities Section can also identify potential conflicts with overhead and underground utilities or verify those which have previously been identified. The District Utilities Engineer should be contacted as early in the design phase as possible.

Structures Design - The Engineer of Record for Structures Design provides the design of the sign structures for overhead cantilever and overhead truss sign assemblies. This includes the design of the foundation for these structures. The Engineer of Record must be contacted early in the design phase to allow adequate time for coordination with the Geotechnical Engineer in obtaining the necessary soils information.

Right of Way – The State Motorist Information Services Administrator must be contacted on any projects that may impact Interstate Logo Signs. See ***Section 13.5.4*** for requirements and additional information.

7.2.6 Foundation Criteria

Refer to ***Section 7.6***, ***Foundation Design***, for geotechnical requirements.

7.2.7 Signing for Bridges with Steel Decks

Slippery When Wet Signs (W8-5) shall be placed in advance of all movable and non-movable bridges with steel decks. Refer to ***Section 2.1*** of the ***Traffic Engineering Manual (Topic No. 750-000-005)***. This also applies to temporary bridges.

7.2.8 Guidance on Use of Various Pavement Marking Materials

The Engineer should consider several factors before selecting the pavement marking materials to be used during the Maintenance of Traffic Operations or in application of the permanent markings.

7.2.8.1 Maintenance of Traffic Applications

The factors which should be considered in a Maintenance of Traffic (MOT) should include:

1. How long do the markings need to last?
2. Will the markings need to be removed or will they be covered by an asphalt course?
3. Cost.
4. Traffic Volumes.

Paint is normally used in MOT operations and is appropriate for short term operations lasting for approximately six months. When a MOT operation lasts between six months to a year under moderate traffic volumes, a high-build paint or hot-spray thermoplastic marking should be considered. If a MOT operation lasts for more than a year under heavy traffic volumes a refurbishment thermoplastic should be considered.

7.2.8.2 Permanent Marking Applications

The factors which should be considered for permanent marking should include:

1. How long do the markings need to last?
2. What are the traffic volumes?
3. Type of Surface.
4. Does the marking need to meet special requirements (audible & vibratory, contrast, etc?)
5. Cost.
6. If it is a refurbishment marking, what is the thickness and condition of the existing markings?

Thermoplastic is the Department's primary material to be used for the permanent markings on asphalt surfaces. When used in conjunction with RPM's on centerline application, it provides excellent wet night visibility and long term performance at a reasonable cost. When used in an edge line application, it provides moderate wet night visibility and long term performance at a reasonable cost.

On concrete pavements and bridge decks contrast markings shall be used. Options include thermoplastic, tapes and two-component reactive materials. On concrete surfaces, tapes are normally used for only centerline applications and are the preferred alternative. Two-component reactive or thermoplastic materials are normally used for edge line applications in conjunction with tape.

For guidance on contrast, audible & vibratory and other special use marking, contact the State Traffic Standards Engineer.

7.2.9 Delineators and Object Markers

The ***MUTCD*** defines the differences between delineators and object markers. Object markers are used to mark obstructions within or adjacent to the roadway. The ***MUTCD*** describes four object markers and how they are to be used. Type 1 or Type 3 object markers are used to mark obstructions within the roadway and Type 2 and Type 3 markers are used to mark obstructions adjacent to the roadway. Type 4 object markers, end-of-roadway markers are used to alert users of the end of the road.

Delineators are considered guidance devices rather than warning devices. The ***MUTCD*** shows the use of delineators along the edge of freeways and expressways and on the side of interchange ramps. ***Design Standards, Index 17345*** details the use of this type of delineator. This delineator may be a flexible or a non-flexible type delineator. District maintenance units generally have a preference on which should be specified.

The Department also uses delineators to mark median opening for both rural and urban openings. In general, flexible delineators are used on urban median openings and non-flexible are used on rural median openings. A high visibility median delineator should be used on traffic separators in the following locations:

1. At multilane intersections where additional visibility is required for the marking of the traffic separator,
2. Where the separator is obstructed due to crest vertical curves,
3. At intersections where the alignment thru the intersection is not straight, and
4. Where traditional flexible delineators are constantly being replaced.

High visibility median delineators can be specified for urban median separators.

High performance delineators should be used in all applications where the delineator is being used to maintain lane positions, restrict vehicle movements or any other area where the delineator is subject to being frequently hit.

The particular type of object marker or delineator should be identified in the plans by the use of the pay item.

7.3 Lighting

The designer responsible for a highway lighting project should be aware that the design must comply with various standards. In addition to the Department's Standard Specifications, the following standards should be consulted:

Roadway Lighting Design Guide, AASHTO - This is the basic guide for highway lighting. It includes information on warranting conditions and design criteria.

***AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*, and FDOT Structures Manual** - This specification contains the strength requirements of the poles and bracket arms for the various wind loadings in Florida as well as the breakaway requirements. All luminaire supports, poles and bracket arms must be in compliance with these specifications.

Design Standards - These indexes are composed of a number of standard drawings or indexes which address specific situations that occur on a large majority of construction projects.

7.3.1 Design Criteria

The ***AASHTO Roadway Lighting Design Guide*** permits either the illuminance technique or the luminance technique to be used in the design of highway lighting. The luminance technique requires a more complex design process and knowledge of the reflective characteristics of the pavement surface used. These reflective characteristics change as the pavement ages and with variations in weather conditions. The Department has elected to use the illuminance technique for lighting design. The design values for light levels given by the ***AASHTO Roadway Lighting Design Guide*** are maintained values. The light levels given in this criteria have been adjusted and are listed as average initial foot candle. This, in effect, sets the maintenance factor to be used in the calculation process to a value of 1. Lighting criteria is contained in ***Tables 7.3.1 – 7.3.5***. Refer to ***Section 7.2.1*** for Overhead sign lighting criteria.

Mounting height (M.H.) for conventional lighting is the vertical distance from the roadway to the light source, regardless of lateral placement of the pole. Pole setback is the horizontal distance from the edge of the travel lane to the pole.

Refer to ***Chapter 29*** of this volume for more information.

Table 7.3.1 Conventional Lighting - Roadways

ROADWAY CLASSIFICATIONS	ILLUMINATION LEVEL AVERAGE INITIAL HORIZONTAL FOOT CANDLE (H.F.C.)	UNIFORMITY RATIOS	
		AVG./MIN.	MAX./MIN.
INTERSTATE, EXPRESSWAY, FREEWAY & MAJOR ARTERIALS	1.5	4:1 or Less	10:1 or Less
ALL OTHER ROADWAYS	1.0	4:1 or Less	10:1 or Less
* PEDESTRIAN WAYS AND BICYCLE LANES	2.5	4:1 or Less	10:1 or Less

Note: These values should be considered standard, but should be increased if necessary to maintain an acceptable uniformity ratio. The maximum value should be one and one-half values.

* This assumes a separate facility. Facilities adjacent to a vehicular roadway should use the levels for that roadway.

Table 7.3.2 Highmast Lighting - Roadways

ROADWAY CLASSIFICATIONS	ILLUMINATION LEVEL AVERAGE INITIAL (H.F.C.)	UNIFORMITY RATIOS	
		AVG./MIN.	MAX./MIN.
INTERSTATE, EXPRESSWAY, FREEWAY & MAJOR ARTERIALS	0.8 to 1.0	3:1 or Less	10:1 or Less
ALL OTHER ROADWAYS	0.8 to 1.0	3:1 or Less	10:1 or Less

Table 7.3.3 Underdeck Lighting - Roadways

LUMINAIRE TYPE	LIGHT SOURCE	MOUNTING LOCATION
PIER CAP	150 watt to 250 watt HPS	Pier or Pier Cap
PENDANT HUNG	150 watt to 250 watt HPS	Bridge Deck

Note:

1. The light levels for underdeck lighting shall be equal to the adjacent roadway lighting.
2. Underdeck lighting is accomplished by mounting either pier cap or pendant hung fixtures under the bridge structure.
3. Pier cap luminaires should be installed when bridge piers are located less than 15 ft. from edge of travel lane.
4. Pendant hung luminaires shall be mounted to the bottom of the bridge deck and should suspend where 50% of the lamp is below bridge beam.

Table 7.3.4 Rest Area Lighting

AREA ILLUMINATED	ILLUMINATION LEVEL AVERAGE INITIAL (H.F.C.)	UNIFORMITY RATIOS	
		AVG./MIN.	MAX./MIN.
ENTRANCE & EXIT	1.5	4:1 or Less	10:1 or Less
INTERIOR ROADWAYS	1.5	4:1 or Less	10:1 or Less
PARKING AREAS	1.5	4:1 or Less	10:1 or Less

Table 7.3.5 Mounting Height Restrictions

LUMINAIRE WATTAGE	LIGHT SOURCE	MOUNTING HEIGHT (MIN.) (FEET)
150	High Pressure Sodium (HPS)	25
200	High Pressure Sodium (HPS)	30
250	High Pressure Sodium (HPS)	30
400	High Pressure Sodium (HPS)	40
750	High Pressure Sodium (HPS)	50
1000	High Pressure Sodium (HPS)	80

7.3.2 Pole Design Criteria

7.3.2.1 General

Chapter 2 of this volume specifies the minimum horizontal clearances for light poles. High mast lighting poles should not be located in gore areas within the runout length as defined in the ***AASHTO Roadside Design Guide***. Engineering judgment should be used when locating high mast poles adjacent to bridges and high fills. All conventional height poles shall be breakaway unless bridge or barrier wall mounted.

Breakaway pole installations shall not be used in areas of heavy pedestrian traffic where the hazard of a falling pole is a greater hazard to others than it is to the motorist. See the ***Design Standards*** for breakaway requirements.

The installation of lighting in certain locations (e.g., adjacent to residential areas) may require the luminaires to be shielded. This is especially true for high mast poles.

Poles on bridges over open bodies of water or on causeway sections should be considered for dampers. These poles are subject to sustained winds of a critical velocity that may induce vibrations in the pole.

7.3.2.2 Standard Aluminum Light Poles

The Department has developed an aluminum light pole standard for Conventional Lighting. The standard provides details for 40, 45 and 50 foot luminaire mounting heights on poles mounted either at grade or on fills up to 25 feet in height, all of which accommodate fixture arm lengths of 8, 10, 12 and 15 feet. Standard Aluminum Light Poles have been designed for 110, 130 and 150 mph design wind speeds.

The manufacturer of the Standard Aluminum Light Poles will be pre-approved by the Department and added to the Qualified Products List (QPL). When the standard assemblies are used, neither design details in the plans nor Shop Drawing submittals are required. Special designs, for those locations where the Standard Aluminum Light Poles are not appropriate, will require the pole Fabricator's complete Shop Drawings and the Specialty Engineer's sealed calculations, all submitted as Shop Drawings in accordance with ***Section 5*** of the ***Standard Specifications for Road and Bridge Construction***.

7.3.3 Foundations Criteria

Refer to ***Section 7.6***, ***Foundation Design***, for geotechnical requirements and ***Chapter 29*** of this volume for additional design information.

7.3.4 Wind Loading Criteria - Lighting

See ***Chapter 29*** of this volume.

7.3.5 Lighting Project Coordination

Coordination with other offices and other agencies is a very important aspect of project design. The offices discussed in this section are not intended to be an all inclusive list with which the designer should coordinate; instead it includes offices that are normally involved in projects.

Roadway Design - Normally the designer of a lighting project receives the base sheets for lighting design from the roadway designer. The roadway designer can also provide any required cross sections. If the lighting project is not an active roadway design project, base sheets may be obtained from existing plans.

Utilities - The District Utilities Engineer provides the coordination between the designer and the various utilities involved in the project. This usually is limited to agreements with the power company for electrical service. The Utilities Section can also identify potential conflicts with overhead and underground utilities or verify those which have previously been identified.

The Utilities Engineer should be contacted as soon as pole locations are set and the electrical load has been determined. The designer should indicate a preferred location for the electrical service.

Drainage - When the locations of high mast poles are established, they should be checked with the Drainage Section to determine if high water level is a problem. High mast poles are often located in the center of interchange loops. These same areas may be used as drainage retention areas. Coordination with the Drainage Section will alleviate this type problem.

Structures Design - Conventional height poles require the standard base shown in the ***Design Standards*** and ***Standard Specifications***. A foundation design is only required in special cases. High mast poles, on the other hand, require foundation designs for each location. Soil bores are required for this design. The Engineer of Record for Structures Design provides the foundation design for high mast poles. He or she must be contacted early in the design phase to allow adequate time for coordination with the Geotechnical Engineer in obtaining necessary soils information.

Normally the District Traffic Operations Engineer in conjunction with the District Utilities Engineer obtains the required maintenance agreements. The designer should coordinate with these offices to ensure that this activity is either underway or scheduled.

Any lighting project, especially high mast, adjacent to or in the vicinity of an airport, may be a potential problem. Any lighting project within 3 miles of an airport should be discussed with the Office of Public Transportation, Aviation Office to determine if a problem exists.

7.3.6 Voltage Drop Criteria

When determining conductor sizes for lighting circuits, the maximum allowable voltage drop from the service point on any one circuit is 7%.

7.3.7 Maintenance of Existing Lighting During Construction

The maintenance of existing lighting shall be the responsibility of the contractor only if the lighting is affected by the construction. The contractor should not be expected to replace lamps and pole knockdowns or to repair wiring if these problems are not caused by the construction work. As an example, a milling and resurfacing project should have no effect on the roadway lighting and the contractor should not be responsible for the maintenance of the lighting system.

The plans should specify the scope of the contractor's responsibility for the maintenance of existing lighting.

7.3.8 Grounding

The grounding requirements for lighting systems shall be as follows:

1. Install 20’ of ground rod at each conventional height light pole and at each pull box.
2. Install 40’ of ground rod at each electrical service point.
3. At each high mast pole, install an array of 6 ground rods 20’ in length, as shown in the ***Design Standards, Index 17502***.

This information is covered in the ***Design Standards***. The above lengths of ground rod will be installed at each pole, pull box and service point, and the cost will be incidental to the unit or assembly being installed.

7.4 Traffic Signals

The designer responsible for a traffic signal project should be aware that the design must comply with various standards. In addition to the Department's ***Standard Specifications***, the following standards should be consulted:

Manual on Uniform Traffic Control Devices (MUTCD), ***FHWA*** - The ***MUTCD*** was adopted by the Department as the uniform system of traffic control for use on the streets and highways of the State. The action was in compliance with ***Chapter 316.0745*** of the ***Florida Statutes***. The ***MUTCD*** is therefore the basic guide for traffic signals. The requirements of the ***MUTCD*** must be met, as a minimum, on all roads in the State.

AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, FDOT Structures Manual and ***Chapter 29*** of this volume - These documents provide structural design criteria.

Design Standards - These standards are composed of a number of standard drawings or indexes which address specific situations that occur on a large majority of constructions.

Traffic Engineering Manual – This Department publication provides traffic engineering standards and guidelines to be used on the State Highway System.

7.4.1 Design Criteria

The design of traffic signal mast arms and foundations shall be included in the plans. Refer to ***Section 7.6***, ***Foundation Design***, and ***Chapter 29*** of this volume for more information.

The horizontal clearance requirements for signal poles and controller cabinets are given in ***Chapters 2*** and ***25*** of this volume. Final location of these devices should be based on safety of the motorist, visibility of the signal heads, ADA requirements, and access by maintenance. When these clearances cannot be met with standard mast arm designs, alternatives and special designs must be coordinated with the District Design Engineer.

The ***MUTCD***, as noted above, has been adopted as the uniform system of traffic control for use on the streets and highways of the state. The ***MUTCD*** is the basic guide for traffic signal design; therefore, the traffic signal designer should be familiar with this document. The criteria in the following sections supplement the ***MUTCD***.

7.4.2 Certification and Specialty Items

Traffic signal equipment installed in Florida is required to be certified by the Department. The Office of Traffic Engineering in the Central Office is charged with the responsibility of certifying traffic control equipment. The designer of a traffic signal project, if requiring new equipment types or types not normally used, should contact Traffic Engineering in Tallahassee to determine the certification status of the equipment. Noncertified equipment cannot be used.

Standard Specifications have not been developed for all signal equipment. Some items are project dependent and the development of standard specifications is difficult. Specifications for these items must be developed on a project by project basis and included in the contract as a special provision. Some of these specialty items are included on the Department's approved products list. For these items, detailed specifications are not required. The Office of Traffic Engineering should be consulted on these items.

7.4.3 Stop Line Location

A stop line that is not properly located invites violation by the motorist. The ***MUTCD*** specifies the minimum and maximum distances from the signal head to the stop line for adequate visibility. The traffic signal designer must insure that this requirement is met.

Instead of relocating the signal heads, the stop lines at many intersections have been moved from their proper location to comply with these requirements. The tendency for the motorist is not to stop at the new stop line location, but rather to creep beyond the stop line. This could in some cases result in valid calls being dropped, thereby increasing delay and decreasing the overall efficiency of the intersection.

The first step in the design process should be to locate crosswalks and stop lines properly. Then the signal head location should be determined to meet the ***MUTCD*** requirements. This may require changing the mounting configuration. A box span, for example, may be required where a diagonal span would normally be installed.

7.4.4 Controller Assemblies

Controller Timings: The development of controller timings is a basic part of traffic signal design. A recent ruling from the Board of Professional Engineers stated that the development of timings is considered engineering and therefore requires the signature and seal of a professional engineer.

All traffic signal designs prepared for or by the Department shall include initial timings of all controllers. This is also true for signals to be included in local systems. If the timings in the plans are not implemented, it will be the responsibility of the agency providing the timings to insure they were prepared under the supervision of a professional engineer.

Future Intersection Expansion: Any planned intersection improvements, should be considered in the signal design. The controller type, cabinet type and the number of load switches are examples of design features that may be affected by future intersection improvements. It is the responsibility of the signal design engineer to determine if the current design should include capabilities for future improvements.

Upgrade of Existing Controller Assemblies: For projects requiring an upgrade to an existing controller assembly, the assembly may either be expanded or replaced. Minor expansions include the addition of load switches, new controller timings, and/or new controller unit if the cabinet is properly wired. These may be made in the field; therefore, expansion is the logical choice. On the other hand, major expansions include cabinet rewiring or any work requiring the removal of the cabinet back panel. Major expansions shall not be made in the field and replacement of the assembly is required. The designer may wish to contact the District Traffic Operations Engineer before making the decision to expand or replace an existing controller assembly.

7.4.5 Left Turn Treatments

The guidelines given below should be followed when determining signal treatments for left turns.

1. Single Turn Lane

    a. Restrictive/Permissive Phasing - A five-section cluster should be used for this location. The head should be installed over the lane line between the left turn lane and through lane. The five-section cluster can serve as one of the two indications required for the through traffic.

b. Restrictive Phasing - A separate signal head for the left turn lane with red, yellow and green arrow indications should be positioned over the center of the left turn lane.

2. Dual Turn Lanes - Only restrictive phasing should be used. Permissive movements should not be allowed for dual turn lanes. A single three-section head with red, yellow, and green arrow indications should be centered over each turn lane. These heads are in addition to the dual indications required for the thru movement.

3. Separated Turn and Thru Lanes - Turn lanes that are separated from the thru lanes more than 12 ft. by a raised or painted island shall not be operated in the permissive mode.

4. Single Lane Approach on Stem of "T" - Two three-section heads are required as minimum. All indications must be circular in this situation.

5. Two Approach Lanes on Stem of "T"

   Option #1: The approach may display two three-section heads with circular indications on all sections.

   Option #2: The approach may display a five-section cluster in conjunction with a three-section head. If the lanes are exclusive left and right turn lanes, then the five-section cluster should be placed over the center of the lane line and the three-section head over the major movement lane. If one of the lanes is a shared left and right lane, then the five-section cluster should be placed over the center of this lane and the three-section head over the center of the other lane.

   Option #3: The approach may display two three-section heads for the major movement and a single three-section head for the secondary movement.

6. Three Approach lanes on Stem of "T"

   Option #1: The approach may display two three-section heads for the major movement and one for the secondary movement (Exclusive left and right turn lanes).

   Option #2: The approach may display a five-section cluster in conjunction with three-section head (exclusive left and right turn lanes). The five-section cluster should be placed over the center of the lane line separating the left turn lane(s) from the right turn lane(s). The three-section head should be placed over the other lane line to provide dual indication for the major movement.

   Option #3: When the middle lane is a shared left and right turn lane, then a five-section cluster should be placed over the center of this lane and a three-section head placed over each of the other two lanes. Each head must contain green and yellow arrow indications in this situation.

NOTE:

1. For all cases, the approach shall display "dual indications". This means that there must be at least two heads with identical indications on the major approach. For example, if a green arrow is displayed on one head of the major movement or approach then a green arrow must be displayed on the second head.
2. The same signal display option should be used throughout an urban area to provide consistency in display to the motorist.
3. The use of advance and/or overhead lane use signs should be used as a supplement to pavement arrows on stems of signalized "T" intersections.

7.4.6 Signal Preemption

The engineer responsible for the design of a traffic signal project shall, as a matter of routine, check each intersection to determine if the need for signal preemption is present.

Intersections located in accordance with ***Department Procedure 750-030-002*** should be considered for preemption. Department signalization projects may also include preemption or priority systems for emergency vehicles or mass transit vehicles.

Refer to ***Department Procedure 750-030-002, Signalization Preemption Design Standards***, for more information.

7.4.7 Intersection Design - Lane Configuration

The engineer responsible for the traffic signal design may be asked to verify the number and configuration of traffic lanes required for an intersection to function properly when signalized.

The results are dependent upon the traffic volumes used in the analysis. The traffic used for this calculation shall be the design hourly volume based on the 30th highest hour (K factor) and not a peak to daily (P/D) ratio based on a 24-hour count. The K factor volumes account for traffic variations through the year, and, in most cases, are higher than P/D volumes.

The K, D, and T factors convert the two-way AADT volumes to a one-way Design Hourly Volume (DHV). This is appropriate for the total approach movements. The AM and PM peak turning movement counts on each approach should be addressed individually. Current turning movement counts should be taken to determine the percentage of turns for each approach. These percentages should then be applied to the DHV for each approach volume to determine the turning volumes that should be used for the turn lane design calculations. These values should be compared to the movement counts supplied by Planning and the greater of the two values used for the design of turn lanes. The District Planning Office should be contacted to determine if recent counts are available and also if any use changes are planned which would require adjustments to the turn percentages found in the current counts.

Storage lanes for left turns can affect the capacity and safety of intersections. The storage length of a left turn lane is a critical design element. The queue of left turn vehicles in a storage lane of inadequate length may extend into the through lanes. The result is loss of capacity for the through lanes. The queue of through vehicles may also extend beyond the entrance of a short left turn storage lane, blocking access to the storage lane. Either case results in a less efficient operation of the intersection and may cause last minute lane changes, thereby increasing the possibility of conflicts.

Turn lanes should comply with the ***Design Standards***, ***Index 301*** to the extent practical. The available queue length provided should be based on a traffic study.

The important factors that determine the length needed for a left turn storage lane are:

1. The design year volume for the peak hour (see discussion above).
2. An estimate for the number of cycles per hour.

   NOTE: If the cycle length increases, the length of the storage for the same traffic also increases.
3. The signal phasing and timing.

There are several techniques used to determine necessary storage length. The following are suggested guidelines for left turn lanes.

1. Where protected left turn phasing is provided, an exclusive turn lane should be provided.
2. Left turn lanes should be provided when turn volumes exceed 100 vehicles per hour (VPH) and may be considered for lesser volumes if space permits.
3. For signalized intersections, the following formula may be used, assuming an average vehicle length of 25 feet.

$$Q = \frac{(2.0)\ (DHV)\ (25)}{N}$$

   Where:

   Q = design length for left turn storage in ft.
   DHV = left turn volume during design peak hour, in VPH.
   N = number of cycles per hour for peak hour, use N = 30 as default.

   Note: Computer programs, such as ***TRANSYT-7F***, are used to develop signal phasing and timing. One of the outputs of these programs is the queue length. For projects where traffic signal timing is included as a part of the project, the output of these programs should be considered in determining storage length.
4. Where left turn volumes exceed 300 vph, a double left turn should be considered.
5. When right of way has already been purchased, and the designer has to choose between a long wide grass median or a long left turn lane, the storage length for the left turn should be as long as practical without hindering other access.

Right turn lanes are provided for many of the same reasons as left turn lanes. Right turns are, however, generally made more efficiently than left turns. Right turn storage lanes should be considered when right turn volume exceeds 300 vph and the adjacent through volume also exceeds 300 vehicles per hour per lane (vphpl).

7.4.8 Signal Loops

Traffic signal loops are detailed in the ***Design Standards, Index 17781***. These loops are standard and will be appropriate for most locations.

The traffic signals for each intersection should be individually designed. The requirement for type and placement of loops is a part of this design. The above standard allows for some variation in size and placement of the standard loops. These modifications are intended to be used only when required by the design of a particular location.

7.4.9 Grounding and Electrical Bonding

The grounding requirements for traffic signal components shall be as follows:

1. Install 20' of ground rod at each signal pole, mast arm, pedestrian signal, etc. and at each pull box.
2. Install 40' of ground rod at each electrical service and controller cabinet.

This information is covered in the ***Design Standards*** and specifications. The above lengths of ground rod will be installed at each component, and the cost will be incidental to the unit or assembly being installed.

The designer will not be required to add plan notes or develop quantities for ground rods and the use of the 620 pay item number for grounding electrode will not be required on the plans.

Design Standards, Index 17736 requires a bond wire connecting all poles, controllers, mast arms and pedestrian signal pedestals. This conductor is incidental to the cost of the signal installation.

7.4.10 Wind Loading - Traffic Signals

See ***Chapter 29*** of this volume.

7.4.11 Foundation Criteria

Refer to ***Section 7.6, Foundation Design***, for geotechnical requirements.

7.4.12 Mast Arm Supports

All new signals installed on the State Highway System that meet any of the following criteria (considered the mast arm policy area):

1. along designated coastal evacuation routes;
2. along the Strategic Intermodal System routes; or
3. along corridors within the approximate ten mile coastline boundary defined by the State Traffic Engineering Office Implementation Guidelines

shall be supported by mast arms with the signal head(s) rigidly attached to the mast arm. A span wire assembly may be used within this mast arm policy area only when it is impractical to use a mast arm or overhead rigid structure and a Design Variation has been approved in accordance with ***Chapter 23*** of this volume.

Mast arm signal supports or other types of rigid supports outside the mast arm policy area must be carefully considered before inclusion in a project. The districts have the flexibility to provide the total funding if funding is available. If funding is not sufficient, mast arm signal supports or other types of rigid supports outside the mast arm policy area can be installed by the Department with Maintaining Agency providing the funding for the cost difference between the proposed supports and strain pole supports typically installed by the Department.

In addition, an underground communication cable infrastructure shall be utilized for those signals operating as part of an advanced traffic management system on these designated corridors.

The signal support system used for signals located outside the mast arm policy area shall be selected after consideration of appropriate site conditions, design requirements and cost.

The Structures Design Office has developed a Traffic Signal Mast Arm Standard. The standard includes single arm designs, with and without luminaires and double arm designs without luminaires. The standard designs include both 110, 130 and 150 mph design wind speeds. A foundation and base plate design has been developed for each pole type.

The manufacturer of the standard mast arms will be pre-approved by the Department and added to the Qualified Products List (QPL). When the standard assemblies are used, design details in the plans or shop drawing submittals will not be required. Special designs, for those locations where the standard design is not appropriate, will require complete design details for the pole, arm and foundation to be included in the plans, and will require shop drawings.

Mast arm design will require close coordination between the signal designer and the Structures Office. If standard designs are utilized, the Structures Engineer shall review applicability of structural parts with site conditions. Early coordination is important.

The Signal Designer will provide the Structures Office a copy of the mast arm tabulation sheet that includes the following information:

1. The pole and arm locations
2. Elevations and offsets
3. Signal and sign sizes and locations on the mast arm

The Structures Office will analyze the data and determine the standard pole and arm configuration required, and complete the "Standard Mast Arm Assemblies Data Table" (Structures CADD cell table) for the plans. If a special design is required the Structures Office will provide the complete design details for the special mast arm assembly. A special design will require additional design time for either the Department or Consultant Structures Office. As noted above, the standard includes a foundation design for each pole. These designs were based on assumed soil conditions. The Structures Office will verify the project soil conditions to ensure the standard foundations are adequate. A special design will be developed if required.

The engineer responsible for signal design will seal the mast arm tabulation sheet and the Structures Design Engineer will seal the structures data table and special design details if required for the plans.

Refer to ***Volume II, Chapter 24*** for instructions on the mast arm tabulation sheet.

7.4.13 Traffic Signal Project Coordination

Coordination with other offices and other agencies is a very important aspect of project design. The offices discussed in this section are not intended to be an all inclusive list with which the designer should coordinate, instead it includes offices that are normally involved in projects.

Roadway Design - Normally the designer of a signal project receives the base sheets for design from the roadway designer. The roadway designer can also provide any required cross sections. If the signal project is not an active roadway design project, base sheets may be obtained from existing plans.

Utilities - The District Utilities Engineer provides the coordination between the designer and the various utilities involved in the project. This usually is limited to agreements with the power company for electrical service. The Utilities Section can also identify potential conflicts with overhead and underground utilities or verify those that have previously been identified.

The Utilities Engineer should be contacted early in the design phase. The designer should indicate a preferred location for the electrical service.

Structures Design - The Engineer of Record for Structures Design provides the design of the traffic signal mast arms and strain poles. This includes the design of the foundation for these structures. The Engineer of Record must be contacted early in the design phase to allow adequate time for coordination with the Geotechnical Engineer in obtaining the necessary soils information.

Pedestrian and Bicycle Coordinator - The pedestrian and bicycle coordinator should be consulted to be sure that all of the pedestrian and bicyclist concerns have been fully considered.

7.4.14 LED Light Sources

The Light Emitting Diode (LED) is the standard light source for all signal indications.

7.4.15 Pedestrian Countdown Signal Applications

Countdown pedestrian signals are the Department's standard installation on all projects that include pedestrian signal head devices. The Department's ***Traffic Engineering Manual, Section 3.9***, contains specific criteria for their installation and operation.

7.5 Intelligent Transportation System (ITS) Components

Intelligent transportation system (ITS) designs utilize electronics, communications, or information processing systems singly or in combination to improve the efficiency and safety of a surface transportation system. ITS components are devices and subsystems that provide certain specialized functions within an ITS system. These devices are typically deployed to obtain information (including traffic data, video imagery, weather information, and other information relevant to roadway management) from field sites along Florida's Intrastate Highway System. This information is transmitted to transportation management centers (TMCs) and associated control facilities, where traffic managers use it to assess conditions, respond to incidents, and conduct other activities. ITS components also provide various means of disseminating travel-related information and alerts to motorists concerning traffic or weather conditions they may encounter.

The inclusion of new ITS design guidelines in this chapter will occur as statewide minimum specifications for ITS devices are finalized and adopted by the Department. Because this is an ongoing process, those individuals seeking the latest information on ITS device design requirements and specifications should contact the ITS Section in the Traffic Engineering and Operations Office.

The plans preparation information provided in this section applies to the placement and installation of ITS devices and systems along Florida's limited-access and non-limited-access corridors. ITS device requirements as adopted by the Department are published by the State Specifications Office and available online at the FDOT Web site. The ITS project designer is advised that plans involving ITS devices must also include provisions for grounding and surge suppression in order to protect ITS equipment and ensure human safety.

7.5.1 Design Criteria

ITS design criteria, in general, require that devices and systems be able to gather, analyze, and distribute accurate information to support the overall goal of improving the safety, efficiency, mobility, security, and integration of transportation systems. Designers must consider the strengths and limitations of various technologies for collecting, analyzing, and disseminating information, and select devices that are most appropriate for a specific application. Many ITS devices have specific placement and configuration requirements that must be met for the equipment to perform properly. Designers are strongly encouraged to familiarize themselves with the strengths and limitations of various devices and technologies prior to incorporating them into their designs. Other general considerations for

ITS designs include promoting safety for road users, monitoring traffic and travel conditions, supporting traffic management operations, providing equipment access for maintenance personnel, and disseminating useful information to motorists. Lastly, the designer needs to ensure that the ITS project is consistent with the FDOT regional ITS architecture, and that the project reflects the application of system engineering management principles.

For vehicle detection systems, such as those utilizing video, microwave, magnetic field, or acoustic technologies, the designer should consult with the device manufacturers to ensure that placement and installation plans facilitate proper operation of a particular device type. Be aware of a technology's capabilities and limitations in a given location in order to create a design that is capable of achieving the required levels of detection accuracy.

The clearance requirements for poles, sign structures, field cabinets, and communication hubs for ITS deployments should conform to those provided in ***Chapters 2*** and ***25*** of this volume. Any deviation or alternative or special design must be coordinated with the District Design Engineer.

7.5.2 ITS Device Approval and Compatibility

ITS devices sold or installed in Florida are required to be evaluated by the Traffic Engineering and Operations Office's Traffic Engineering Research Laboratory (TERL) prior to their use on the state's highways. The evaluation of ITS devices by the TERL will occur as statewide minimum specifications for ITS devices are finalized and adopted by the Department. Designers should consult the FDOT Approved Product List (APL) for the device types requiring evaluation and the currently approved devices. If the designer wishes to utilize a new device type or a device not on the APL, they should contact the TERL in Tallahassee to determine the appropriate course of action.

Designs should ensure that ITS devices which share communications networks or provide related functions are compatible with each other and will not interfere with the operation of other devices or systems. In addition, designs should incorporate features and functions that allow interoperability with other ITS deployments throughout the state. Examples of general design characteristics that promote interoperability include:

1. Systems and products based on open architectures and standards.
2. Systems and products that are scalable and nonproprietary.
3. Compatibility with the Department's SunGuide℠ Software System directly or via support of one or more of its related Interface Control Documents (ICDs).

7.5.3 Required Information

The basic information necessary for ITS plans includes device placement and installation requirements (including communication and power interconnect), roadway geometrics, street names, construction stationing or milepost information, right of way lines, location of underground utilities, and presence of other roadside features or existing devices that may impact ITS device locations in the field.

The requirements for a complete set of ITS project plans are found in ***Chapter 29 of Volume 2***.

7.5.4 Motorist Information Systems

7.5.4.1 Dynamic Message Sign (DMS)

The DMS is an electronic sign capable of displaying more than one message, which is changeable manually, by remote control, or by automatic control. The DMS is intended primarily to advise approaching motorists of freeway conditions, such as road construction or a traffic incident ahead, so that they can take appropriate action. In some instances the DMS could be used to display other messages, such as AMBER Alerts or traveler information related to special events, emergencies, and incidents impacting mobility and safety. A DMS generally displays messages that can be selected or modified by electronic means from a TMC or other central command location. As such, system designs utilizing DMS must also include designs for a communication infrastructure that supports this remote control capability.

The DMS should be positioned and illuminated to be readable from the roadway, taking into account the display characteristics of DMS technology (e.g., the vertical and horizontal viewing angles of the LED displays).

The DMS and its support structure must meet the wind load requirements as specified in ***Chapter 29*** of this volume and comply with the ***AASHTO 1994 Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals*** (50-year reoccurrence).

Placement of a DMS should be determined by project-specific needs, as well as the following general design criteria:

1. Ability to communicate a meaningful message that can be read and comprehended by motorists within a brief time period (dictated by the sight distance characteristics of the location and the design features of the sign). This is also dependent upon the posted speed limit of the roadway.
2. Placement prior to freeway interchanges that offer alternate routes.
    a. In advance of 1-mile exit approach signing.
    b. Maintain minimum 800-foot spacing between existing and planned overhead static sign panels and other signs, per the MUTCD. Consider increased spacing when conditions allow.
    c. Maintain minimum of 1450-foot distance from decision points (meets MUTCD/AASHTO Green Book requirements).
3. Placement in advance of high crash locations and traffic bottlenecks.
4. Placement that accommodates access for service and maintenance.
5. Placement in advance of system interchanges.
6. Placement along key commuter or evacuation corridors.

The sign enclosure must be mounted with a minimum vertical clearance height as specified in ***Table 2.10.4***.

7.5.4.2 Highway Advisory Radio

A highway advisory radio (HAR) system design should include all the equipment necessary for the operator to record verbal messages from onsite or remote locations, and to continually broadcast live, prerecorded, or synthesized messages from roadside transmission sites. HAR designs also include highway signs with remotely operated flashing beacons to notify motorists of HAR broadcasts.

The designer should be aware of the Federal Communications Commission (FCC) regulations in ***CFR Title 47, Part 90.242***, pertaining to the operation of travelers' information stations. Additional information on licensing issues, frequency allocation, and other specifics can be obtained by contacting the FDOT ITS Telecommunications Office.

Radio waves are also propagated through the ground and grounding components are used to ensure peak performance. This necessitates a well-designed and well-constructed ground field, a circular space radiating from the antenna location. This design is critical to the successful operation of the HAR site, and may require a significantly sized circle around the antenna mast. An array of wiring emanating from the antenna mast radiates outward; ground assemblies at the end of each wire or cable are drilled into the ground.

Placement of a HAR installation should be determined by project-specific needs, as well as the following general design criteria:

1. Ability to transmit a meaningful message that can be received by motorists traveling through the broadcast zone.
2. Placement prior to freeway interchanges that offer alternate routes.
3. Placement in advance of high crash locations and traffic bottlenecks.
4. Placement that accommodates access for service and maintenance.
5. Placement along key commuter or evacuation corridors.

7.5.4.3 Road Weather Information System

A road weather information system (RWIS) receives input from an environmental sensor station (ESS) in the field to produce readings for temperature, precipitation, barometric pressure, wind speed and direction, visibility, and other variables. The designer should locate the ESS where its weather observations will be the most representative of the roadway segment of interest.

The ESS towers on which the weather instruments are mounted are frequently installed within a range of 30 to 50 feet from the roadway's edge to avoid the effects of passing traffic (e.g., heat, wind, splash), yet still be able to detect the weather conditions affecting motorists there. The location of ESS towers shall conform with the horizontal clearance requirements of ***Table 2.11.10.***

Avoid standing water or locations where billboards, surrounding trees or other vegetation would affect the weather measurements. Median placement of an ESS on a divided highway is generally not feasible unless the median is 100 feet or wider. For more siting criteria, refer to the ***FHWA's Road Weather Information System Environmental Sensor Station Siting Guidelines, Publication No. FHWA-HOP-05-026***, available at www.ops.fhwa.dot.gov/publications/ess05/index.htm.

At locations where the FDOT has Motorist Aid System towers, preference should be given in the design to mounting RWIS instruments on these structures. Also, consider the communication link the RWIS installation requires for transmitting the weather data. Options include twisted-pair copper wire, microwave, Ethernet communications over a fiber optic network, or use of a cellular telephone network.

7.5.5 Video Equipment

7.5.5.1 Closed-circuit Television Cameras

Closed-circuit television (CCTV) systems consist of roadside cameras, communication devices, as well as camera control and video display equipment at one or more remote monitoring locations that allow surveillance of roadway and traffic conditions

CCTV device placement and overall system design should be determined by project-specific needs, as well as the following general design criteria:

1. A camera should be strategically located to obtain a complete view of the freeway (keeping all ramps in mind) and to view the arterial traffic.
2. Camera location should provide the ability to view any nearby DMS for message verification.
3. A camera's location should provide the ability to view crossing features (i.e., streets, rail, bridges), as feasible.
4. Camera structures must be placed in accordance with ***Section 2.11***.
5. Device placement should be such that it accommodates access for service and maintenance with minimal to no impact on traffic. For instance, the use of lowering devices to allow cameras to be lowered from the pole top to ground level for servicing with little or no disruption of traffic.

Designs and plans should consider and illustrate camera mounting height. Mounting height should be selected based upon project specific needs, as well as the following general design criteria:

1. Required viewing distance.
2. Roadway geometry and lane configuration.
3. Roadway classification (i.e., arterial or freeway).
4. Life-cycle cost, including maintenance impacts.
5. Environmental factors, such as glare from the horizon or from headlights.
6. Vertical clearance.

All camera housings, enclosures, lowering devices, and mounts must be designed to withstand sustained wind loads and gust factors according to ***Chapter 29*** of this volume.

CCTV camera poles should also be designed and installed according to the requirements of ***Section 641, Prestressed Concrete Poles***, or ***Section 649, Steel Strain Poles, Steel Mast Arms and Monotube Assemblies***, in the ***FDOT Specifications***, and as depicted in ***Index 17723*** and ***Index 17725*** of the ***Design Standards***.

Designs for support structures and foundations should be based on the ***PPM*** guidelines***,*** the ***Design Standards***, and on the ***AASHTO LTS-4*** standard with current addenda. The wind load requirements as specified in ***Volume 9*** of the ***FDOT Structures Manual*** should also be used as design criteria for CCTV structures and their associated foundations.

7.5.5.2 Video Display Equipment

Video display equipment is utilized in the TMC for viewing CCTV images and other information obtained from field locations. It is important to develop a display system design plan that is based on a detailed, documented analysis of the control center room dimensions, the operator's console desk layout, various distances from the operator's seating position to the video wall display, and the viewing angles to the display wall at the proposed mounting height for the display supporting structure.

The designer should consider any potential limitations introduced or imposed by existing facility construction that may hinder the installation of the video wall display. The video display components should be capable of being brought into the TMC control room and assembled in place without the Contractor having to make modifications to existing doorways, walls, floors, or ceilings.

7.5.6 Network Devices

Network devices utilized in ITS include a variety of Internet Protocol (IP)-addressable electronic equipment used for the collection and dissemination of video, traffic data, and other information.

Due to the critical nature of the network equipment described below, the complexity of the electronics, and harsh environmental conditions at installation locations, designs utilizing network devices should facilitate immediate replacement of defective or damaged units with minimal system downtime.

Consideration should be given to designs that promote open architecture, non-proprietary systems, as well as survivability and reliability. Designers should consider solutions that provide immunity to single-point failure and implement redundant paths for reliability and survivability.

7.5.6.1 Managed Field Ethernet Switch

The managed field Ethernet switch (MFES) is an environmentally hardened field device that provides Ethernet connectivity from the remote ITS device installation location to the ITS network trunk interconnection point. Local connections from nearby Ethernet field devices or other cabinet electronics to the MFES are generally accomplished using CAT5e or CAT6 UTP cables connected to RJ-45 Ethernet ports on the MFES. However, when planning connections of the MFES to other Ethernet devices beyond a distance of 300 feet, fiber optic cabling from optical ports on the MFES is generally the preferred method. The designer should also consider fiber optic connection to devices outside the local cabinet if the design requires additional protection from transients or interference that may be induced on copper-based interconnects.

The design should provide an Ethernet port for the connection of each remote ITS field device. Field devices that typically connect to an MFES include, but are not limited to, CCTV camera systems, HAR field assemblies, vehicle detection systems, DMS, road weather information systems (RWIS), and traffic controllers.

7.5.6.2 Device Server

The device server encapsulates serial data in network packets and transports the packets across IP networks. Designs generally include device servers when remote field devices must connect to an Ethernet network, yet only possess serial communication interfaces.

Equipment that may require the use of device servers includes, but is not limited to, HAR field assemblies, DMS, vehicle detection systems, RWIS stations, and other low-speed data output devices

7.5.6.3 Digital Video Encoder and Decoder

Digital video encoders (DVEs) and digital video decoders (DVDs) are specialized network-based hardware devices and software that allow data signals and analog video to be encoded to digital format and transmitted across IP networks. These networks are designed so that the digitized video and data packets the DVE produces and places on the network can be reconstructed (decoded) by hardware-based and software-based DVDs also attached to the network.

When designing a video and data transmission system incorporating DVE and DVD hardware with existing or planned network infrastructure, ensure that the system can transport video and data from multiple remote field locations simultaneously to multiple monitoring locations. If applicable, the designer should also seek to maintain video, data, and switching interoperability with legacy systems.

7.5.7 Fiber Optic Cable and Interconnect

The following sections describe the various fiber optic facilities that are used for device control and data communications between ITS field devices, TMCs, regional transportation management centers (RTMCs), and other identified stakeholder facilities. Designs that include network facilities should meet project-specific needs, as well as include the following information:

1. Facility diagrams illustrating facility routes.
2. General network topology.

7.5.7.1 Fiber Optic Cable

Fiber optic cable is utilized in the statewide ITS network infrastructure to provide data and device control communications between TMCs, RTMCs, ITS devices, and other identified stakeholder facilities. The designer should refer to Department specifications for material requirements of fiber optic cable and related material.

7.5.7.2 Fiber Optic Conduit

The type of fiber optic cable installation will determine the design for the conduit needed. For example, use polyvinyl chloride (PVC), fiberglass, or high-density polyethylene (HDPE) conduit for fiber optic cable that is exposed or placed underground along the roadway. Use HDPE SDR 11 conduit underground along the interstate. Use a UV-rated, flexible conduit to protect the cable in above-ground installations.

The design of the conduit should depict all required fittings and incidentals necessary to construct a complete installation. The conduit system should allow the fiber optic cable to maintain the minimum bend radius after installation.

7.5.7.3 Fiber Optic Splices and Terminations

Fiber optic splices provide a continuous optical path for transmission of optical pulses from one length of optical fiber to another. Designs and plans should identify splice points and provide splicing diagrams that detail the interconnection of specific fiber strands, their origination and final destination points, and expected link loss. The preferred method of presentation is a graphical format.

Fiber optic terminations connect the optical fibers housed within a cable to a fiber distribution panel (FDP) or a fiber patch panel (FPP). The FDP and FPP help connect the optical fibers to the electronic equipment and devices located throughout the network. Therefore, all fiber optic terminations should include the installation of a FPP or a FDP. Field terminations also include the installation of fiber optic connectors to the optical fibers if factory-installed connectors are not used.

7.5.7.4 Fiber Optic Cable Designating System

The fiber optic cable designating system provides visual notification of the presence of the underground fiber optic conduit/cable system, and provides a mechanism for electronically locating the physical presence of the conduit system below ground. The designating system provides a means to identify, locate, and protect the statewide fiber optic network between RTMCs, TMCs, ITS devices, and other facilities.

The designating system may consist of several components, including electronic markers, above-ground route markers, tone wire access points, buried cable warning tape, underground tracers, and tone wires. Design the designating system to support both high-power, office-based tone generators and portable field tone generators.

The design and construction of the designating system should consist of furnishing and installing the type, size, and quantity of system components as specified by the project, and meeting the following functional requirements based on project needs:

1. Provide visual notification of the presence of the conduit installed on FDOT projects.
2. Inform the public of potential hazards and provide contact information for conduit system marking prior to planned excavation.
3. Provide an end-to-end electrical conductor (tone wire) attached to the conduit system for conductive facility locating.
4. Provide above-ground access to the tone wire.

7.5.7.5 Fiber Optic Access Points

Fiber optic access points consist of splice boxes and pull boxes. They are utilized to provide access to the statewide fiber optic conduit system for the installation, operation, and maintenance of fiber optic cables between RTMCs, TMCs, ITS devices, and other identified stakeholder facilities. More information about pull and junction boxes is provided in ***Section 635*** of the ***FDOT Specifications***.

Access point items should be planned and designed according to the type, size, and quantity necessary for the project. Design the access points to meet the following minimum functional requirements:

1. Provide at-grade access to fiber optic cables housed within conduit systems used for FDOT ITS communications.
2. Provide assist points to aid in fiber optic cable installation.
3. Provide protection for the fiber optic cable.
4. Provide adequate space for storing cable slack/coils and splice enclosures.
5. Make certain that pull boxes and splice boxes provide sidewall entry of the fiber optic cables.

Fiber optic access points should be placed at the following locations unless otherwise directed by the Engineer:

1. All major fiber optic cable and conduit junctions.
2. At all planned or future splice locations.
3. Every 2,500 feet in a continuous straight conduit section if no fiber optic cable splice is required.
4. At a maximum of 1,000 to 1,500 feet in metropolitan areas.
5. On each side of a river or lake crossing and at each end of a tunnel.
6. On each side of an above-ground conduit installation (i.e., attachment to bridge or wall).
7. All 90-degree turns in the conduit system.

Use splice boxes as the preferred access points on fiber optic cable backbone routes. Use pull boxes as the access points when the conduit system extending from the backbone to the ITS field devices requires an access point to house only fiber optic drop cables.

7.5.8 Infrastructure

7.5.8.1 Grounding and Transient Voltage Surge Suppression

Effective grounding and surge suppression is generally achieved through a combination of three primary techniques: proper bonding and installation of grounding rods, use of air terminals, and the application of a transient voltage surge suppressor (TVSS). These three methods work in concert to protect ITS equipment installed in the field and should be incorporated, as applicable, in ITS designs and plans.

Designs and plans should consider existing geological and other physical characteristics at proposed installation locations that may affect the design or layout of grounding systems. Information such as locations of rock formations, buried utilities, gravel deposits, soil types and resistivity, and presence of groundwater should be considered when developing plans that include these systems. Any pertinent survey data gathered during plans development, such as soil resistivity measurements, should be noted on the plans.

Placement and layout of grounding arrays should be planned in such a way that grounding paths from the down cable to the primary electrode are as straight as possible. Where practical, plans should provide detail related to cable routing and other installation details required to maximize the efficiency of Grounding and TVSS.

Grounding and TVSS device placement and overall system design should be determined by project-specific needs, as well as these general design criteria:

1. Follow best practices defined in the NFPA 780 Standard for the Installation of Lightning Protection Systems.
2. Place TVSS equipment so that grounding connections are as short and straight as possible.
3. Cable routing should avoid excessive bending and provide physical separation between low-voltage and high-voltage signal paths.
4. Avoid routing unprotected or grounding wires parallel or adjacent to protected wiring.

7.5.8.2 ITS Pole and Lowering Device

For installations of pole-mounted devices where height precludes easy access using a bucket truck, consider using a lowering device.

If designs call for a lowering device to be attached to an existing pole or similar structure, ensure that the design includes external conduit for housing the cabling, the necessary mounting box hardware at the top of the structure, and any other component details required for installation. Do not create designs that would require an operator to stand directly beneath equipment while it is being lowered.

The designer should consider the placement of all devices on the pole and how they affect the ability to utilize the lowering device.

7.5.8.3 ITS Field Cabinet

ITS field cabinets are designed and furnished to house any combination of several ITS devices installed along the roadway, including managed field Ethernet switches, hub switches, device servers, digital video encoders, vehicle detection system electronics, DMS communication devices, CCTV camera hardware, and power supplies for these items.

Final location of the cabinet should be based on safety of the motorist, visibility of roadside devices, and access by maintenance. ITS field cabinets can be base mounted on a concrete pad, structure mounted, or pole mounted.

The cabinet should be sized appropriately to accommodate the equipment to be installed inside. In addition, the cabinet design should take into account the ease of access to the equipment and the ability to achieve proper ventilation in order to maintain an internal operating environment that does not exceed the operating temperature ranges for the devices housed inside.

7.5.8.4 Equipment Shelter

An equipment shelter is utilized at the roadside to house network devices or telecommunications equipment that require a level of protection, security, or climate control beyond that is provided by typical ITS field cabinets. Equipment shelters are modular products manufactured from concrete or concrete composite and delivered to the installation site for placement on a prepared concrete slab. The location of equipment shelters shall conform with the horizontal clearance requirements of ***Table 2.11.10.***

Though equipment shelters are prefabricated in large part, the designer must determine, and detail the site layout, including the shelter dimensions, site preparation work, fencing, landscape, conduit and pull box installation, as well as details for electrical, lighting, grounding, alarm, and HVAC systems necessary to accommodate the types and quantity of equipment the shelter will house. The design shall also include details that illustrate the equipment layout inside the shelter, including positioning of overhead cable trays, the quantity and placement of standard EIA/TIA 19-inch racks, demarcation and patch panels, and the equipment placement within each rack.

7.5.9 Vehicle Detection and Data Collection

The FDOT uses vehicle detectors along roadways to collect traffic information. Data from these detectors are used in the TMCs to initiate traffic control measures. There are various kinds of detectors available, each with its unique attributes and limitations. The four types described here are considered nonintrusive because their operation does not interfere with the flow of traffic, and installation does not require altering the roadway surface.

Prepare a design that details a complete detection assembly, including all other necessary components to be supplied and constructed. Detail in the drawings the exact location and placement of system components, and include installation details for the required cables. Design the cabling installation according to the manufacturer’s recommendations.

7.5.9.1 Microwave Vehicle Detection System

The Microwave Vehicle Detection System (MVDS) is installed above ground on the side of the road (i.e., side-fire) for multilane detection, or over the travel lanes for single lane coverage only. This detection system uses a FCC-certified, but non-site licensed, low-power microwave radar beam to measure vehicle presence, volume, speed and occupancy.

7.5.9.2 Video Vehicle Detection System

The Video Vehicle Detection System (VVDS) measures vehicle presence, volume, occupancy, and speed by analyzing video signals generated by the video camera used to detect traffic.

Besides vehicle detection, the VVDS can also function as a roadway surveillance device. When surveillance capability is desired, dual-use VVDS systems are used. In the surveillance mode, these systems automatically turn off the vehicle detection functions.

The recommended deployment geometry for optimal video detection and surveillance requires that there be an unobstructed view of each travel lane where detection and surveillance are required. Though optimal results can be achieved when the cameras are directly above the travel lane, the cameras are not required to be directly over the roadway.

Cameras can be positioned so they can view either approaching or receding traffic or both in the same field of view. The preferred orientation for optimal detection is the view of approaching vehicles because there are more high-contrast features on vehicles viewed from the front than from the rear. Cameras should be positioned high enough to minimize the effects of occlusion from closely spaced vehicles and to avoid glare from the horizon.

7.5.9.3 Magnetic Traffic Detection System

The Magnetic Traffic Detection System (MTDS) relies on magnetic sensors or probes that are placed in conduits under the road surface. A probe is a transducer that converts changes in the vertical component of the earth's magnetic field to changes in inductance in a loop. Vehicles on the road surface increase the vertical component of the earth's magnetic field at the detection point when they move over the sensor. The increased magnetic field changes inductance in a loop connected to the sensor, and the system converts this input into traffic data.

7.5.9.4 Acoustic Vehicle Detection System

The Acoustic Vehicle Detection System (AVDS) utilizes a passive acoustic sensor that measures traffic parameters by detecting vehicle-generated acoustic signals. The AVDS can be mounted over the travel lane on a bridge or a mast arm, or on roadside poles or sign structures for a side-fire mounted configuration.

Acoustic detection systems measure traffic flow parameters for five adjacent lanes on a lane-by-lane basis. The system can identify acoustic signals from approaching vehicles with a different signal level and a different wave front angle (i.e., arrival angle) than that of passing vehicles that are leaving the detection area. The system also processes acoustic signals generated by stationary (i.e., idling) vehicles in real time.

The detection system can also be used to emulate a dual-loop speed trap configuration for speed measurement.

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7.6 Foundation Design

For foundations for standard conventional Roadway Lighting Poles, refer to the ***Design Standards, Index 17515***. Refer to the ***Design Standards, Index 17503*** for foundations for non-standard conventional Roadway Lighting Poles. ***Section 715*** of the ***Specifications*** allows the screw type foundation as an alternate. The Geotechnical Engineer shall determine whether the soil characteristics meet the requirements of ***Section 715***. If it is determined that the soil conditions do not allow the use of the screw type foundation as shown in ***Section 715***, a note shall be added to the plans stating: "Use of the screw type foundation is not allowed on this project."

The ***Design Standards, Index Nos. 17743 and 17745*** include foundations for standard Mast Arm Assemblies, and ***Index 17746*** includes foundations for standard Monotube Signal Structure assemblies. Unique site circumstances may require the foundation variables to be modified from the foundations shown. If special designs are required, the Geotechnical Engineer shall provide the soil information to be used by the District Structures Design Engineer during the design phase of the project.

The foundation design and drawings where special foundations are required for locations where standard Mast Arm Assemblies and Standard Monotube Signal Structures are used and for overhead sign structures, high mast light poles, and traffic signal strain poles shall be the responsibility of the Structures Engineer of Record (EOR). The Geotechnical Engineer shall provide the EOR the following soils information (this information may be derived from the borings of other nearby structures or from roadway borings):

1. Soil Type
2. Effective Unit Weight of the Soil
3. Seasonal High Water Table Elevation
4. Effective Friction Angle of the Soil (if applicable)
5. Cohesion Value (if applicable)
6. Allowable Bearing Capacity (if applicable)

The above soils information shall be included in the plans. Additionally, Soil Boring Data Sheets shall be included in the plans, except for strain poles. This will provide the Contractor with the conditions for which the foundations were designed as compared to actual on-site conditions and establish criteria for any future analysis of the foundations.

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Chapter 8

Pedestrian, Bicycle and Public Transit Facilities

Tables

Figures

On roadways with flush shoulders, the minimum width of sidewalk is 5 feet.

On existing roadways with flush shoulders, sidewalks or pedestrian pathways should be placed as far from the roadway as practical in the following sequence of desirability:

1. Outside of the roadway right of way in a separate, offsite and/or parallel facility.
2. At or near the right of way line.
3. Outside of the clear zone.
4. As far from edge of driving lane as practical.

For new roadway construction with flush shoulders, the sidewalk should be outside of the clear zone.

8.3.2 Disability Considerations

Pedestrian facilities must be designed in accordance with ADA to accommodate the physically and visually challenged citizens whose mobility is dependent on wheelchairs and other devices. In areas with sidewalks, curb ramps shall be incorporated at locations where a marked crosswalk adjoins the sidewalk. ***Index 304*** of the ***Design Standards*** sets forth requirements. Pull boxes, manholes, and other types of existing surface features in the location of a proposed curb ramp should be relocated when feasible. When relocation is not feasible, the feature shall be adjusted to the new ramp to meet the ADA requirements for surfaces (including the provision of a non-slip top surface, and adjustment to be flush with and at the same slope as the curb ramp).

The detectable warning systems on the QPL are designed to work with concrete surfaces. In areas where the pedestrian facility has an asphalt surface, such as a shared use path, the engineer must specify an appropriate detectable warning system. In these cases, consider including a short section of concrete that will accommodate any system.

To assist pedestrians who are visually or mobility impaired, curb ramps should be parallel to the crossing. By providing ramps parallel to the crossing, the pedestrian is directed into the crossing. At intersections where more than one road is crossed, each crossing should have a separate curb ramp. Under no circumstance shall a curb ramp be installed allowing a pedestrian to enter a crossing without providing a curb cut (or at grade sidewalk if no curb is present) on the opposite side of the crossing. Crossings shall also meet the same grade and cross slope requirements as sidewalks where the grade should not exceed 5%, and the maximum cross slope shall be no more than 2%.

8.3.3 Marked Crosswalks at Uncontrolled Locations

There are a number of treatments that may be used to get pedestrians safely across the street, whether crossing at an intersection or midblock. A marked crosswalk is one of these tools, but it is best used in conjunction with other treatments (including signs, flashing beacons, curb extensions, raised crossing islands, and enhanced overhead lighting). Not only are marked crosswalks used to advise pedestrians where to cross, but also to alert motorists to expect pedestrians crossing at those locations. The criteria provided in this section do not apply to school crossings.

Marked crosswalks shall not be installed in an uncontrolled environment (without signals, stop signs, or yield signs) when posted speeds are greater than 40 mph or on multilane roads where traffic volumes exceed 12,000 vpd (without a raised median) or 15,000 vpd (with a raised median).

Roundabouts present a unique challenge for the design of pedestrian crossings. In a roundabout, the crosswalk markings should comply with the ***MUTCD*** and the ***FDOT Traffic Engineering Manual***.

8.3.3.1 Midblock Crosswalks

Marked crosswalks can be used to supplement the pedestrian crossing needs in an area through the use of midblock crosswalks. This can provide pedestrians with a more direct route to their destination. The use of unsignalized midblock crosswalks should be carefully considered. When used, midblock crosswalks should be illuminated, marked and outfitted with advanced warning signs or warning flashers in accordance with the ***Manual of Uniform Traffic Control Devices (MUTCD)***. Pedestrian-activated, signalized midblock crosswalks may be appropriate at some locations, but the locations must meet the warrants established in the ***MUTCD***.

In addition to the requirements in ***Section 8.3.3***, the following conditions also apply:

1. Midblock crosswalks should not be located where the spacing between adjacent intersections is less than 660 feet
2. Midblock crosswalks should not be located where the distance from the crosswalk to the nearest intersection (or crossing location) is less than 300 feet
3. Midblock crosswalks shall not be provided where the crossing distance exceeds 60 feet (unless a median or a crossing island is provided)

4. Midblock crosswalks shall not be provided where the sight distance for both the pedestrian and motorist is not adequate (stopping sight distance per ***Table 2.7.1***)
5. Midblock crosswalks shall not be provided where the roadway lighting illuminating the proposed crosswalk is inadequate
6. Midblock crosswalks shall not be located where the ADA cross slope and grade criteria along the crosswalk cannot be met (per ***Section 8.3.2***).

An engineering study is required before a marked midblock crosswalk is installed at an uncontrolled location. This study shall examine such factors as sight distance for pedestrians and vehicles (stopping sight distance), traffic volume, turning volumes near proposed crosswalk location, roadway width, presence of a median, lighting, landscaping, drainage, traffic speed, adjacent land use (pedestrian generators / destinations), pedestrian volume and existing crossing patterns. Midblock crosswalks should only be used in areas where the need truly exists, and the engineering study will help to determine if an uncontrolled midblock crosswalk is a viable option. Refer to the Department's ***Manual on Uniform Traffic Studies (MUTS)***.

If any problem areas are identified that would preclude the placement of a justified midblock crosswalk, additional features must be included in the design to remedy those problem areas before a midblock crosswalk can be placed at that location. Features like overhead signing can help alert motorists and be used to light the crossing. Curb extensions or bulb-outs can improve sight distance and decrease the crossing distance. Adjustment of the profile on the roadway crossing may be required to improve the cross slope of the crosswalk.

Additional guidance on marked crosswalks at uncontrolled locations can be found in the ***AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities***, or ***FHWA's Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines*** (http://safety.fhwa.dot.gov/ped_bike/docs/cros.pdf).

8.4 Bicycle Facilities

The bicycle has become an important element for consideration in the roadway design process. The emphasis in bicycle planning has changed from the attempts to provide completely separate facilities for bicyclists, to the growing recognition that bicyclists are legitimate users of the roadway. Appropriately designed and located bicycle facilities play an important role in encouraging safe bicycle travel. Bicycle facility needs include bicycle lanes, route systems, and separate paths with the appropriate signs, control devices, parking facilities, etc. Measures that can considerably enhance a route's safety and capacity for bicycle traffic are:

1. Paved shoulders, either designated or undesignated as bike lanes
2. Bicycle-safe drainage grates
3. Manhole covers flush with grade
4. Maintaining a smooth, clean riding surface
5. Bicycle corridors on off-system routes

8.4.1 Bicycle Lanes (Designated)

A designated bicycle lane is a portion of the roadway designated by striping, signing and/or special pavement markings for the exclusive use of bicyclists. FDOT striping is shown in the ***Design Standards***. Designated lane signs shall be used in accordance with the ***MUTCD***.

Designated bicycle lane width requirements are provided in ***Chapter 2*** of this volume.

On roadways with flush shoulders, the FDOT standard 5' paved shoulder provides for a bicycle lane.

On curb and gutter roadways, a 4' width measured from the lip of the gutter is required. This provides for a 5.5' width to the face of curb when FDOT Type F curb and gutter is used. The 1.5' gutter width should not be considered as part of the rideable surface area, but this width provides useable clearance to the curb face. Where parking is present, the bike lane should be placed between the parking lane and the travel lane and have a minimum width of 5'. At intersections with right turn lanes, the bicycle lane should continue adjacent to the through lane between the through lane and the right turn lane, and should be 5' in width, 4' minimum. Standard drawings for various bicycle lane configurations are provided in ***Design Standards, Index 17346***.

Table 8.6.8.2 Minimum Stopping Sight Distances

MINIMUM STOPPING SIGHT DISTANCE (FEET) FOR 20 MPH PATH = 127 FEET, FOR 30 MPH PATH = 230 FEET														
Design Speed	GRADES													
	-9%	-8%	-7%	-6%	-5%	-4%	-3%	3%	4%	5%	6%	7%	8%	9%
20 MPH	Use 30 MPH Values					137	134	121	119	118	116	115	114	113
30 MPH	298	287	277	268	260	Use 20 MPH Values								

8.6.9 Vertical Alignment

The minimum length of vertical curve necessary to provide minimum stopping sight distance at various speeds on crest vertical curves is selected by using the formula listed below:

When $S > L$: $L = 2S - (900 / A)$

When $S < L$: $L = AS^2 / 900$

L = Min. Length of Vertical Curve (ft.)
A = Algebraic Grade Difference (%)
S = Stopping Sight Distance (ft.)

8.6.10 Separation Between Shared Use Path and Roadway

When two-way shared use paths are located adjacent to a roadway, a separation shall be provided. This demonstrates to both path users and motorists that the shared use path is a separate facility.

On roadways with flush shoulders, this separation is 5 feet measured from the outside edge of shoulder to the inside edge of the path. On roadways with curbs, the separation is 4 feet measured from the back of curb to the inside edge of the path, with consideration of other roadside obstructions (signs, light poles, etc.).

8.6.11 Path Railings

Railings or fences shall be provided as indicated in ***Section 8.8***.

8.6.12 Lighting

Lighting for shared use paths is important and should be considered where riding at night is expected, such as paths serving college students or commuters, and at roadway intersections. Lighting should also be considered through underpasses or tunnels. Lighting standards are provided in ***Table 7.3.1*** of this volume.

8.6.13 Signing, Pavement Marking, and Signalization

The ***MUTCD*** shall be consulted for all signage, pavement markings, and signals, especially on path/roadway intersections.

8.8 Drop-off Hazards for Pedestrians and Bicyclists

Drop-off hazards are defined as steep or abrupt downward slopes that can be perilous to pedestrians and bicyclists. The Engineer should consider shielding any drop-off determined to be a hazard. Generally, pedestrians and bicyclists will be adequately protected from a drop-off hazard if a guardrail or barrier has been installed between the path or sidewalk and the drop-off. However, circumstances do exist that will ultimately dictate when a railing is needed. Railings or fences should be provided for vertical drop-off hazards. The horizontal clearance discussed in ***Section 8.6.5*** should be maintained where practical when railings or fences are used for drop-offs along shared-use paths.

The following guidelines will be useful in standardizing the identification and treatment of drop-off hazards for pedestrians and bicyclists.

There are two cases that require shielding. As shown in ***Figure 8.2 (Case I)***, a drop-off greater than 10 inches that is closer than 2 feet from the pedestrians' or bicyclists' pathway or edge of sidewalk should be considered a hazard and shielded. Also, as shown in ***Figure 8.2 (Case II)***, a slope steeper than 1:2 that begins closer than 2 feet from the pedestrians' or bicyclists' pathway or edge of sidewalk should be considered a hazard and shielded when the total drop-off is greater than 30 inches. Also, depending on the depth of the drop-off and severity of the conditions below, shielding may be necessary for cases other than described above.

However, in determining if shielding a drop-off hazard would be feasible for protecting pedestrians and bicyclists, the following should be considered:

1. The engineer should ask the Pedestrian/Bicycle Coordinator for information on the number of pedestrians and bicyclists and their routes.
2. Installing fencing or railings are two ways to shield the drop-offs. Fencing is generally intended for rural areas along paths and trails. Standard railing is generally intended for urbanized areas, locations attaching to bridge rail or along concrete walkways. Railings* shown on ***Indexes 850*** and ***860*** of the ***Design Standards*** are appropriate for all drop-offs. ***Indexes 870*** and ***880*** of the ***Design Standards*** are appropriate where drop-offs are 30 inches or less.
   * Note: Care should be taken when using railings or fencing near intersections as they could obstruct the driver's line of sight.
3. Along continuous sections where the drop-off varies above and below the 30" threshold for using ***Index 870*** or ***880***, for uniformity the engineer should consider using only one of the railing types appropriate for all drop-offs (***Index 850*** or ***860***).

4. The height of railings for bicyclists are generally the same as the minimum pedestrian railing height of 42 inches, except a minimum 54 inch railing or fence should be considered on bridges and retaining walls for special circumstances as identified in the commentary of the ***AASHTO LRFD Bridge Design Specifications Section 13.9***. Specify the height of the pedestrian/bicycle railing in the contract plans.

8.9 Florida Intrastate Highway System/Strategic Intermodal System

Department Procedure No. 525-030-250, ***Development of the Florida Intrastate Highway System (FIHS)***, gives the following guidance relating to the provisions of bicycle and pedestrian facilities on the FIHS:

"Bicycle and pedestrian facilities shall not be provided on FIHS limited access roadways. For FIHS controlled access facilities, the safe movement of bicycles and pedestrians must be carefully considered and accommodated in such a way as to have no adverse impact to safety, capacity or speed. Separate, offsite, and/or parallel facilities, shall be used where practical and feasible. Bicycle facilities shall be consistent with the requirements of the Department's ***Plans Preparation Manuals, (Topic Nos. 625-000-007*** and ***625-000-008)***."

The above guidance will apply to the Strategic Intermodal System (SIS), until such time that a SIS procedure is developed.

Chapter 9

Landscaping

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9.4 Community Structures

Community Structures are designed and placed on the highway right of way for the sole purpose of representing, reflecting, or recognizing nearby community cultural and/or natural values and resources, or to enhance the sense of place through which a highway passes. The following criteria do not apply to Place Name Signs or Customized Place Name Signs. Requirements for Place Name Signs and Customized Place Name Signs are in ***Rule 14-51 Part IV Place Name Signs***:

http://www.dot.state.fl.us/trafficoperations/Operations/Studies/TEM/14-51_PartIV.htm

A proposed Community Structure located on the Interstate System must be approved by the State Roadway Design Engineer and the Federal Highway Administration (FHWA). A proposed Community Structure located on the State Highway System but not on the Interstate System can be approved by the District Design Engineer without further approvals if consistent with the established criteria.

For consideration, plans for a proposed Community Structure must be accompanied by a resolution of the local government legislative body endorsing their financial support of project design, construction, and perpetual project maintenance. If private funding is to be used, local endorsement is also required.

Prior to any construction within the highway right of way, the local government (or private enterprise) must execute a maintenance agreement with the Florida Department of Transportation.

These features are not eligible for regular federal-aid. They would not be eligible for repair or replacement under FHWA's Emergency Relief (ER) program.

Any changes to the FDOT's criteria shall be reviewed and approved by FHWA. Approval by the State Roadway Design Engineer is required when any of the Community Structure criteria in ***Section 9.4.1*** cannot be met.

9.4.1 Design Criteria

The design of a Community Structure must meet the following:

1. The structures/features site plan should be laid out so as to strongly discourage drivers from stopping to take pictures, or otherwise create an unsafe situation by stopping on the shoulder.
2. The location must be as far outside the appropriate clear zones as practical. Placement on Interstate routes should be well outside the minimum clear zone, a minimum of 50 feet, 100 feet preferred, from edge of the travel lane or ramp, whether guardrail is present or not. The 50 feet minimum/100 feet preferred lateral placement will help to minimize driver distraction, and reduce the likelihood that vertical structures will become storm debris blown across the roadway.
3. Structures shall not be placed in the median regardless of median width.
4. The object's highest point must not be greater in elevation than 14 feet above the nearest point of the roadway.
5. The structures must not contain any messages (alpha-numeric characters), signs , other traffic control features, auditory devices, flashing lights, or moving illumination, and be devoid of advertising per the ***MUTCD*** and ***23CFR 1.23*** which prohibits advertising on or commercial use of the right of way. Commercial advertising on state right of way is prohibited by ***Section 479, Florida Statutes***, including charitable, fraternal, religious, or political signs, symbols, logo's, banners or any other such device. The permit for the Community Structure shall be immediately revoked by the Department for violation of this provision.
6. Only one structure is allowed per mainline interchange approach; thus, pick one site from amongst the ramp and the mainline, along the outside of a ramp, or the area inside a loop ramp.
7. The structure must meet all applicable building codes and design criteria for similar structures or landscapes placed adjacent to the highway's right of way, including wind loading commensurate with highway signs in the area.
8. The structures/features must meet all environmental regulations.
9. The structure must not obstruct any signs or interfer with any sight triangle or view zone (see ***Section 9.1***).

congestion. Because they give travelers the information they need to make their own travel choices; public information campaigns can be the single most effective of all TMP elements.

TMPs should be developed and implemented in sustained consultation with stakeholders e.g., other transportation agencies, railroad agencies/operators, transit providers, freight movers, utility suppliers, police, fire, emergency medical services, schools, business communities, and regional transportation management centers.

Consideration of TMPs must begin at the Project Development and Environmental (PD&E) study stage. Impacts on traffic, traffic handling options, constructability, and design features and constraints, as they affect traffic and transit operations, are to be evaluated for each alternate alignment studied. The Project Development Summary Report (PDSR) must specifically address the TMP.

As the design progresses, using the TMP material from the PD&E study as the basis, the following should be considered:

Design features and constraints. Length of the project, lane configuration, transit stops, bike lanes, sidewalks and grade differentials between existing and proposed, interchanges and intersections, pavement materials, storm drains, roadway lighting, utilities and bridge features are some of the design element decisions that might be influenced by work zone traffic control considerations.

Contract specifications. Provisions such as time restrictions on construction activities; incentive-disincentive clauses; daily, weekly and seasonal restrictions and special materials may be necessary. Time restrictions could include work stoppages for Manatee (or other endangered/protected species) inhabitation, sporting events, holidays or other special considerations. The designer should coordinate with local agencies as to the dates of local events or other community sensitive issues. Public relations activities such as media releases, television and radio spots, and handbills may be specified.

Other actions. Actions may need to be taken by the Department prior to or during construction that may not be a contract requirement. Examples are dealing with the media and local businesses, provisions for mass transit options to commuters, service patrols, improvements to alternate routes, coordination with other projects and maintenance activities, and special inspection requirements.

Public input. On very large and complicated projects, it may be necessary to involve the public through informal public meetings to be held early in the design of a project. Close coordination with city and county officials may be necessary. Citizen and business advisory committees may be established as sources of input.

Utility work. If contract utility work is anticipated in conjunction with or during the highway construction, the Temporary Traffic Control plan must account for and adequately protect all work activities. The phasing of construction activities must be compatible with the utility work. Utilities, whose work affects traffic, are required to have a TTC plan by FHWA. This requires early and effective coordination with utilities.

Step #1 Understand the Project

1. Field reviews by designers should be required.
2. Review the scope.
3. Examine the plans early in the plans development process.
4. Look at plan-profiles and cross sections for general understanding.
5. Review PD&E study for any constraints.
6. Consider transit and bicycle/pedestrian needs during construction.
7. For complex projects consider developing a TTC plan study and other possible strategies such as public awareness campaigns, alternate route improvements, service patrols, etc...

Step #2 Develop Project Specific Objectives

What are your objectives? Examples might be:

1. Use barrier wall to separate workers from traffic.
2. Close road if adequate detour exists.
3. Maintaining 2-way traffic at all times.
4. Maintaining existing roadway capacity during peaks.
5. Maintaining business/resident access.
6. Maintaining transit operations.
7. Provide bike/pedestrian access.
8. Minimize wetland impacts.
9. Expedite construction.

Step #3 Brainstorm TTC Plan Alternatives

Develop some rough alternatives considering what could be used to accomplish the work, such as constructing temporary pavement and/or temporary detours, using auxiliary lanes, placing 2-way traffic on one side of divided facility, using detour routes, etc. Also, south side as opposed to north side on an east-west roadway. Don't worry that an alternate doesn't meet all objectives.

Designers should check condition of any proposed detour routes. If the detour route is off the state system, additional documentation of the agreements with local agencies will be required (See ***Section 10.12.9***). Design should prevent or minimize interruption of local transit operations.

Step #4 Develop a Construction Phasing Concept

1. Examine existing facility versus what is to be built. This is a major task on jobs other than resurfacing.
2. Coordinate with bridge designer.
3. Involve the Construction office as early as practical for input on alternate traffic control plans.
4. Color or mark the plan-profile sheets to show existing roadway versus new construction. Then, check station by station, the plan sheet against cross section sheets. Make notes on plan sheets as to drop-offs or other problems. Use profile grade lines or centerlines for reference points.
5. List out major tasks to be completed, such as:
    a. Construct new WB Roadway
    b. Construct new EB Roadway
    c. Construct frontage roads
    d. Construct bridge/flyover

    Note: The designer may need input from construction personnel or even contractors' representatives in determining construction phases.
6. Make notes on plan sheets or notepad as to "decisions" that you make along the way.

Step #5 Examine/Analyze Alternatives Which Meet Objectives (for each phase)

Next, consider how you could achieve the proposed alternatives and meet the stated objectives.

1. Examine pros and cons of various alternatives.
2. Consider how much work and expense is involved for each alternative.
3. Consider detour/transition locations, signal operations during construction, how to handle buses, bicycles, pedestrians, service vehicles, etc...

Step #6 Develop Detailed TTC Plan

Select the most feasible alternative for each phase. Add details such as:

1. Detour/transition geometrics and locations.

10.12.8 Pacing Specification (a.k.a. Rolling Roadblock)

A Technical Special Provision is required to pace traffic for up to twenty (20) minutes maximum to allow work in or above all lanes of traffic for the following purposes:

1. Placing bridge members or other bridge work
2. Placing overhead sign structures
3. Other work items requiring interruption of traffic

The Contractor shall provide a uniformed Traffic Control Officer(s) with marked patrol vehicle and blue flashing light for each lane in the direction of pacing. When ready to start the work activity, the Traffic Control Officer(s) will pull into the travel lane(s) and act as a pilot vehicle(s) slowing the traffic thereby providing a gap (not to exceed 20 minutes) in traffic, allowing the Contractor to perform the work. Any on-ramps between the pace and the work area shall be blocked during pacing of traffic.

Extreme care must be taken to assure that traffic on connecting roads will not be backed up causing excessive delays.

10.12.9 Detours, Diversions, and Lane Shifts

A **detour** is the redirection of traffic onto an alternate route, using state roads, county roads, or city streets, to bypass the work zone. A **diversion** is a special detour onto a temporary roadway adjacent to the existing or permanent roadway. A **lane shift** is the redirection of traffic onto a section of the permanent roadway or shoulder.

Detour signing is usually done under the direction of the traffic engineer who has authority over the roadway to be used. The detour should be signed clearly so drivers can traverse the entire detour and return to the original roadway. When detours are required, the geometry of the detour route should be compared against the type of traffic being routed through the detour. For example, detouring of traffic which includes large trucks and transit vehicles will require certain pavement widths, turning radius, and overhead clearance (including low power lines, span wires, and low hanging tree limbs). The structural capacity of the detour pavement should also be considered.

When detours are off of the state system, the designer shall coordinate with the local agency. The designer shall document that the local agency approves the detour route. The design should prevent or minimize interruption of local transit operations and emergency services. The designer shall coordinate with any affected local transit operations and emergency services and shall document that the affected agencies have been informed of the detour route.

The designer has two methods of paying for diversions: by (1) using the "special detour" lump sum pay item or (2) using the lump sum Maintenance of Traffic (MOT) pay item. When the special detour pay item is used, the work and quantities included for pay under the item are to be tabulated and noted in the plans. The special detour pay item is intended to be used in all situations where traffic is shifted one lane width or more onto temporary pavement.

A Diversion, which is to be signed as a lane shift, may be paid for under Special Detour, Pay Item 102-2 (Lump Sum). The ***Basis of Estimates Handbook*** should be referenced to make sure that the appropriate items are included in this lump sum.

TTC plans shall include sufficient detail for diversion geometry. Diversions should be designed with shoulders (2 ft. min.) whenever practical. The radius of curvature and taper lengths shall be shown. Diversions should be designed and operated as close to the normal speed as possible. When speed reductions are necessary, the reduction should be in accordance with the ***Design Standards**, **Index 600**.* The recommended minimum radius of curvature (without superelevation) for diversions is shown in ***Table 10.12.2***.

Chapter 13

Initial Engineering Design Process

Tables

Exhibits

Exhibit 13-A Major Activities – Initial Engineering Process

Review & Confirm:
... Project objectives/scope
... PD&E study results
... Typical section data accuracy
... Environmental evaluation
... PD&E and Environmental commitments (i.e., Sound barriers, TDLC, pond sites, etc.)
... Budget (WP) & staff-hour estimates
... Schedule & production dates
... Approvals & authorizations

↓

Prepare, Document & Approve:
1. Typical section standards
2. Design controls - speed, design period, vehicle, traffic volumes, LOS, access class & function, bike & pedestrian LOS, ADA
3. Design project standards & assumptions, Pavement Type Selection

↓

Compare & Confirm:
... Project design standards vs. R/W
... PD&E study vs. standards
... Design controls vs. standards
... Objectives & scope vs. standards
... Documentation & approval

↓

Field Review and Verify:
... Adequacy of survey data
... Updates required
... Transfer survey data to design files
... Adequacy of R/W survey data

Surveyor signs off on location files

↓

Review, Confirm & Approve:
... Alignment and topo in CADD
... Alignment vs. standards
... New alignments, CL construction
... Exceptions & variations

Initiate utility contact

↓

Review & Establish Needs:
... Environmental issues
... PD&E and Environmental commitments (i.e., Sound barrier locations, TDLC features, etc.)
... Retention/outfalls
... Permits, mitigation, R/W field review

↓

Develop:
... Preliminary project layout: grades, superelevation rates, transitions, vertical curves, geometry calculations

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Review:
... Grades vs. soil data vs. Base Clearance Water Elevation
... Clearances above and below
... Existing drainage structure size used on existing facility vs. grades

↓

Develop:
... Existing ground cross sections
... Approval of alignment & grades along project, computations
... Soil data on existing ground cross sections
... Utility locations & potential conflicts

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Develop:
... Roadway cross section templates
... Special ditch profiles
... Check impact on utilities
... Drainage outfalls

↓

Develop:
... Geometric layout - intersections, interchanges, transitions & connections
... Verify and confirm access management design
... Confirm bike, pedestrian, transit & ADA needs vs. project standards
… Sound barrier geometry

↓

Field Review:
... All preliminary engineering activities & decisions
... Approvals documented

↓

Finalize:
... Alignments, grades, geometry, reports
Begin:
... R/W requirements, Summary of Pay Items

↓

Review & Confirm:
... Preliminary project design report
... Project objectives/scope
... Project design controls/standards
... Environmental issues/permits
... Budget, staff-hour estimate & production dates
... Engineering support data & services

↓

To Final Engineering Design

Chapter 13

Initial Engineering Design Process

13.1 General

The engineering design process, as discussed in this and following chapters, includes the data gathering, development and contract preparation phase of highway construction projects. It begins with the approval of the Project Location/Design and ends with the construction letting. It also includes the update process when the construction plans and specifications are ready and on hold in the district and require revising to make them contract ready. Throughout this design process, quality control will be exercised by those responsible for the engineering design and plans preparation activities by having a plan-do-check routine for each and every significant task or operation.

The engineering and design activities and the schedules depend on the type of project and the required effort to accomplish the desired objectives. Projects can be designated as three basic types:

1. **New Construction -** A highway or bridge project along a new corridor on new alignments, horizontal and vertical.
2. **Add Lanes and Reconstruct -** A highway project along an existing facility to add lanes, widen or add bridges, improve intersections, and, in general, upgrade and improve the capacity and safety of the facility.
3. **Other Projects -** May include Resurfacing, Restoration and Rehabilitation (RRR), Local Agency Program (LAP), or other projects such as a highway and/or enhancement projects - A highway and/or bridge project undertaken to extend the service life of an existing facility and to enhance the safety of the facility. These projects generally do not require a PD&E phase. The scopes are so varied that it is difficult to define them, except project by project. They can vary in magnitude from installing highway lighting for enhanced safety or resurfacing pavement to extend the service life, to minor lane and shoulder widening, bridge rail modification or intersection improvements. These projects may also include transit facilities, bike paths, sidewalks and landscaping projects.

13.2 Initial Engineering Design (Phase I)

It is important to distinguish the initial engineering design activities from planning and the preliminary engineering done during the Project Development and Environmental (PD&E) phase. If a PD&E phase has been completed, some of the activities discussed here may have been performed to varying levels during that phase. The information contained in the preliminary engineering report should be considered as the starting point for the initial engineering phase. In the case where there was not a PD&E phase, the initial engineering design activities must establish the project scope, controls and standards, data gathering requirements, right of way (R/W) needs, and major design elements necessary to determine that the project is viable and R/W can be cleared.

Generally, the initial engineering process **should** accomplish or complete the following activities:

1. Completely and fully define and document the objectives of the project and the scope of activities to accomplish them. This will almost always require an on-site review.
2. Develop and document a realistic staff-hour estimate and production schedule to accomplish the scope of activities identified.
3. Establish and document the design controls, assumptions, project design standards, exceptions, and variations. Significant changes to previously approved PD&E elements may result in a re-evaluation of the environmental document. Discuss with the District Environmental Management Office.
4. Identify all prior PD&E and environmental commitments such as the need to design and locate sound barriers (with insertion loss calculations), special pond site requirements, landscape or aesthetic considerations, transportation design for livable community issues, pedestrian and bicycle commitments, access commitments, wildlife management commitments, wetland issues, transit issues, etc.
5. Identify and document additional engineering, data gathering, and support services.
6. Determine and document the structural design requirements.
7. Determine and document if R/W is required.
8. Establish and document the review procedure and number of submittals, if different from guidelines provided in this manual.
9. Establish preliminary geometry, grades, and cross sections.
10. Identify and implement needed public involvement activities.
11. Develop Pavement Type Selection Report based on FDOT ***Pavement Type Selection Manual (Topic No. 625-010-005)***.

13.3 Scope, Objectives, Schedule and Budget

The project manager and other FDOT managers are responsible for the development, review and approval of the project objectives, scope of work, and schedule in accordance with the ***Project Management Guidelines.*** They also must verify that required funds are in the work program.

The project objectives and scope are best confirmed and/or completed by:

1. Reviewing the PD&E study recommendations, conclusions and commitments, if they exist.
2. Performing a field review of the project with the project manager and personnel from other FDOT offices, such as Roadway Design, Traffic Operations, Safety, R/W Engineering, Utilities, Survey, Maintenance and Construction, as appropriate.
3. Requesting a review of the draft scope of services activities by FDOT offices, such as Maintenance, Construction, Design, Traffic Operations, Access Management, Public Transportation, Pedestrian and Bicycle, etc.
4. Developing the scope of services sufficient to advertise for professional services. After the scope of services is completed and approved, the schedule and budget may be confirmed and/or updated by the engineer/project manager and approved by the appropriate district manager.
5. After consultant selection or in-house assignment, the designer or consultant should review and confirm the scope by completing steps one through four above.
6. The scope should anticipate and include the most cost effective methods that may be used in Subsurface Utility Engineering (SUE) for locating subsurface anomalies, structures, and utilities. Its use may affect the design process and should be considered in the scoping process. Selecting which methods to be employed should be accomplished by balancing risk versus benefit. Seldom will the use of only one method provide the most value. For example: Using radar tomography may have an initial higher cost but yield significantly more information much earlier in the design process which can facilitate drainage design, shorten the over all project time, reduce contractor risk, minimize redesign, and identify unknown facilities. Conversely, radar tomography has limited depth and resolution issues in a salt or high mineral environment, but other high technology methods exist and are worthy of consideration. The designer must recognize that SUE is a process that has many old and new technologies at its disposal. Consulting a SUE provider who can demonstrate state of the art knowledge will yield the most benefit.

13.4 Project Design Controls and Standards

Among the activities the Engineer of Record (EOR) will accomplish on a project are the identification of the given design controls and the selection of the appropriate design standards. These will be documented in the project file(s).

The design controls as addressed in this manual and AASHTO include such things as rights of way constraints, major utilities, design speed, design vehicle, design period, traffic volume and service level, functional classification of the corridor, the access class, and other factors that control the selection of project standards that will ensure the facility will function safely at the level desired and expected by the motorists.

Establishing the project standards is one of the first requirements of the engineering design process. The decisions, assumptions and calculations for the design are based on these factors. All project standards shall be documented in the project file(s).

The preliminary engineering report (PD&E) or concept report may include some of the controls and standards to be used on the project. These values should be reviewed, confirmed as valid and consistent with the overall corridor or system, and documented. Significant changes to approved PD&E elements of design may require a re-evaluation of the environmental document.

The Engineer of Record must coordinate with the District Design Engineer, the District Traffic Operations Engineer, and the responsible PD&E engineer to discuss the anticipated posted speed and determine the appropriate design speed for the project.

If project standards must be used that do not meet recommended values, these must be documented and receive approval/concurrence by the appropriate FDOT and/or FHWA engineer. These are either exceptions or variations as described in ***Chapter 23*** of this volume and must be maintained in the project file(s).

When all project standards are selected, documented, and agreed upon, the engineer should get the District Design Engineer to concur that the appropriate standards are being used. The Typical Section package will include some of the project standards. Those not included, and all known exception/variation justification shall be documented in the project file(s).

13.5 Support Services

Any information or support services that have been provided must be reviewed by the Engineer of Record to determine the completeness of the information. Conditions and data may have changed drastically if they are not current.

Technical data required for the design of a roadway project can be available from various sources, such as:

1. Surveys - design, topographical, aerial, drainage, right of way location, soil, utilities
2. Traffic Data
3. Pavement Design
4. Environmental Documents (including Noise Study Report)
5. Original Plans
6. Accident Data
7. Access Management Classification

During the design process, the project will require coordination with different sections or departments. When engineering decisions, information, or other support services are required from FDOT functional areas, it is the project manager's responsibility to coordinate and facilitate the request and expedite a timely response. The functional areas include but are not limited to:

1. Planning and Programs
2. Surveying and Mapping
3. Traffic Plans
4. Geotechnical
5. Drainage
6. Maintenance
7. Construction
8. Utilities
9. Estimates and Specifications
10. Right Of Way
11. FHWA
12. Value Engineering
13. Traffic Operations
14. Environmental Mgmt. Office
15. Access Management
16. Structures
17. Safety
18. Plans Review
19. Public Transportation Office
20. District Landscape Architect

13.5.1 Aviation Office Coordination

If it is determined that an airspace obstruction exists (based on the criteria contained in ***Table 2.10.5***), refer to ***Table 13.5.1*** for applicable FAA notification guidelines. For guidelines on airspace obstruction permitting, refer to ***Chapter 333, Florida Statutes, "Airport Zoning",*** and ***Chapter 14-60, Florida Administrative Code, "Airport Licensing and Airspace Protection".***

While the responsibility for filing FAA notifications and permitting applications for FDOT Airspace Obstruction Permits or Variances to the local ordinance rests with the Engineer of Record, the FDOT Aviation Office is available to provide any requested technical assistance on planned projects that may impact the national airspace system in Florida. Please direct your request to the following:

FDOT Aviation Office
Airspace and Land Use Manager
605 Suwannee St., M.S. 46
Tallahassee, FL 32399-0450
Tel: (850) 414-4500
Fax: (850) 414-4508
Internet: http://www.dot.state.fl.us/Aviation/

Table 13.5.1 Construction of Airspace Obstructions - Notification

FAA Notification Federal law, ***Title 14 Code of Federal Regulations (CFR), Federal Aviation Regulations (FAR), Part 77, "Objects Affecting Navigable Airspace"***, requires that prior notification must be given to the Federal Aviation Administration (FAA) regarding any construction or alteration of structures that meet specific criteria (See ***Table 2.10.5***, this volume). If FAA notification is required, ***FAA Form 7460-1, "Notice of Proposed Construction or Alteration"*** is submitted to the FAA Southern Regional Office in Atlanta. This notification must be submitted at least 30 days before the earlier of the following dates: 1. Date proposed construction or alteration is to begin. 2. Date an application for a construction permit is to be filed.
FAA Emergency Notification In the case of an emergency involving essential public services, public health, or public safety, that requires immediate construction or alteration, the 30-day advance notice requirement does not apply. In such a case, the required notification may be sent by telephone or any expeditious means to the nearest FAA Flight Service Station, and within 5 days thereafter, a completed copy of the ***FAA Form 7460-1***, must be submitted to the FAA Southern Regional Office in Atlanta.

13.5.2 Projects Involving Existing Bridges

Special coordination efforts are required of the Design Project Manager on projects that involve demolition, renovation, repair, repainting or replacement of any bridge.

13.5.2.1 Projects Involving Steel Bridges

For all projects that involve the repair, repainting or replacement of a steel bridge, the Design Project Manager shall contact the State Corrosion Engineer in the State Materials Office to determine if the bridge contains lead or other hazardous elements. The State Corrosion Engineer will furnish a site specific specification for disposition of the lead based paint waste for that particular project.

The Design Project Manager must provide the site specific specification to the Engineer of Record who is preparing the contract plans and specifications. The Engineer of Record must ensure that the project specifications conform to the site specific specifications and that they prohibit the use of lead based paint. A mandatory pre-bid conference is not required unless special conditions exist and the district determines one is needed.

The Design Project Manager shall notify the Contracts office (State or District) that the project requires the contractor to show proof of qualification before receipt of the bid proposal if 51% or more of the project is painting or at the time of award if less than 51% of the project is painting. The Contractor must have a QP2 Category A certification, from the Society for Protective Coatings (SSPC), for painting projects. For structure removal projects, consult with the Construction Office (State or District) to determine if QP2 Category A certification will be required, or a less stringent qualification. The contractor will be required to present proof of qualification prior to beginning any structure removal work and not at award. Qualifications for both painting and structure removal projects must be noted in the advertisement and specification.

13.5.2.2 Projects Involving Bridges with Asbestos Containing Materials

There may be asbestos containing materials used in bridges. For projects involving bridges that are to be either partially or fully demolished or renovated, the Project Manager must follow the Department Procedure on ***Asbestos on Bridges / Inspection, Abatement and Notification (Topic No. 625-020-020)*** which requires coordinating as early in the project as possible with the District Asbestos Coordinator for information on asbestos inspections, abatement and for notification requirements. Some bridge elements potentially containing asbestos include (but are not limited to) the following:

1. Tender House Roof Materials (felts, flashings, mastics, etc)
2. Tender House Floor Materials (tiles, sheet flooring, mastics, etc.)
3. Tender House Wall Materials (drywall muds, joint compounds, etc.)
4. Tender House Window Materials (caulks, gaskets, etc.)
5. Bridge Equipment Materials (gaskets, packings, linings, insulation, etc.)
6. MSE Wall Gaskets
7. Beam/Deck Bearing Pads
8. Asbestos-cement pipes (scuppers, etc.)
9. Bascule Bridge Machinery Brake Pads
10. Trowelled-on or Sprayed-on Decorative Coatings

13.5.2.3 Projects Involving Bridge Demolition

At or before the 30% plans phase, the Department shall determine if it has a need for the debris resulting from the demolition of a bridge. If no such need exists, and in response to ***Section 1805, SAFETEA-LU Legislation,*** the Department is then required to notify local, State and Federal government agencies of the availability of the bridge debris for their beneficial use (use as shore erosion control or stabilization, ecosystem restoration, and marine habitat restoration). For any projects that involve the complete demolition of a bridge, the Design Project Manager is required to notify these agencies of the availability of the resulting debris. The Bridge Development Report (BDR)/30% Structure Plans (see ***Chapter 26***) will include the approximate volume of debris and the estimated timeframe in which the material will be available.

The Design Project Manager must coordinate with the receiving agency and the District Construction Engineer to develop a Joint Project Agreement. The receiving agency will be responsible for all additional costs associated with the processing, delivery, placement and use of the material. The following items must be determined in order for the Joint Project Agreement to be developed:

1. The volume of raw (unprocessed) debris (a more detailed quantity than original estimate).
2. The estimated timeframe for the debris availability.
3. The location of the receiving agency’s staging/storage site to which the raw debris is to be delivered. Any further work involving processing and/or final placement of the material is expected to be the responsibility of the receiving agency and not part of the FDOT's contract for bridge demolition.
4. An estimated cost to transport the debris to that site. This estimate will be amount the receiving agency must pay the FDOT.

Once this information is determined, the contract plans will include the instructions for the delivery of the debris.

If no agency expresses interest in the debris material, then the material will be disposed of in accordance with FDOT Specifications.

Requirements for the original notification to agencies (including a sample Notification Letter) and the resulting Joint Project Agreement are found in the ***Project Management Handbook, Chapter 3.***

13.5.3 Projects Involving Bridges Over Navigable Water

For projects involving bridges over navigable water, the Project Manager must provide the District Structures Maintenance Engineer (DSME) sufficient notification prior to engaging in any action in, on, or around the bridge(s). This includes any field reviews involving persons conducting activities that may be perceived as suspicious (i.e., parking on the bridge, repeated viewing from a boat or other vehicle, carrying cameras and other electronic equipment like a GPS, etc.) This will allow the DSME to notify the U.S. Coast Guard prior to such activities taking place.

13.5.4 Projects Affecting Interstate Logo Signs

On projects that may impact Interstate Logo Signs through any construction activities, any affected logo signs must be identified so that early coordination can take place and so those signs can be properly addressed in the plans. When the affected logo signs are identified, that information must be coordinated with the State Motorist Information Services Administrator, the District Traffic Operations Office, and Florida Logos, Inc. to determine the degree of impact, and the maintenance of the signs during construction. Through this coordination, the following questions must be answered:

1. Will the logo signs need to be removed during construction?
2. Can the logo signs be reinstalled after construction?
3. Can the logo signs be temporarily relocated out of the work zone during construction so the service will not be interrupted, and then permanently reinstalled after the work is complete?
4. If the logo signs cannot be temporarily relocated during construction, where can they be stored until they are reinstalled?

13.5.5 Buy America Provisions

The Buy America provisions, established in ***CFR 635.410***, requires that on all Federal-aid highway construction projects, if steel or iron materials are to be used, all manufacturing processes for these materials, including application of a coating, must occur in the United States. Buy America requirements are covered in ***FDOT Standard Specification Section 6-12.2***. ***Section 6-12.2*** identifies allowable levels of foreign steel or iron and contractor certification requirements.

While ***Section 6-12.2*** applies to contractors, designers also have a responsibility to insure Buy America provisions are met. When Buy America provisions are not met, the entire project is not eligible for Federal funds. The design engineer of record needs to do sufficient research to determine that any steel or iron called for in the plans is manufactured in the United States. This is necessary when the plans include the following:

1. Non-standard or special grade steel components and shapes.
2. New proprietary products containing steel or iron materials.
3. Sole source products containing steel or iron materials.
4. Special machinery with steel or iron components.
5. Heavy sections of steel sheet pile wall.

It is not necessary to conduct such research for the following:

1. Standard domestic steel beams and shapes of standard grades as shown on the National Steel Bridge Alliance (NSBA) website.
2. Standard concrete reinforcing steel sizes and grades.
3. Standard steel drainage pipe sizes and gages.
4. Items covered in the ***Design Standards*** including:
    a. Standard mast arm assemblies.
    b. Standard steel guardrail, posts, and end treatments.
    c. Standard drainage grates.
    d. Standard steel fences.
    e. Standard steel sign supports and structures.

If it is determined that a steel or iron product being proposed is not manufactured in the United States, then the Designer shall determine if the estimated costs of such foreign steel or iron is within the thresholds stated in the specification. If the costs exceed such threshold, the Designer shall explore alternatives that utilize domestic steel or iron, or seek a waiver from FHWA. Generally it is preferred to select a different engineering solution utilizing domestic products.

Should a waiver become necessary, it must be obtained BEFORE the contract letting to insure federal funding is not jeopardized. Buy America waiver requests shall be submitted to the Central Office for concurrence by the Directors of Design and Construction. Requests will then be forwarded to the FHWA Florida Division Office for approval and coordinated with the FHWA headquarters in Washington D.C. for further concurrence. Originals will be returned to the District by the Central Office. These issues must be identified early in the plans preparation process.

13.5.6 Traffic Monitoring Sites

One or more traffic monitoring sites should be considered for addition to each construction project which has a type of work consistent with the construction of such sites. Examples of compatible work types include traffic signals, resurfacing, reconstruction, and other work that involves either pavement surfaces or electrical systems. Inquiries about monitoring sites should be addressed to the Traffic Data Section Manager of the Transportation Statistics Section, Office of Planning.

13.6 Preliminary Geometry, Grades, and Cross Sections

To establish geometry, grades, and cross sections, the following activities should be accomplished or near completion:

1. Supporting data such as surveys, traffic and pavement evaluation data.
2. Typical sections and pavement design.
3. Standards, variations and exceptions.
4. PD&E and environmental commitments addressed and if necessary, re-evaluation.
5. Need for R/W phase addressed.
6. Utility initial contact and survey data.
7. Transit initial contact and facility location.

The initial engineering design activities to establish the preliminary project plans are:

1. Set and calculate the horizontal alignment.
2. Set the proposed profile grade lines.
3. Develop preliminary cross sections at selected intervals or control locations.
4. Develop preliminary layout of roadway, intersections, interchanges, transitions, and connections.
5. Field review all proposed preliminary engineering layout and decisions for conflicts, R/W needs, connections, updates and additional needs.

The initial engineering review (Phase I) is used to obtain confirmation and approval of the objectives, scope, standards, decisions, and assumptions to be used as the basis for the engineering and design. The Engineer now has the decisions and direction necessary to perform final engineering. If this is not the case, the necessary initial engineering activities must be accomplished before continuing to the final design process.

The results of the above activities should be that:

1. Structures can now be given the horizontal and vertical alignment and clearance requirements for bridges.
2. R/W Engineering can be furnished with mainline R/W requirements for the project.
3. Plan-profile sheets can be clipped.
4. Traffic plans development can be initiated.

5. Cross sections, grades and alignments, as required, can be provided to the drainage section.
6. Work sheets, as needed, can be provided to the permits section for initial evaluation.
7. Utility/Agency Owners (UAOs) can be provided plans, profiles and cross sections as required to identify/verify and designate their existing utilities as well as indicate proposed installations.
8. The TRNS*PORT pay item listing can be initiated by identifying the items of work involved at this point.
9. The need for sound barriers has been confirmed and locations established.

13.7 Distribution of Exempt Public Documents

It is the policy of the Department to protect the State Highway System's infrastructure from disclosure under Florida's public records law for documents concerning Department structures. This exemption is created by ***Section 119.07(3)(ee), F.S.*** and covered by Department Procedure "***Distribution of Exempt Public Documents Concerning Department Structures and Security System Plans*** (***Topic No. 050-020-026***)."

Structure is defined in ***Section 334.03(28), F.S.***, as "a bridge, viaduct, tunnel, causeway, approach, ferry slip, culvert, toll plaza, gate, or other similar facility used in connection with a transportation facility." This includes pipes and pipe systems. Therefore, those portions of Department plans that depict pipes, pipe systems, or the internal layout and structural elements of a structure owned or operated by the Department, are exempt from a public records request under ***Section 119.07(3)(ee), F.S.***. This applies to all formats (paper, electronic, etc.), and at any phase of completion (existing, draft, preliminary, phase reviews, or final).

Entities or persons outside the Department requesting or receiving copies of any portion of plans considered Exempt Documents will need to complete a request form (***Form No. 050-020-26***). The form also advises the requestor that the entity or person receiving the information shall maintain the confidential and exempt status of the information.

This procedure applies to both Department internal or contracted staff who produce such Exempt Documents in their Department work or have other methods of access to such Exempt Documents in the distribution to persons or entities outside of the Department. Refer to ***Topic No. 050-020-026*** for further requirements.

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   c. A crossroad which may affect a structure exists.

   d. Major work of significant length is being done on an intersecting roadway.

2. **May** be required if a change in design speed occurs within the project limits.

The proposed typical sections for roadway and bridges are to be submitted by the responsible engineer for concurrence by the District Design Engineer. Coordination with the District Structures Design Engineer is also required on all bridge typical sections. The roadway and bridge typical sections shall be submitted together to ensure compatibility.

The typical section package for both roadway and bridges shall be approved as part of the Project Development & Environmental (PD&E) process. Typical section package preparation, and coordination between the responsible PD&E engineer and the District Design Engineer, must occur during the development of project alternatives prior to preferred alternative selection. The responsible PD&E engineer shall prepare, seal and submit the typical section package for concurrence. Typical section package concurrence by the District Design Engineer shall be obtained after the preferred alternative is selected. A copy of the approved typical section package shall be included as part of the PD&E Final Preliminary Engineering Report.

For projects that do not contain a PD&E phase, the typical section package shall be prepared, sealed and submitted by the responsible engineer for concurrence by the District Design Engineer. The typical section package should be concurred with prior to the final engineering process.

The Engineer of Record must coordinate with the District Design Engineer, the District Traffic Operations Engineer, and the responsible PD&E engineer to discuss the anticipated posted speed. The selected design speed shall be jointly approved by the District Design Engineer and the District Traffic Operations Engineer. This joint approval shall be documented on the Typical Section Data Sheet (see ***Exhibit 16-B, Sheet 1 of 6***).

Exhibit 16-B contains example typical section package sheets. The following is an outline of the information which is required as part of the typical section package submittal. This information is critical for proper evaluation by the District Design Engineer. Missing information may require a resubmittal of the typical section package.

The following information is required on the project controls sheet:

1. Financial Project ID

2. County (and Section)

3. Project Description
4. Functional Classification
5. Highway System
6. Access Classification
7. Traffic Data (AADT, for Current, Opening and Design Year, Design Speed, Posted Speed; K, D, and T Factors)
8. Potential Exceptions and Variations related to the typical section elements
9. List Major Structures Requiring Independent Structures Design (including location and description)
10. List Major Utilities within project corridor
11. List other information pertinent to the design of the project

The following information is required on the project identification/proposed typical section sheet:

Project Identification:

1. Financial Project ID
2. State Project No. (if assigned)
3. Federal Aid Project No. (if assigned)
4. Work Program Item (if assigned)
5. Road Designation
6. County Name (and Section)
7. Limits (In Milepost)
8. Project Description

Proposed Roadway Typical Section Drawing:

1. Design Speed
2. Limits (station limits of the typical section shown if available)
3. Lanes (dimension width, show cross slope of each lane, label bike and HOV lanes)
4. R/W Line (graphically show, label and dimension from centerline const.)
5. Shoulder (dimension width, show cross slope, paved shoulder is dimensioned and labeled separately)

Exhibit 16-B Typical Section Package
Sheet 1 of 6

PROJECT IDENTIFICATION

FINANCIAL PROJECT ID ________________ COUNTY (SECTION) ________________

PROJECT DESCRIPTION ________________________________

PROJECT CONTROLS

FUNCTIONAL CLASSIFICATION

( ) RURAL
( ) URBAN
( ) FREEWAY/EXPWY. ( ) MAJOR COLL.
( ) PRINCIPAL ART. ( ) MINOR COLL.
( ) MINOR ART. ( ) LOCAL

HIGHWAY SYSTEM

Yes	No	
( )	( )	NATIONAL HIGHWAY SYSTEM
( )	( )	FLORIDA INTRASTATE HIGHWAY SYSTEM
( )	( )	STRATEGIC INTERMODAL SYSTEM
( )	( )	STATE HIGHWAY SYSTEM
( )	( )	OFF STATE HIGHWAY SYSTEM

ACCESS CLASSIFICATION

( ) 1 - FREEWAY
( ) 2 - RESTRICTIVE w/Service Roads
( ) 3 - RESTRICTIVE w/660 ft. Connection Spacing
( ) 4 - NON-RESTRICTIVE w/2640 ft. Signal Spacing
( ) 5 - RESTRICTIVE w/440 ft. Connection Spacing
( ) 6 - NON-RESTRICTIVE w/1320 ft. Signal Spacing
( ) 7 - BOTH MEDIAN TYPES

TRAFFIC

	YEAR	AADT
CURRENT	_____	_____
OPENING	_____	_____
DESIGN	_____	_____

DISTRIBUTION

DESIGN SPEED	_____	K	%
POSTED SPEED	_____	D	%
		T_{24}	%

DESIGN SPEED APPROVALS

________________________ ________
DISTRICT DESIGN ENGINEER DATE

________________________ ________
DISTRICT TRAFFIC OPERATIONS ENGINEER DATE

CRITERIA

( ) NEW CONSTRUCTION / RECONSTRUCTION
( ) RRR INTERSTATE / FREEWAY
( ) RRR NON-INTERSTATE / FREEWAY
( ) TDLC / NEW CONSTRUCTION / RECONSTRUCTION
( ) TDLC / RRR
( ) MANUAL OF UNIFORM MINIMUM STANDARDS (FLORIDA GREENBOOK) (OFF-STATE HIGHWAY SYSTEM ONLY)

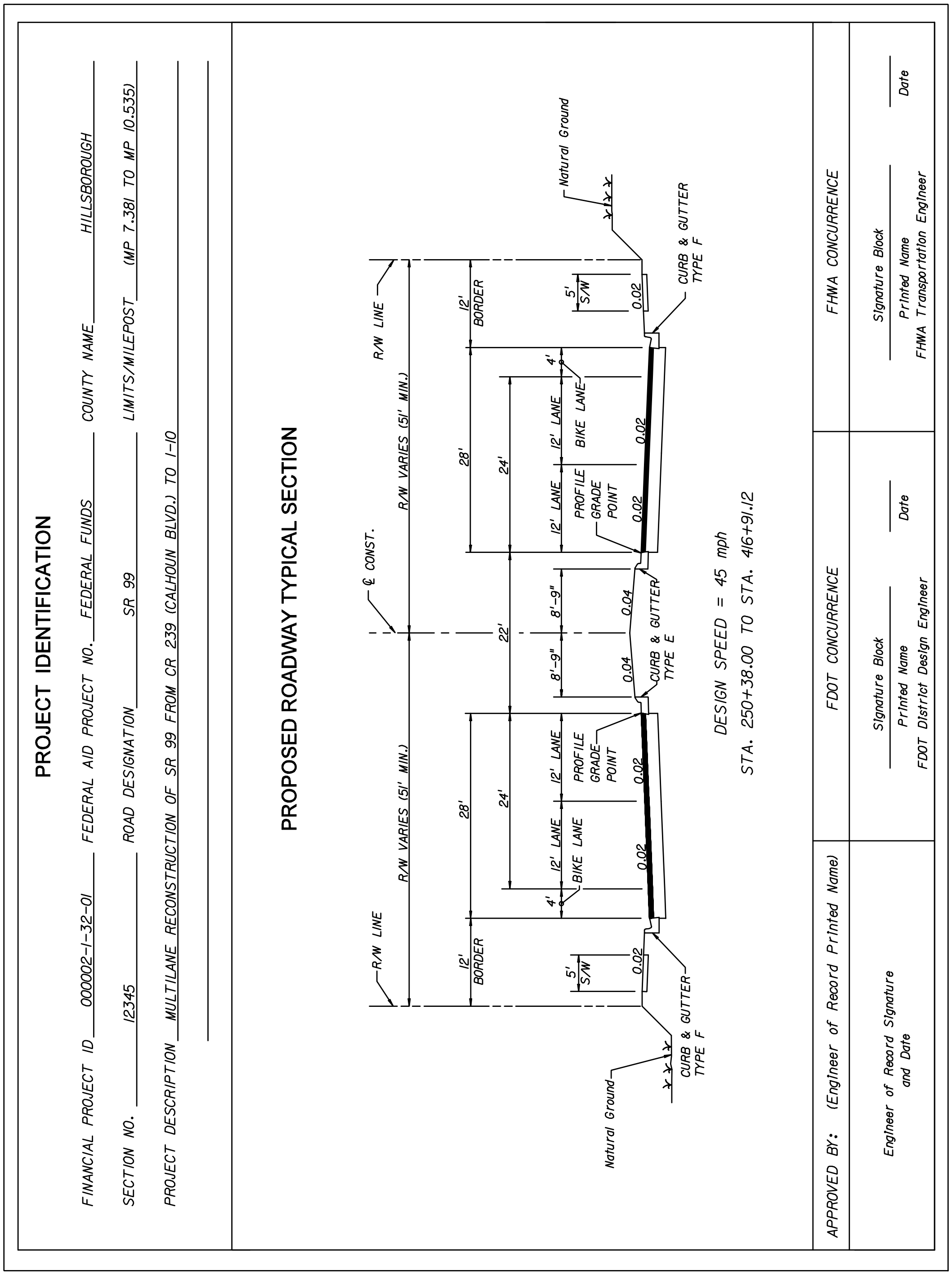
LIST ANY POTENTIAL EXCEPTIONS AND VARIATIONS RELATED TO TYPICAL SECTION ELEMENTS:

LIST MAJOR STRUCTURES LOCATION/DESCRIPTION - REQUIRING INDEPENDENT STRUCTURE DESIGN:

LIST MAJOR UTILITIES WITHIN PROJECT CORRIDOR:

LIST OTHER INFORMATION PERTINENT TO DESIGN OF PROJECT:

Exhibit 16-B, Sheet 2 of 6

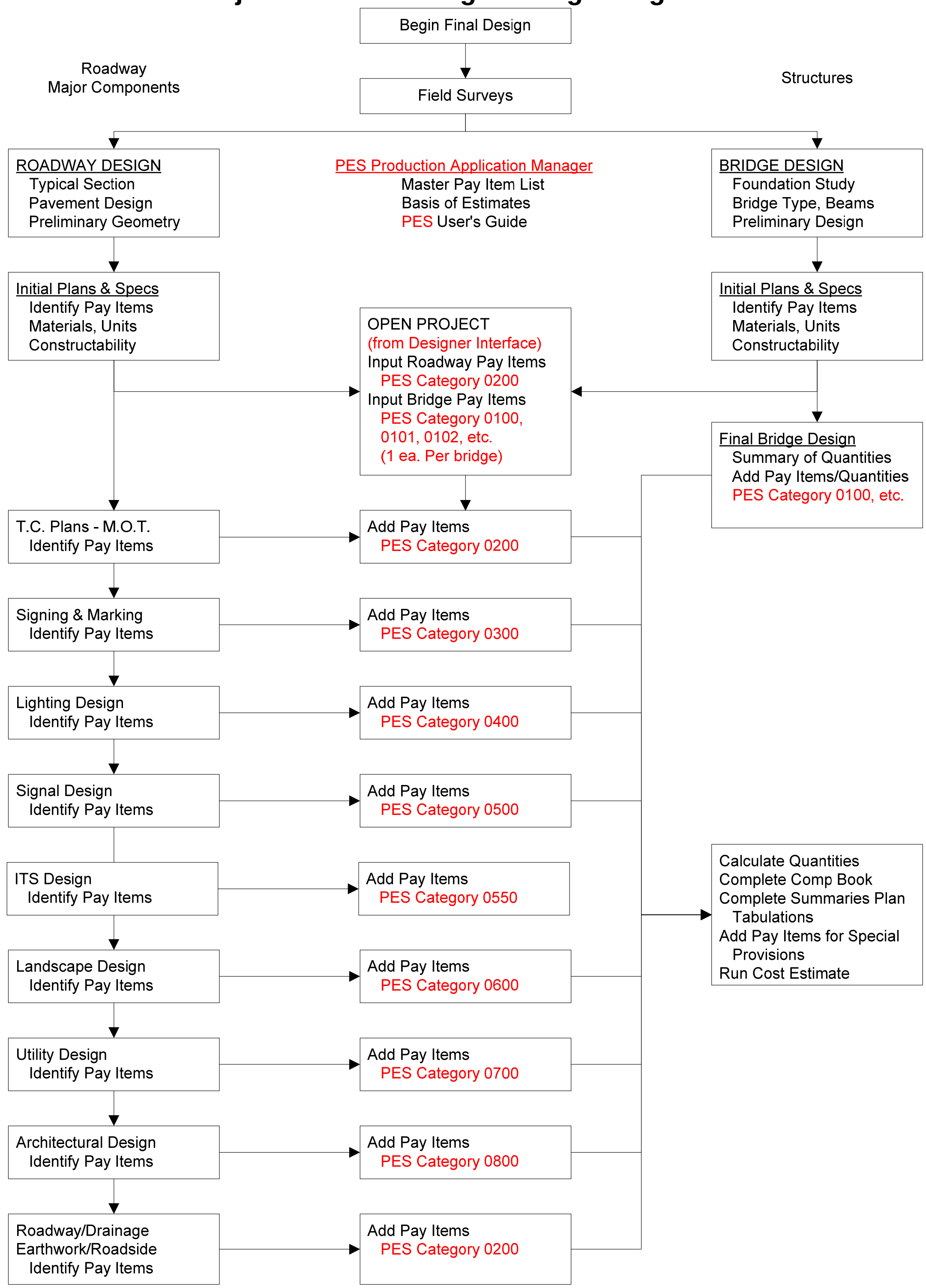


Chapter 17

Engineering Design Estimate Process

Exhibits

Exhibit 17-A Major Activities - Engineering Design Estimate Process



17.4.2 Breakdown of Quantities

For projects that have partial federal funds, adequate distinction should be clearly made between participating (included in federal aid) and nonparticipating (not included in federal aid) items. All nonparticipating items with quantities should be identified in TRNS*PORT and the Computation Book. The method of presenting this information must be of sufficient detail for project personnel to readily distinguish between participating and nonparticipating work, including its physical location on the project. Project personnel must be able to properly account for the necessary separation of quantities. These separated quantities should be properly identified as to participating and nonparticipating work when entered into TRNS*PORT. In a few cases certain lump sum items such as mobilization, maintenance of traffic, etc., may be at least partially federal aid nonparticipating depending upon the nature of other nonparticipating items which must be separated. Where it is determined that certain lump sum items should be partially nonparticipating, the percentage assignment of nonparticipating should be negotiated with the FHWA. Upon mutual agreement, this percentage should be reflected when entering data into TRNS*PORT. These items should be determined during early stages of project development. Coordinate TRNS*PORT data entry of nonparticipating items with the District Estimates Office.

Where joint project agreements are involved between the Department and a City or County, appropriate participation information regarding this particular phase of the work should be so noted.

When a contract contains more than one Financial Project ID, with or without participating/nonparticipating quantities, the Summary of Pay Items and Summary of Quantities must show the separate quantities for each project. The computation book should clearly distinguish the location of each part of the work. The designer should also verify that the method of payment for an item of work agrees among all projects when projects are combined into a single contract.

17.4.3 Utility Contract Plans (Joint Participation Agreements)

When separate plans for utility construction are to be included in the contract, special attention should be given to establishment of pay items and loading the projects into TRNS*PORT. Reimbursable work is indicated in the Financial Project ID by phase number 56 and nonreimbursable work is indicated by phase number 52.

For contracts with more than one project, the pay items for Mobilization and Maintenance of Traffic will be shown on each project's Summary of Pay Items. An exception to this is when the contract contains a Joint Participation Agreement (JPA). The pay items for Mobilization and Maintenance of Traffic will not be shown on the Summary of Pay Items for the JPA. The cost of these items will be included in the lead project.

17.4.4 Plan Notes

Plan notes are intended to be used to clarify design detail, construction practices or method for payment. In general, plan notes should be kept to a minimum. Only those notes that are job specific should be used. Many of the "old" standard notes have been eliminated recently and incorporated into the specifications. Notes that restate the standard specifications or standard indexes shall not be used. This will help to place proper emphasis on those notes that are job specific and avoid discrepancy of documents.

Chapter 20

Plans Processing and Revisions

Exhibits

Chapter 20

PLANS PROCESSING AND REVISIONS

20.1 General

This chapter describes in general terms the critical activities required to process the contract plans, specifications and estimate for letting. It identifies the documents, transmittal forms and certifications prepared by the District and the various offices that process a plans package. This chapter also outlines the revision process, and the steps to resubmit a project withdrawn from letting.

Beginning with the July 2005 letting, all projects shall be delivered in electronic format. Although this chapter was primarily built around paper plans, the same elements are required for electronic plans. Because the process continues to be adjusted, the latest information regarding the letting of electronic plans and specifications (including critical dates) will be posted on the Roadway Design Office web page as new information becomes available:

http://www.dot.state.fl.us/rddesign/electronic-letting

Other specific requirements for processing the electronic delivery including information on the Electronic Delivery software may be found in the ***CADD Manual***, and the ***CADD Production Criteria Handbook***, both found on the Engineering/CADD Systems Office web page:

http://www.dot.state.fl.us/ecso/downloads/publications/

20.2 Glossary

Contract Plans - The plans prepared during the design phase and used by construction personnel to build a project. When design is complete, the Engineer(s) of Record (EOR) either electronically seals the plans or seals a first generation plot of the set of plans and this becomes the legal Record Set in accordance with ***Chapter 471*** of the ***Florida Statutes*** (see ***Chapter 19***, this volume).

Final Plans - The Contract Plans after construction is completed, all revisions have been included and with the title on the key sheet changed to Final Plans.

20.3 Plans Processing

20.3.1 District Activities

There are certain plans processing activities that must occur at the District level prior to submitting plans to Tallahassee. These activities have schedule implications which will vary by District. The following activities should be considered as a guide. Contact the District for specific requirements.

On the Plans to Specifications Date, the project manager submits to the District Specifications section, the contract file and a plans package consisting of the following items:

1. Request for Control Group Change (***Exhibit 20-H***).
2. Two copies of the plans (including all components).
3. One copy of the Computation Book.
4. Two copies of the Technical Special Provisions (if applicable).

The contract file consists of the Transmittal of Plans, Specifications, and Estimates (PS&E) Package memo (***Exhibit 20-A***) which incorporates the Contract File Index (***Exhibit 20-B***) with attachments.

The Specifications section forwards one copy of the plans and the copy of the Computation Book to the District Estimates section. Upon receipt of the plans, the Estimates section changes the Control Group.

Any modification to the plans or quantities after the Estimates Section changes the Control Group, and before the Plans are sent to Tallahassee, will be referred to as Plans Changes. These Plans Changes include the modification, deletion, or addition of data on individual sheets, adding new sheets, or the removal of entire sheets. These changes are not revisions and are not noted in the Revision Block on the sheet(s).

A Change Memo (***Exhibit 20-I***) is required to notify the District Specifications and Estimates sections of any changes to the plans or quantities.

When changes are necessary, the project manager prepares a Change Memo listing all plan and quantity changes and submits a copy to the District Specifications and Estimates section. The Estimates section changes the Control Group back to the Designer for them to make the changes to the summary of pay items file and notifies the project manager, who then has twenty-four hours to make changes to the summary of pay items file. The project manager submits the original Change Memo and two copies of all changed sheets to the Specifications section.

One week prior to the Plans to Tallahassee Date the Specifications section submits the following items to the project manager, or District Plans Processing Section, who assembles the PS&E Package for mailing:

1. Electronically Sealed Specifications Package.
2. Contract file.

20.3.2 Submittal to Tallahassee

Districts are responsible for preparing the PS&E Package and mailing/transmitting it to Central Office so that it arrives in the Plans Processing Section of the Specifications Office no later than the due date assigned in the Work Program. For total electronic jobs, e-mail the Transmittal of PS&E Package and attachments to the group name “CO-CPKG”.

Before mailing/transmitting plans to Central Office, the District will assemble the PS&E Package and insure it is complete, as follows:

1. The Transmittal of Plans, Specifications, and Estimates Package (***Exhibit 20-A***) and applicable documents are attached/posted (this includes the Contract File Index (***Exhibit 20-B***) with attachments).
2. An original set of the Contract Plans is sealed in accordance with ***Chapter 19*** of this volume. All sheet numbers match the key sheet index, and the Financial Project ID is correct and consistent on all sheets. On strung projects, the lead key sheet shows the Financial Project IDs that go with the lead project. Also, on strung projects all Summary of Pay Items sheets are included in the lead project. If the project is FA Oversight, the Sealed Contract Plans Set plus one copy (copy can be from unsealed plans) are provided. If the project is not FA Oversight, only the sealed Contract Plans Set is provided.

   For hardcopy plans, all sheets are CADD produced first-generation plots or laser prints, size B (11x17), on good quality multipurpose (typewriter/printer) paper, legible and reproducible. Sheets are punched with two holes (standard holes are 8½ inches apart on the left edge of the sheet), and bound with fasteners such as Chicago Screw Posts.

3. An electronically sealed Plans Package and/or an electronically sealed Specifications Package are/is posted to the Plans Processing Server.
4. E-mail the "Intent and Scope" information for each project to the Tallahassee Contracts Office using the group name "FDOT-ISCOPE".
5. Other components of the Plans Package such as Utility Certification, etc.

When submitting the PS&E Package to Central Office, the Project Manager (or designated district person) sends a copy of the contract plans set, a copy of the specifications package, the original computation book and one copy of the computation book to the District Construction Engineer (***Exhibit 20-E***). The Project Manager keeps a copy of the transmitted documents in the project file(s). Documentation that the District Director of Transportation Development (Production) has certified the package is also to remain in the District's project file.

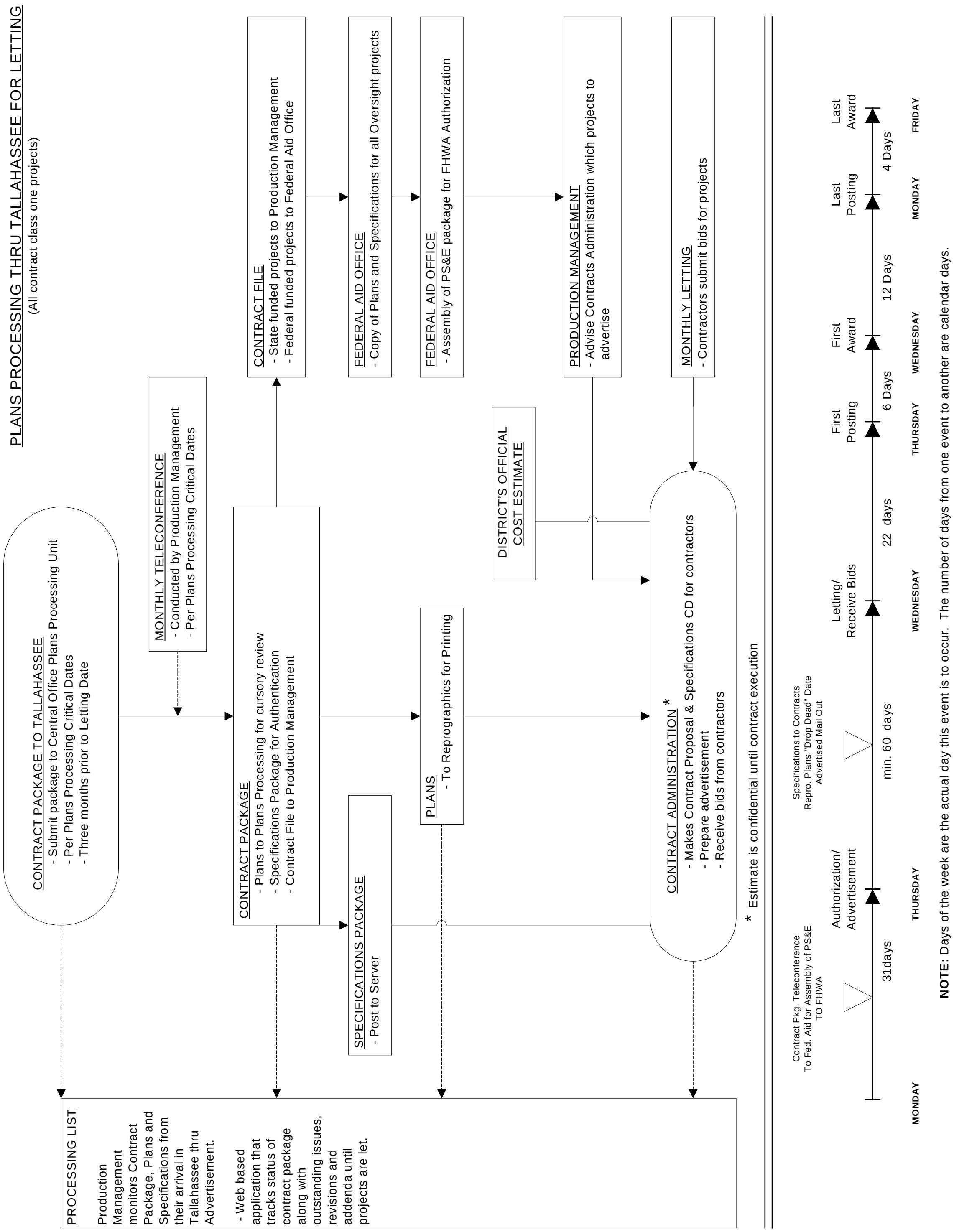
Exhibit 20-D must be completed on all federally funded projects. On federally funded projects strung with non-FA projects, the FA project is to be the lead project. Regarding federal environmental compliance, the limits of the environmental document will control the scope of compliance with NEPA requirements. NEPA requirements (including staging areas and contractors' off-site activities) must only be met for that portion of the project included within the "logical termini" as described in the NEPA document associated with the federally funded portion of the contract.

Several activities are required by the units in Central Office to get a project ready for letting (***Figure 20.1***). Upon receipt of the Plans Package, the Plans Processing Section checks the package for completeness and stamps the date received on the Transmittal Memo. If incomplete, Plans Processing notifies the District Project Manager or District Plans Processing Section to provide the required items. Once verified as complete, the Plans Package is distributed.

After the project is awarded, the sealed Contract Plans Set and a copy of the Specifications Package are sent to the District Construction Engineer. This sealed Contract Plans Set will be used during construction to show all significant revisions to the plans (including those affecting payments to the contractor).

The Contract Plans set plus all revisions made during construction becomes the Final Plans set. The sealed Final Plans set is used by District Final Estimates to make the final payout of a construction project. After the final payout, the sealed Final Plans are processed in accordance with ***Procedure No. 050-020-025, Records Management and Distribution***.

Figure 20.1 Plans Processing Thru Tallahassee



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20.4 Revisions to the Contract Plans Package

Design revisions are modifications to the PS&E Package after it has been accepted by Central Office Plans Processing but prior to bid opening. The Project Manager insures a revision is complete as follows (see ***Figure 20.2***):

1. If the project is FA Oversight, obtain concurrence from FHWA prior to making revisions. Include the name of the FHWA contact who gave concurrence and the concurrence date on the revision memo. FHWA concurrence may not be required on minor changes such as in quantities or to relocate a driveway.

2. Revisions include the modification, deletion, or addition of data on individual sheets, adding new sheets, or the removal of entire sheets.

    a. All plans revisions require sealed revised sheet(s).

    b. For revisions to plans sheets other than a Key Sheet, place a conspicuous unique numbered symbol (e.g., a numbered triangle) beside the revision that corresponds to the Revision Number on the Revision Memo. Begin the revision numbering with "1" and number subsequent revisions of the plans sequentially. Place the revision date, corresponding numbered symbol for the revision, and a brief description of the revision in the Revision Block on each modified sheet. The same applies to adding sheets, however the added sheets may be numbered with alpha characters (e.g., 22a, 22b, 22c). If a sheet is being deleted, the sheet numbers for the following sheets remain unchanged. For revisions involving revised, added or deleted pay items, see ***Exhibit 20-C***.

    c. The revisions of plans sheets other than a Key Sheet are also noted on the lower left corner of the Key Sheet in the "Revisions" area. (See ***Exhibit KS-1, Chapter 3, Volume II***). If the changes to a Key Sheet only involve notes in the Revisions area, no entry is made in the Key Sheet Revisions Block at the lower right corner. The Key Sheet Revisions Block is only used to record changes other than revisions notes. Revisions to component sets such as the Signalization Plans are noted in the Revision Block of the modified sheet and on the **lead** Key Sheet in the Revisions Area. If a sheet is being deleted, this must be noted in the Revisions Area on the lead Key Sheet, and the Index of Sheets must be revised to show the sheet number(s) of the deleted sheet(s), with a sheet description of "(DELETED)". This also must be recorded in the Key Sheet Revisions Block as a revision to the Index of Sheets. A newly sealed lead Key Sheet is required when any sheet is revised.

3. Prepare the Revision Memo (***Exhibit 20-C***), provide a Revision Number, and describe modifications. Record the revision date for each revised sheet, using the date shown in the revision block on the sheet. The District Design Engineer, District Consultant Project Management Engineer or the District Structures Design Engineer, as appropriate, reviews and concurs with the revision.

4. The District Specifications Engineer reviews the revisions for any effect on the specifications and dates and signs the Revision Memo.

5. The number of revision packages submitted should be kept to a minimum. When more than one revision is expected, hold until all revisions are ready and submit as a package. Revision packages should be submitted by the Monday prior to Authorization for Advertisement, whenever practical. Revisions after this date should be coordinated with the District Estimates Engineer, as soon as possible.

6. Revisions Involving Pay Item Changes:

    a. Send the Revision Memo to the District Estimates Staff for review.

    b. The District Estimates Staff or appropriate person for the District is required to fax the Revision Memo to the State Estimates Office.

    c. The State Estimates Office will determine who will make the Changes to the Pay Items (Central Office or District Office) and will pass control as required to the District. Note: Control will be passed to Decentralized Districts for revisions. When control is passed, the Revision must be completed within 24 hours.

    d. The District will complete the Revision and change the Control back to the State Estimates Office (within the 24 hours). The District will also notify the State Estimates Office that the revision is complete via email using the Distribution List FDOT-PRELEST.

7. Ensure that sealed plans sheets are attached to the Revision Memo. The Engineer of Record seals each revised document in accordance with ***Chapter 19, Sealing Design Documents***, of this volume.

8. Mail the signed original Revision Memo with attachments (or scan the signed original and email) to Plans Processing at (Mail Station 75). If a Supplemental Specifications Package is required, submit it as an electronically sealed package accompanying the Revision Memo. Send the revised original computation sheets and one copy to the District Construction Engineer. If the original Revision Memo will be received in Plans Processing between 15 and 6 working days prior to letting, the District Secretary must approve by signing the Revision Memo. Revisions within five work days of letting are not allowed since there is no assurance that all prospective contractors will get these documents on time to consider in their bids.

After this date the project must be let as is, or must be withdrawn from letting. Withdrawing the Plans Package after advertisement requires approval by the District Secretary and the State Highway Engineer.

9. The revision package includes the Revision Memo and as applicable:

   a. sealed contract plans sheets including key sheet,

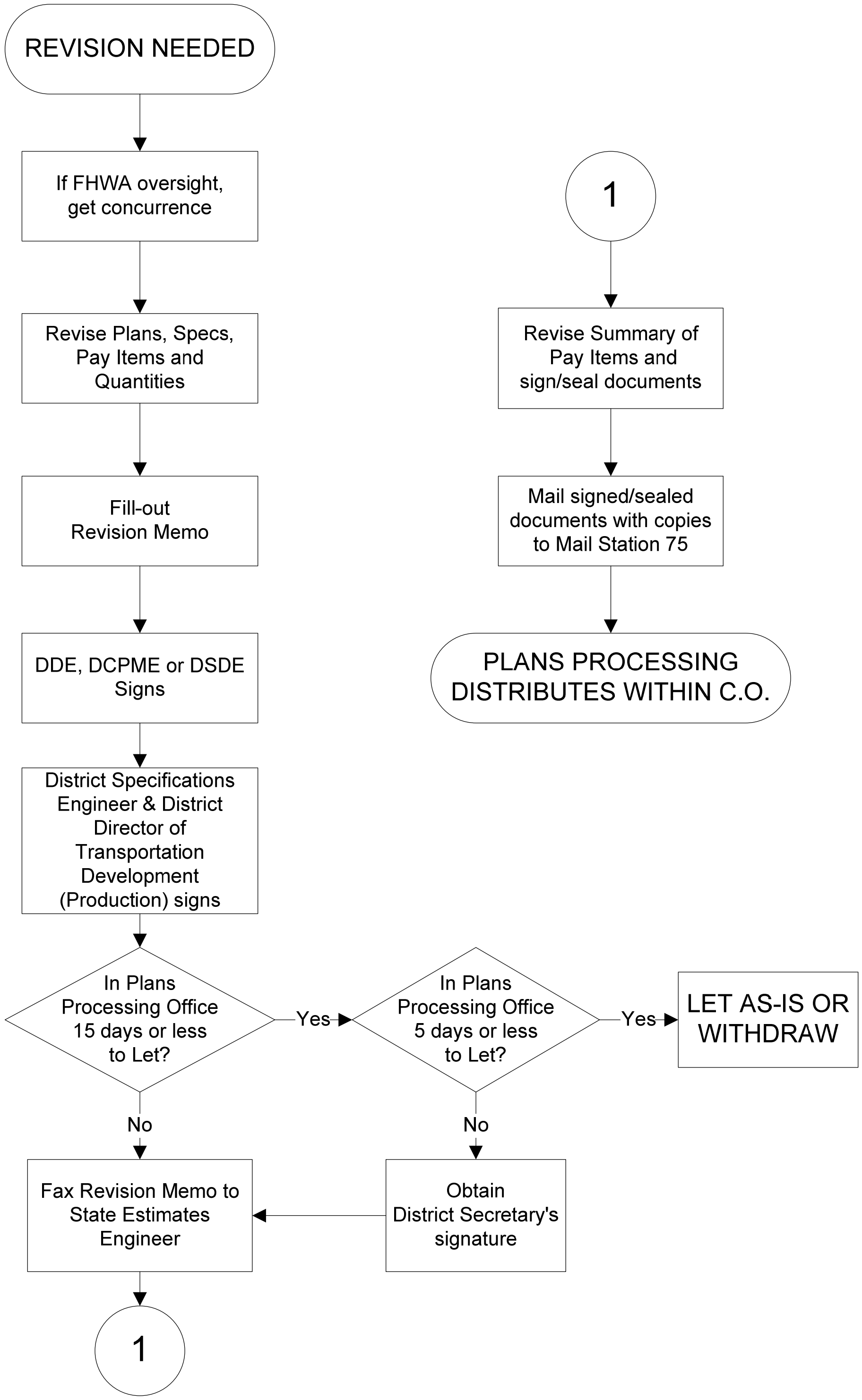
   b. revised Summary of Pay Items,

   c. electronically signed and sealed Supplemental Specifications Package.

10. Upon receipt of the signed original Revision Memo (or scanned original), Plans Processing checks the revision package for completeness.

After contract award, revisions are done by district construction in accordance with the ***Preparation and Documentation Manual (Topic 700-050-010)***.

Figure 20.2 District Revisions



20.5 Resubmittal of Withdrawn Project

If prior to letting a district requests that the entire Plans Package be returned for major revisions, such project will be resubmitted as follows:

1. Resubmit PS&E Package as a new transmittal with all required components. On the Transmittal memo, write this note by the Transmittal date “Plans completely revised”. On the lead Key Sheet, write this note on the lower left corner: “Plans completely revised. (date)”. All copies of project documents in Central Office from the previous submittal will be destroyed. This action requires a total reprint.
2. A project withdrawn for a significant period (nine months or longer) will be updated according to the process outlined in ***Chapter 15*****,** this volume.

Plans rejected from letting by the Awards Committee or withdrawn for minor revisions may not need to follow the above process. District coordination with Central Office Production Management is required to reschedule a letting. Note that a new Proposal/Contract ID number is generated and shall be shown when resubmitting.

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Exhibit 20-A Transmittal of Plans, Specifications, and Estimates Package Sheet 1 of 2

TRANSMITTAL OF PLANS, SPECIFICATIONS, AND ESTIMATES PACKAGE

Date: ____________________

Financial Project ID(s): ______________________________

Proposal/Contract ID: T____________________ **Letting Date:** ____________________

County: ____________________ **State Road No.:** ____________________

Federal Funds: ☐No ☐ Yes **Federal Aid No.:** ____________________

Work Type: ______________________________

____

On ___/___/_____, the District Director of Transportation Development (Production) certified that the Plans, Specifications and Estimates (PS&E) Package is complete, has no known errors or omissions, has been reviewed for constructability and biddability, and is ready to advertise for construction.

The following items transmitted as noted:

SEALED CONTRACT PLANS SET (_____ SHEETS):
☐ Hardcopy ☐ Electronic (If "Electronic", the Electronic Plans Package was reviewed by ______________________________ and posted to the server on _____/_____/_____).

SEALED SPECIFICATIONS PACKAGE (_____ PAGES):
The Electronic Specifications Package was reviewed by ______________________________ and posted to the server on____/____/____.

ESTIMATES OFFICE INFORMATION:
The Authorization Estimate will be reviewed by ______________________________ and will be posted to the server on____/____/____.

FEDERAL AID OFFICE INFORMATION:
Federal Aid Oversight: ☐ No ☐ Yes

FHWA: Approved by ______________________________ Date: ________________
Print Name of FHWA Engineer

CONTRACTS OFFICE INFORMATION:
Contract Time: _________ Calendar Days
Special Start Time: ☐ No ☐ Yes (If yes, Start Date: ____/____/____)
Flexible Start Time: ☐ No ☐ Yes (If yes, ______ Calendar Days)
Acquisition Time: ☐ Standard ☐ Other (________ days)
Lead-based paint: ☐ No ☐ Yes (If yes, is it greater than 51% of the work? ☐ No ☐ Yes)
Alternative Contracting: ☐ No ☐ Yes
(If yes, Type: ______________________________
TRNS*PORT Site Record: User Cost Per Day $____________ Maximum Days _________)
(If Lump Sum, Checklist 22-A submitted to District Specs. Office: ☐ No ☐ Yes)
Pre-Bid Conference Mandatory? ☐ No ☐ Yes (Date:____/____/____ Time:_______ A.M./P.M.)
(Contact Person and Phone:______________________________)
(Location of Conference: ______________________________)

SPECIAL NOTES and REQUIREMENTS (List/Explain):

____

____

____

If any items are missing please contact, ______________________________.
Contact Name and Phone Number

Exhibit 20-A Transmittal of Plans, Specifications, and Estimates Package Sheet 2 of 2

REMINDER

1. The sealed Contract Plans Set is from first-generation CADD produced plots or laser prints, size B (11x17), on good quality multipurpose (typewriter/printer) paper.*
2. Punch 2 holes (standard holes are 8 1/2 inches apart on the left edge of the sheet), and bind plans sheets with fasteners such as Chicago Screw Posts (do not staple).*
3. Check that all components of the Contract Plans Set are included as listed on the lead key sheet.
4. Check that all sheets are included according to key sheet index(es).
5. Check that all sheets have the correct Financial Project ID.
6. Check that all sheets are legible and reproducible.
7. On strung projects, check that all Summary of Pay Items sheets from the Proposal/Contract ID go in the lead project and the Financial Project ID of the strung project is shown on the lead key sheet.
8. Check that bridge pay item sheets show bridge numbers and the quantity breakdowns.
9. Organize attachments in the order listed.
10. E-mail the Transmittal and all applicable documents (including the Contract File Index and attachments) to the group “CO-CPKG” and copy the Project Manager. If submitting hardcopy plans, mail to Plans Processing at Mail Station 75.
11. COMPUTATIONS - Send original computation book and 1 copy to the District Construction Engineer.

* Applies to jobs with hardcopy plans.

Exhibit 20-B Contract File Index
Sheet 1 of 2

CONTRACT FILE INDEX

Financial Project ID ____

Proposal/Contract ID ____

ATTACHMENTS (check or expected day of transmittal to Central Office)

______ Calendar Days Recommendation*
______ Preliminary Engineering Certification*
______ Utility Certification
______ Status of Environmental Certification*
______ Permit Transmittal Memo
______ Railroad Clear Letter
______ Special Component Plan Approval**

☐ No ☐ Yes Federal Authorization Request (FAR) Form has been electronically transmitted*

☐ No ☐ Yes FHWA Cost Estimate Summary Sheet has been transmitted*

☐ No ☐ Yes Project exempt from FHWA oversight under agreement dated April 26, 1999*

☐ No ☐ Yes Right of Way Certification was mailed to State R/W Administrator

☐ No ☐ Yes Local Funds Agreement sent to Office of Comptroller

☐ No ☐ Yes Local Funds Sent to Office of Comptroller

☐ No ☐ Yes Project is Federally Funded off the State Highway System, requiring a Maintenance Agreement. If yes, a Maintenance Agreement (Number _________) was executed on ____________________. A copy is available upon request.

---

* Include if federally funded.

** Per Volume 2, Section 2.1.

Name:_________________________________ Date:______________________________
Print Name of Project Manager/Other Title

Exhibit 20-B Contract File Index, Sheet 2 of 2

REMINDER

PROCESS:

1. Organize attachments in the order listed.
2. Show the number of Maintenance Agreements (Federal funds – off the State Highway System).
3. Show anticipated date of arrival on any item not included in package.

NOTE: The Contract File Index is an integral part of the Transmittal of Plans, Specifications, and Estimates Package.

Exhibit 20-C Revision Memo
Sheet 1 of 6

DATE: ______________________ 1 of ___

TO: Plans Processing, Mail Station 75

FROM: ____________________________, Project Manager

SUBJECT: **Revision Memo** - Letting (mo./yr.) __________

Financial Project ID ____________________________ (Lead number only)

Proposal/Contract ID ___________________________

Federal Funds: ☐No ☐ Yes Federal Aid No. _______________________

County ___________________________ State Road No. ___________

Concurred by: _________________________________ Date: __________________
Signature of DDE, DCPME or DSDE

I have reviewed for effects on the Specifications Package and a package revision **is** ___ **is not** ___ required. Approved By: _______________________ Date: ______________
Signature of District Specifications Engineer

If FA Oversight, Authorized By: ___________________________ Date: ______________
Print Name of FHWA Engineer

THE DISTRICT SECRETARY MUST APPROVE REVISIONS RECEIVED IN PLANS PROCESSING BETWEEN 15 AND 6 WORK DAYS BEFORE LETTING.

NO REVISIONS ALLOWED WITHIN 5 WORK DAYS BEFORE LETTING.

Approved By: ____ Date:___________
Signature of District Secretary

☐ SUPPLEMENTAL SPECIFICATIONS PACKAGE NUMBER ________ (______Pages).

☐ PLANS REVISION NUMBER ___ (______Sheets): ☐ Hardcopy ☐ Electronic

CONTRACT TIME REVISED: ☐ No ☐ Yes (If yes, ______ Calendar Days)

Sheet No(s).	Rev. Date	Description
___________	_________	____
___________	_________	____
___________	_________	____
___________	_________	____

Central Office Use:
Processed By: ____

Exhibit 20-C Revision Memo, Sheet 2 of 6

REMINDER

PROCESS:

1. Fill out headings.
2. On oversight projects, get FHWA concurrence. Print name of FHWA Engineer and date.
3. Get concurrence signature from the District Design Engineer, District Consultant Project Management Engineer or the District Structures Design Engineer, as appropriate.
4. Get signature of the District Specifications Engineer.
5. If revisions will be received in Plans Processing between 15 and 6 workdays before the letting date (bid opening), get approval signature from the District Secretary. Notify Plans Processing. No revisions are allowed within 5 workdays before letting.
6. Enter the sheet number and:
   a. Describe new pay item number with quantity, or
   b. deleted pay item number only, or
   c. revised quantities by entering pay item number with old and new quantities.
7. If a revision(s) will impact the utility plans, adjustments and/or schedules, provide a copy of the revision memo and affected plans sheets to the District Utilities Engineer.
8. If adding or deleting a pay item, revise the whole Summary of Pay Items design group to insure any pay item rollover between sheets is properly printed.
9. Fax the Revision Memo to the State Estimates Engineer at (850) 414-4877 to unlock the summary of pay items.
10. Make revisions to the Summary of Pay Items with an Addendum within 24 hours after changing of Control Group.
11. Mail Revision Memo with attachments to Plans Processing (Mail Station 75). If transmitting the revisions electronically, scan the signed Revision Memo and e-mail it (with attachments) to Plans Processing.

ATTACHMENTS:

1. Revised sealed plans sheets including Summary of Pay Items.
2. Revised District Cost Estimate if federally funded.
3. Electronically sealed Supplemental Specifications Package.

COMPUTATIONS:

Show Financial Project ID on revised computation book sheets, and mail originals and one copy to the District Construction Engineer.

Exhibit 20-C Revision Memo, Sheet 3 of 6

DATE: ____________ ____of___

Financial Project ID __________________________________

Proposal/Contract ID __________________________________

PLANS REVISION NUMBER _____

Sheet No(s).	Rev. Date	Description

Exhibit 20-C Revision Memo, Sheet 4 of 6

EXAMPLE REVISION MEMO

DATE: March 14, 2007 1 of 2
TO: Plans Processing, Mail Station 75

FROM: _____, Project Manager

SUBJECT: **Revision Memo** - Letting (mo./yr.) _____/_____

Financial Project ID 197707-1-52-01 (Lead number only)

Proposal/Contract ID T1235

Federal Funds: ☒No ☐ Yes Federal Aid No. _________

County County Name State Road No. 25

Concurred by: ______________________________ Date: _____
Signature of DDE, DCPME or DSDE

I have reviewed for effects on the Specifications Package and a package revision **is** _____ **is not** _____ required. Approved By: ______________________ Date: _____
Signature of District Specifications Engineer

If FA Oversight, Authorized By:________________________ Date: _____
Print Name of FHWA Engineer

THE DISTRICT SECRETARY MUST APPROVE REVISIONS RECEIVED IN PLANS PROCESSING BETWEEN 15 AND 6 WORK DAYS BEFORE LETTING.

NO REVISIONS ALLOWED WITHIN 5 WORK DAYS BEFORE LETTING.

Approved By:____ Date:_____
Signature of District Secretary

☐ SUPPLEMENTAL SPECIFICATIONS PACKAGE NUMBER _____ (_____ Pages).

☐ REVISED SPECIFICATIONS PACKAGE (_____ Pages).

CONTRACT TIME REVISED: ☒ No ☐ Yes (If yes, ______ Calendar Days)

☒ REVISION (4 Sheets) REVISION NO. 2 : ☐Hardcopy ☒ Electronic

Sheet No(s).	Rev. Date	Description
1	3-14-07	Listed Revisions.
2	3-14-07	Revised pay item 120-1 from 121,172 CY to 128,237 CY; 120-6 from 96,143 CY to 95,680 CY; Added pay item 425-1-559 Quantity of 1 EA.
3	3-14-07	Revised pay item 530-3-3 from 54.7 TN to 57.7 TN.

Central Office Use:
Processed By: ____

Exhibit 20-C Revision Memo, Sheet 5 of 6

EXAMPLE REVISION MEMO

DATE: March 14, 2007 2 of 2

Financial Project ID 197707-1-52-01

Proposal/Contract ID T1235

Sheet No(s).	Rev. Date	Description
		and 530-3-4 from 86.7 TN to 32 TN.
4	3-14-07	Transport updated.

Exhibit 20-C Revision Memo, Sheet 6 of 6
EXAMPLE SUMMARY OF PAY ITEMS SHEET

△6 1 DATE: 07/14/07 FLORIDA DEPARTMENT OF TRANSPORTATION PROPOSAL SUMMARY OF PAY ITEMS PAGE: 1 A0001

PROPOSAL : T1235 LEAD PROJECT : 19770715201 COUNTY : POLK , MANDIST: 01
PROJECT(S): 19770715201 COUNTY/SECTION: 16180000 ,

0001 SUMMARY OF ROADWAY — PAY ITEMS

SPC	ALT	ITEM NUMBER	ITEM DESCRIPTION	UNIT	19770715201		QUANTITY TOTAL
		0999-102- 2	SPEED & LAW ENFORCEMENT OFFICER, STATE FURNISHED, DISTRICT CONTRACT	MH	1.000		1.000
		0101- 1-	MOBILIZATION	LS	1.000		1.000
		0102- 1-	MAINTENANCE OF TRAFFIC	LS	1.000		1.000
		0102- 3-	COMMERCIAL MATERIAL FOR DRIVEWAY MAINTENANCE	CY	1050.000		1050.000
T		0102- 14-	TRAFFIC CONTROL OFFICER	MH	48.000		48.000
		0102- 60-	WORK ZONE SIGNS	ED	60030.000		60030.000
		0102- 61-	BUSINESS SIGNS	EA	54.000		54.000
		0102- 71- 11	BARRIER WALL, TEMPORARY, F&I, CONCRETE	LF	5177.000		5177.000
		0102- 74- 1	BARRICADE, TEMPORARY, TYPES I, II, DI, VP & DRUM	ED	197473.000		197473.000
		0102- 74- 2	BARRICADE, TEMPORARY, TYPE III, 6'	ED	378.000		378.000
		0102- 76-	ADVANCE WARNING ARROW PANEL	ED	290.000		290.000
		0102- 77-	HIGH INTENSITY FLASHING LIGHTS, TEMP, TYPE B	ED	40600.000		40600.000
		0102- 78-	REFLECTIVE PAVEMENT MARKER,TEMPORARY	EA	2979.000		2979.000
		0102- 79-	LIGHTS,BARRIER WALL MOUNT,TEMP,TYPE C,STEADY BURN	ED	69.000		69.000
		0102- 89- 7	CRASH CUSHION/IMPACT ATTENUATOR, TEMPORARY, REDIRECTIVE OPTION	LO	14.000		14.000
	△5	0102- 99-	CHANGEABLE-VARIABLE MESSAGE SIGN, TEMPORARY	ED	118.000 △5		118.000 △5
	△5	0102-150- 1	PORTABLE REGULATORY, SIGN	ED	180.000 △5		180.000 △5
	△5	0102-150- 2	RADAR SPEED DISPLAY UNIT	ED	180.000 △5		180.000 △5
		0104- 12-	STAKED TURBIDITY BARRIER	LF	463.000		463.000
		0104- 13- 1	STAKED SILT FENCE, TYPE III	LF	20646.000		20646.000
		0104- 15-	SOIL TRACKING PREVENTION DEVICE	EA	4.000		4.000
		0104- 16-	ROCK BAGS	EA	1840.000		1840.000
		0109- 71- 3	FIELD OFFICE, 900 SQ FT	DA	725.000		725.000
		0110- 1- 1	CLEARING & GRUBBING	LS	1.000		1.000
		0110- 7- 1	MAILBOX, F&I, SINGLE	EA	17.000		17.000
	△2	0120- 1-	REGULAR EXCAVATION	CY	128237.000 △2		128237.000 △2
		0120- 4-	SUBSOIL EXCAVATION	CY	7065.000		7065.000
	△2	0120- 6-	EMBANKMENT	CY	95680.000 △2		95680.000 △2
		0160- 4-	STABILIZATION TYPE B	SY	105404.000		105404.000
		0285-711-	OPTIONAL BASE, BASE GROUP II	SY	91600.000		91600.000
		0286- 1-	TURNOUT CONSTRUCTION	SY	1068.000		1068.000
		0327- 70- 15	MILLING EXIST ASPH PAVT, 2 3/4" AVG DEPTH	SY	62414.000		62414.000
		0334- 1- 24	SUPERPAVE ASPH CONC, TRAF D, PG76-22	TN	33616.400		33616.400
		0337- 7- 22	ASPH CONC FRICTION COURSE, INC BIT, FC-5, PG76-22	TN	6182.500		6182.500
		0341- 70-	ASPHALT RUBBER MEMBRANE INTERLAYER	SY	62585.000		62585.000
		0400- 1- 2	CONCRETE CLASS I, ENDWALLS	CY	74.000		74.000
		0400- 1- 11	CONCRETE CLASS I, RETAINING WALLS	CY	159.000		159.000
		0400- 1- 15	CONCRETE CLASS I, MISCELLANEOUS	CY	179.600		179.600
		0400- 4- 1	CONCRETE CLASS IV, CULVERTS	CY	139.100		139.100
		0415- 1- 1	REINF STEEL- ROADWAY	LB	20914.000		20914.000
		0425- 1-351	INLETS, CURB, TYPE P-5, <10'	EA	26.000		26.000
		0425- 1-361	INLETS, CURB, TYPE P-6, <10'	EA	20.000		20.000

1 DATE: 06/11/07 FLORIDA DEPARTMENT OF TRANSPORTATION PROPOSAL SUMMARY OF PAY ITEMS PAGE: 2 A0001

PROPOSAL : T1235 LEAD PROJECT : 19770715201 COUNTY : POLK , MANDIST: 01
PROJECT(S): 19770715201 COUNTY/SECTION: 16180000 ,

0001 SUMMARY OF ROADWAY — PAY ITEMS CONTINUED

SPC	ALT	ITEM NUMBER	ITEM DESCRIPTION	UNIT	19770715201		QUANTITY TOTAL
		0425- 1-451	INLETS, CURB, TYPE J-5, <10'	EA	2.000		2.000
		0425- 1-452	INLETS, CURB, TYPE J-5, >10'	EA	4.000		4.000
		0425- 1-461	INLETS, CURB, TYPE J-6, <10'	EA	5.000		5.000
		0425- 1-471	INLETS, CURB, TYPE 7, <10'	EA	6.000		6.000
		0425- 1-511	INLETS, DT BOT, TYPE B, <10'	EA	4.000		4.000
		0425- 1-521	INLETS, DT BOT, TYPE C,<10'	EA	11.000		11.000
		0425- 1-541	INLETS, DT BOT, TYPE D, <10'	EA	2.000		2.000
		0425- 1-549	INLETS, DT BOT, TYPE D, MODIFY	EA	2.000		2.000
	△2	0425- 1-559	INLETS, DT BOT, TYPE E, MODIFY	EA	1.000 △2		1.000 △2
		0425- 1-701	INLETS, GUTTER, TYPE S, <10'	EA	3.000		3.000
		0425- 1-703	INLETS, GUTTER, TYPE S, J BOTTOM <10'	EA	17.000		17.000
T		0425- 1-905	INLETS, SPECIAL, PARTIAL	EA	3.000		3.000
		0425- 2- 41	MANHOLES, P-7, <10'	EA	5.000		5.000
		0425- 2- 42	MANHOLES, P-7, >10'	EA	3.000		3.000
		0425- 2- 71	MANHOLES, J-7, <10'	EA	7.000		7.000
		0425- 2- 72	MANHOLES, J-7, >10'	EA	3.000		3.000

REVISIONS

DATE	DESCRIPTION	DATE	DESCRIPTION
3/14/07	△2 REVISED AND ADDED PAY ITEMS	7/14/07	△6 TRNS*PORT UPDATED
5/15/07	△4 DELETED PAY ITEM 104-5		
6/11/07	△5 ADDED PAY ITEMS		

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
25	POLK	197707-1-52-01

SUMMARY OF PAY ITEMS

SHEET NO. 2

$USER$ $DATE$ $TIME$ $FILE$

NOTICE: THE OFFICIAL RECORD OF THIS SHEET IS THE ELECTRONIC FILE SIGNED AND SEALED UNDER RULE 61G15-23.003, F.A.C.

Exhibit 20-D Status of Environmental Certification

STATUS OF ENVIRONMENTAL CERTIFICATION

Financial Project ID ________________________

Proposal/Contract ID ________________________

Federal Aid No. ________________________

Project Description _____________________________________

This project is a Categorical Exclusion under 23 C.F.R. 771.117:

_____ This project is a Type 1 Categorical Exclusion under (23 CFR 771.117(c)) effective November 27, 1987 as determined on _____________, and the determination remains valid.

_____ This project is a Programmatic Categorical Exclusion per FHWA, FTA, and FDOT Agency Operating Agreement executed on January 15, 2003 as determined on_____________________, and the determination remains valid.

The environmental document for this project was a (check one):

_____ A Type 2 Categorical Exclusion under 23 C.F.R. 771.117(d) approved on ______________________,

_____ A Finding of No Significant Impact under 23 C.F.R. 771.121 approved on ______________________, or

_____ A Final Environmental Impact Statement under 23 C.F.R. 771.125 approved on ___________________.

A reevaluation in accordance with 23 C.F.R. 771.129 was (check one):

_____ Approved on ___________________.

_____ Not required.

Signature: __________________________________ Date: _______________

Environmental Administrator

Exhibit 20-E Plans, Specifications and Computation Book

DATE: ___________

TO: ____________________________, District Construction Engineer

FROM: ____________________________, Project Manager

SUBJECT: **Plans, Specifications and Computation Book**

Letting (mo./yr.) ____________________

Financial Project ID _______________________________

Proposal/Contract ID _______________________________

Federal Aid Yes ____ No _____

County __________________________ State Road No. ________

Attached are a copy of the Contract Plans Set, a copy of the Specifications Package, the Original Computation Book and one copy of the Computation Book for use by Construction.

Exhibit 20-F Project Certification to Federal Standards

PROJECT CERTIFICATION TO FEDERAL STANDARDS IS NO LONGER REQUIRED*

* Refer to ***Section 24.5*** this volume.

Exhibit 20-G Preliminary Engineering Certification

MEMORANDUM

DATE: ________________

TO: ______________________, Federal Aid Programs Manager

FROM: ______________________, Design Project Manager

COPIES:

SUBJECT: **PRELIMINARY ENGINEERING CERTIFICATION** (Federal Aid Projects Only)
Financial Project ID ______________________
Proposal/Contract ID ______________________
Federal Aid No. ______________________

Preliminary Engineering (design) was funded with:
____ State Funds under,
Financial Project ID ______________________
____ Federal Funds authorized under,
Federal Aid No. ______________________
Financial Project ID ______________________

The following projects, designed with the same Preliminary Engineering funds, will be strung to (awarded with) the subject project:
Federal Aid No. _________________, Financial Project ID __________________,
Federal Aid No. _________________, Financial Project ID __________________.

The Preliminary Engineering for the subject project is _____ open/ _____ closed. If open,
____ it will be closed after PS&E authorization, or
____ it is a district wide project. Task order number _____ for this project is closed. The financial number will be open for other projects.
____ it will remain open for additional charges, as follows: ________________________
____.

The FDOT Project Manager may be contacted at (phone): ___________________

Exhibit 20-H Request for Control Group Change

DATE: _________________

TO: District Specifications Engineer

FROM: __________________________________, Project Manager

COPIES: District Estimates Engineer, Production Management, Construction

SUBJECT: **Request for Control Group Change**

Letting (mo./yr.) _________
Financial Project ID __________________________
Proposal/Contract ID __________________________
Federal Aid Project Yes _____ No _____
State Road No. _________
County __________________________

Enclosed is a copy of a complete plans set and a copy of the comp book for use by the District Estimates Office. This project has entered the Specifications Phase.

Exhibit 20-I Change Memo
Sheet 1 of 3

DATE: ___________ 1 of _____

TO: District Specifications Engineer

FROM: ________________________________, Project Manager

COPIES TO: District Estimates Engineer

SUBJECT: **Change Memo**

Letting (mo./yr.) _______________

Financial Project ID ____

Proposal/Contract ID ____

Federal Aid Project Yes _____ No _____

County ____________________________ State Road No. _________

Changes were made to the plans during the District Specifications Phase. Sheets included replace similar sheets in the Estimates Office's copy of plans. The changes listed below should be included in the specifications package as appropriate.

Sheets No(s). Description of Change

____________ ____

____________ ____

____________ ____

____________ ____

____________ ____

____________ ____

____________ ____

____________ ____

____________ ____

____________ ____

____________ ____

Exhibit 20-I Change Memo
Sheet 2 of 3
REMINDER

Changes are modifications to the plans during the Specifications Phase. Ensure that these are considered or incorporated into the Specifications and the Summary of Pay Items prior to mailing to the Plans Package to Tallahassee. Changes are not listed on the key sheet nor noted in the revision blocks of the plans sheets, unless done by other than the Engineer of Record.

1. Describe all changes in this Memo.
2. List all Summary of Pay Items changes to quantities, including additions and deletions.
3. Coordinate all changes with Specifications.

Exhibit 20-I Change Memo
Sheet 3 of 3

DATE: ____________ _____ of ____

Financial Project ID ______________________________

Proposal/Contract ID _____________________________

Sheet No(s).	Description of Change
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20.6 Retention of Electronic Documents

The documents and files created throughout the life of a project must be retained in electronic format. There are several different storage systems used for retaining these records. See ***Figure 20.3***.

Figure 20.3 Storage of Electronic Documents

TIMS	PEDDS DATABASE	**Electronic Data Management System (EDMS)** Legal Records for Department of State Requirements - **Image files (TIF) only**. For Information on Specific Document Types stored in each Group contact the Responsible Office			
		DESIGN EDMS	**CONTRACTS EDMS**	**CONSTRUCTION EDMS**	**STRUCTURES MANAGEMENT EDMS**
File management system for In-house CADD file check in/out. Allows for multiple users to work on same files. Working files only. Can be used during Construction Phase to prepare As-Built Plans.	Electronic Vault for Storage of electronically signed files For Storage of: -Project CD -Plans and Specs CD -Revisions CD -Cat II Bridge As-Built files Files stored in the PEDDS Database cannot be overwritten.	Design Records Groups Architectural Community Involvement Drainage Environmental Permits Estimates FDOT Publications Geotechnical/Materials Landscaping Lighting Product Evaluation Project Management Rdwy Design Documentation **Does not include Plans** Roadway Resource Library Specifications Structures Structures Resource Library Tolls Facilities Traffic Design Utility Agreements **NOTE: Contract Plans are not stored in the Design EDMS**	Contracts Records. Groups Construction Contracts: - Amendments - Bid Blank - Certificate Of Insurance - Contract - Federal Aid Contract Provisions - Permits - Pertinent Pages - Proposal - Special Provisions - Specifications - Supplemental Specifications - Utility Work Schedule - Wage Rate Supporting Construction Contract Documents: - Award Letter - Correspondence - Daily Diaries - Execution Letter - Final Estimates Package Work Progress **NOTE: Contract Plans are not stored in the Contracts EDMS.**	Construction Records Groups Claim Compliance Contract Changes Includes Design Errors and Omissions, Field SA/Work Orders and SA/Change Orders Contract Documents **Does not include Plans** Daily Diary Estimates Final Estimates General Correspondence Job Correspondence Material Sampling and Reporting Pre-Letting Includes Design Correspondence Quality Assurance/Quality Control Service Contracts Shop Drawing Transmittals Structure Sublet Work Time Correspondence Unpaid Bills Utility **NOTE: As-Built Plans are not stored in Construction EDMS, but are stored separately in the Construction Final Plans Management System.**	Maintenance Records Groups Bridge Plans and Specifications Bridge Record Bridge Shop Drawings Correspondence Geotechnical High Mast Record Sign Record Structural Calculations - As-Bid Plans - As-Built Plans - Repair As-Bid Plans - Repair As-Built Plans - Widening As-Bid Plans - Widening As-Built Plans

where right of way is restricted do not have roadsides of sufficient widths to provide clear zones; therefore, while there are specific horizontal clearance requirements for these highways, they are based on clearances for normal operation and not based on maintaining a clear roadside for errant vehicles. It should be noted that curb has no redirectional capabilities except at speeds less than the lowest design speeds used on the State Highway System. Therefore curb should not be considered effective in shielding a hazard. Curb is not to be used to reduce horizontal clearance requirements.

Crashworthy objects shall meet or exceed the offsets listed in ***Tables 21.2*** through ***Table 21.5*** and objects that are not crashworthy are to be as close to the right of way as practical and no closer than the requirements listed in ***Tables 21.2*** through ***Table 21.5.***

Table 21.2 Horizontal Clearance to Utility Installations

ABOVE GROUND FIXED OBJECTS **(Such as Poles)**	Shall not be located within the limited access right of way, except as allowed by Department ***Policy No. 000-625-025, Telecommunications Facilities on Limited Access Rights of Way***. Shall not be located in the median. Rural and Urban Flush Shoulders: Not within the clear zone. Install as close as practical to the right of way without aerial encroachments onto private property. Urban Curb or Curb and Gutter: At the R/W line or as close to the R/W line as practical. Must maintain 1.5 ft. clear from face of curb. Placement within sidewalks shall be such that an unobstructed sidewalk width of 4 ft. or more (not including the width of the curb) is provided. See the ***Utility Accommodation Manual, (Topic No. 710-020-001***) for additional information. Note: may be located behind barriers that are justified for other reasons.
BREAKAWAY OBJECTS **(Such as Fire Hydrants)**	Rural and Urban Flush Shoulders: Locate as close to the right of way as practical. Urban Curb or Curb and Gutter: Locate no less than 1.5 feet from face of curb.

Table 21.3 Horizontal Clearance to Trees

Minimum horizontal clearance for new plantings where the diameter is or is expected to be greater than 4 inches measured 6 inches above the ground shall be:

Rural and Urban Flush Shoulders:
Outside the clear zone.

Urban Curb or Curb and Gutter:
4 ft. from face of outside curb and 6 ft. from edge of inside traffic lane. In areas where the border width or median width are constrained and this criteria cannot be met, this horizontal clearance may be reduced to 1.5 ft. from the face of outside curb and 3 ft. from the edge of the inside traffic lane.

On existing roadways, the minimum horizontal clearance to existing trees where the diameter is or is expected to be greater than 4 inches measured 6 inches above the ground shall be:

Rural and Urban Flush Shoulders:
Outside the clear zone.

Urban Curb or Curb and Gutter:
1.5 ft. from the face of outside curb and 3 ft. from the edge of the inside traffic lane.

21.5.10 Landscaping

Landscaping on a TDLC project can be provided when a local agency or organization agrees to assume the maintenance of the landscaped area in accordance with all Department requirements. See ***Chapter 9*** of this volume and the ***Florida Highway Landscape Guide*** for landscape requirements.

Landscaping shall not interfere with the visibility of "permitted" outdoor advertising in accordance with ***Rule 14-40*** of the ***Florida Administrative Code***. Landscaping shall provide required sight distances in accordance with the ***Design Standards, Index 546***. Landscaping shall also comply with the horizontal clearance requirements found in ***Section 21.5.6*** of this chapter, and ***Chapters 2***, ***4***, and ***25*** of this volume.

Community Structures placed in the right of way to represent the community are discussed in ***Section 9.4*** of this volume.

21.5.11 Parking

On-street parallel parking is preferred over angled parking on low speed urban streets. Angled parking causes conflicts with cars and bicycles, since drivers have poor visibility when backing out. Parallel parking can provide space for bike lanes, medians and wider sidewalks. The design of parking facilities should be coordinated with local transit agencies. For parking lane widths see ***Table 21.1***.

21.5.12 Alternative Roadway Paving Treatments

Alternative paving treatments such as patterned/textured pavement may be used to accent the roadway in accordance with the ***Standard Specifications***. Architectural pavers, however, shall not be used on the traveled way of the State Highway System. See ***Section 2.1.6.1*** for additional requirements.

21.5.13 Conversion to One-Way Pairs

Converting to one-way pairs is the conversion of 2 two-way corridors to 2 one-way corridors operating in opposite directions. This technique requires a great deal of consideration, planning and public involvement.

Advantages to one-way pairs are increased safety for pedestrians and motorists, increased traffic capacity, retention of on-street parking, and easier signal progression along the corridor. One-way pairs may allow enough space to create bus lanes, more bus stops and improve the safe boarding for transit riders.

Disadvantages to one-way pairs are, motorists are likely to drive faster, transit circulation is less direct, and signal progression for cross streets is difficult to achieve.

Chapter 23

Exceptions and Variations

Tables

Exhibits

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Chapter 23

Exceptions and Variations

23.1 General

The Department's roadway design criteria and standards are contained in this volume and are usually within the desirable ranges established by AASHTO. The values given in this volume have been accepted by FHWA and govern the design process. When it becomes necessary to deviate from the Department's criteria, early documentation and approval are required. There are three approval processes: Design Exceptions, Utility Exceptions and Design Variations. When the Department's criteria are met, no Design Exception, Utility Exception or Design Variation is required. However, when the Department's criteria are not met, a Design Exception, Utility Exception or Design Variation is required. This requirement applies to all entities affecting planning, design, construction, maintenance and utilities.

For projects using safety funds and developed to improve specific safety problems, only the elements identified under the scope of work for the safety improvement project are subject to these approval processes. The existing features, within the limits of the safety improvement project that do not meet design criteria do not require approval to remain.

23.2 Identification

To allow time to research alternatives and begin the analysis and documentation activities, it is important proper approval process be identified as early in the Planning and Design as possible. This is preferably done during the PD&E process for major projects and the scope development process for minor projects. It is required that approval be obtained no later than the initial engineering phase.

Design Exceptions are required when the proposed design elements (other than utility elements) are below both the Department's governing criteria and AASHTO's new construction criteria for the 13 Controlling Design Elements.

The 13 Controlling Design Elements are:

1. Design Speed
2. Lane Widths
3. Shoulder Widths
4. Bridge Widths
5. Structural Capacity
6. Vertical Clearance
7. Grades
8. Cross Slope
9. Superelevation
10. Horizontal Alignment
11. Vertical Alignment
12. Stopping Sight Distance
13. Horizontal Clearance

Section 23.9 provides AASHTO's minimum requirements for the above elements.

Utility Exception requirements are found in ***Chapter 13 of the Utility Accommodation Manual (UAM)***.

Design Variations are required when proposed design elements are below the Department's criteria and where a Design Exceptions or Utility Exception is not required.

23.3 Approval

All required approvals shall be obtained as described in this section. Approvals from multiple individuals may be required for certain issues. The Director of Design shall resolve any approval authority issues if conflicting objectives arise.

Approval is required from the State Chief Engineer for the following:

- Design Exceptions for Design Speed on FIHS/SIS facilities (following review by the State Transportation Planner).
- Utility Exceptions for limited access R/W use.
- Design Variations for Design Speed on FIHS/SIS facilities (following review by the State Transportation Planner).

Approval is required from the FHWA Division Administrator for the following:

- Design Exceptions on full FHWA oversight projects.
- Design Exceptions, Utility Exceptions and Design Variations for vertical clearance over an interstate roadway less than 16 feet.
- Exceptions involving horizontal or vertical clearances for railroads not meeting the requirements of ***Rule 14-57 F.A.C.*** or the clearance criteria for the South Florida Rail Corridor (***Topic No. 000-725-003 - South Florida Rail Corridor Clearance Policy for 25 KV service***).

Approval is required from the District Design Engineer or Turnpike Design Engineer for the following:

- Design Exceptions.
- Utility Exceptions.
- Design Variations.

Approval is required from the State Roadway Design Engineer for the following:

- Design Exceptions for elements other than Structural Capacity.
- Utility Exceptions <u>(Except for the specific case where the Utility sufficiently satisfies the District that their facilities are located as close to the R/W as practical.)</u>
- Design Variations involving modifications to or elimination of required rumble strips.

Approval is required from the State Structures Design Engineer for the following:

- Design Exceptions for Bridge Width, Structural Capacity, Horizontal Clearance and Vertical Clearance impacting Category 1 and 2 structures.
- Utility Exceptions impacting Category 2 structures, or impacting Category 1 structures with controlling elements below AASHTO's criteria.
- Design Variations for Bridge Width, Structural Capacity, Horizontal Clearance and Vertical Clearance impacting Category 2 structures.
- Design Variations for Structural Capacity due to deficient load ratings impacting both Category 1 and 2 structures

Approval is required from the District or Turnpike Structures Design Engineer for the following:

- Utility Exceptions impacting Category 1 structures, with none of the 13 Controlling Design Elements below AASHTO's Criteria.
- Design Variations for Bridge Width, Structural Capacity, Horizontal Clearance and Vertical Clearance impacting Category 1 Structures.

23.4 Justification for Central Office Approval

Sufficient detail and explanation must be given in order to build a strong case to those reviewing the request. The 13 Controlling Design Elements are considered safety related and the strongest case must be made to lower these requirements. At some point, this justification may be used to defend the Department's and/or the designer's design decisions. All deviations must be uniquely identified, located, and justified; no blanket approvals are given.

A strong case can be made if it can be shown that:

- The required criteria are not applicable to the site specific conditions.
- The project can be as safe by not following the criteria.
- The environmental or community needs prohibit meeting criteria.

Most often a case is made by showing the required criteria are impractical and the proposed design wisely balances all design impacts. The impacts usually compared are:

- Operational Impacts.
- Impacts on Adjacent Section.
- Level of Service.
- Safety Impacts.
- Long term effects.
- Costs.
- Cumulative Effects.

A case should not be made based solely on the basis that:

- The Department can save money.
- The Department can save time.
- The proposed design is similar to other designs.

23.5 Documentation for Central Office Approval

During the justification process supporting documentation will be generated which needs to accompany each submittal. This documentation includes, but is not limited to the following:

Utility Exception documentation requirements are found in ***Chapter 13 of the Utility Accommodation Manual (UAM)***.

All Design Variations needing Central Office approvals and all Design Exceptions should include the following documentation:

a) ***Exhibit 23-A*** Submittal/Approval Letter Included (Cover Letter)

b) Summary description of included support documentation such as:
    1) Location map or description,
    2) Typical section,
    3) Aerial or Photo logs when they best illustrate the element issues,
    4) Crash History and analysis,
    5) Plan sheets in the area of the exception/variation elements,
    6) Profiles in the area of vertical alignment exception/variation elements,
    7) Tabulation of pole offsets for horizontal clearance exception/variation, and
    8) Any Applicable Signed and Sealed Engineering Support Documents.

c) Project description (general project information, typical section, begin/end milepost, county section number). Include Work Mix, To – From, Objectives, Obstacles and Schedule.

d) Description of the exception/variation element and applicable criteria (AASHTO and Department value or standard). Detailed explanation of why the criteria or standard can not be complied with or is not applicable. Description of any proposed value for project and why it is appropriate.

e) Amount and character of traffic using the facility. Description of the anticipated impact on Operations, Adjacent Sections, Level Of Service, Safety, Long and Short Term Effects. (Is the Exception temporary or permanent?) Description of the anticipated Cumulative Effects.

f) A plan view or aerial photo of the exception location, showing right of way lines, and property lines of adjacent property.

g) A photo of the area.

h) Typical section or cross-section of exception location.

i) The milepost and station location of the exception.

j) Any related work programmed or in future work plans.

k) The Project Schedule Management (PSM) Project Schedule Activities maintained by the Finance Management Office.

l) All mitigating efforts. An explanation of what if any associated existing or future limitations as a result of public or legal commitments. Description and explanation of any practical alternatives, the selected treatment and why.

m) Comments on the most recent 5-year crash history including all pertinent crash reports.

n) Description of the anticipated Cost (Social and to the Department - Benefit/Cost)

o) Summary Conclusions

For the specified conditions the following additional documentation is required:

p) For design speed on FIHS/SIS, provide typical sections at mid blocks and at intersections.

q) For lane width, provide locations of alternative routes that meet criteria and a proposal for handling drainage, the proposed signing and pavement markings.

r) For shoulder width, provide a proposal for handling stalled vehicles and a proposal for handling drainage.

s) For bridge width, provide a plan view of the approaching roadways and existing bridge plans (these may be submitted electronically).

t) For a bridge with a design inventory load rating less than 1.0, a written evaluation and recommendation by the Office of Maintenance is required. Provide the load rating calculations for the affected structure.

u) For vertical clearance, provide locations of alternative routes that meet criteria.

v) For cross-slope, provide a proposal for handling drainage and details on how the cross slope impacts intersections.

w) For conditions that may adversely affect the roadway's capacity, provide the comments on compatibility of the design and operation with the adjacent sections. Effects on capacity (proposed criteria vs. AASHTO) using an acceptable capacity analysis procedure and calculate reduction for design year, level of service).

x) For superelevation, provide the side friction factors for the curve for each lane of different cross-slope at the PC of the curve, the point of maximum cross-slope, and the PT of the curve using the following equation.

$$f = \frac{V^2 - 15Re}{V^2e + 15R}$$

where
f = Side Friction Factor
V = Design Speed (mph)
R = Radius (feet)
e = Superelevation (ft/ft) at the station evaluated

y) For areas with crash histories or when a benefit to cost analysis is requested, provide a time value analysis between the benefit to society quantified in dollars and the costs to society quantified in dollars over the life of the exception.

In general practice the benefit to society is quantified by the reduction in crash cost foreseeable because of the proposed design and the cost due to the implementation of that change such as construction and maintenance costs over the life of the project. This analysis may be performed by using either the Roadside Safety Analysis Program (RSAP), available through AASHTO's publications, or the Historical Crash Method (HCM) depending on their applicability. The RSAP is applicable to crashes into roadside objects and the HCM is applicable to sites with a crash history. Use a 5% time value of money for both the RSAP and HCM methods.

The Historical Crash Method (HCM) uses the following ***Highway Safety Improvement Program Guideline (HSIPG)*** cost per crash by facility type to estimate benefit to society while the cost to society is estimated by the cost of right of way, construction, and maintenance.

HSIPG COST/CRASH BY FACILITY TYPE				
FACILITY TYPE	DIVIDED		UNDIVIDED	
	URBAN	RURAL	URBAN	RURAL
<3 Lanes	$68,800	$152,200	$78,000	$218,900
3 Lanes	$47,100	$152,200	$52,000	$218,900
4 Lanes	$74,500	$181,200	$53,500	$76,400
5 Lanes	$52,400	$181,200	$53,500	$76,400
6 Lanes	$63,300	$181,200	$53,500	$76,400
Interstate	$83,600	$195,700	$83,600	$195,700
Turnpike	$99,700	$228,800	$99,700	$228,800

All State Roads Average Cost/Crash: $83,070
*The above values were derived from 1994, 1995, and 1996 traffic crash and injury severity data for crashes on state roads in Florida, using the formulation described in ***FHWA Technical Advisory "Motor Vehicle Accident Costs", T 7570.1, dated June 30, 1988*** and updated injury costs provided in the companion ***FHWA Technical Advisory, T 7570.2, dated October 31, 1994***.

23.6 Central Office Submittal and Approval

Submittals, when complete, shall contain 3 parts, and shall be compiled in the same order as addressed below.

1. Part 1 shall consist of a cover letter. The cover letter shall be either the ***Plans Preparation Manual Volume 1***, ***Exhibit 23-A Submittal/Approval Letter*** for Design Exceptions or the ***Utility Accommodation Manual Exhibit A Utility Exception Form***. If both types of Exceptions are contained in a single submittal, both forms must be completed and submitted in the same package. They shall not be combined on a single form.
2. Part 2 shall consist of the justification or report proper including all signed and sealed documents. Part 2 may contain or require more than one separately signed and sealed report. An example is a single submittal that includes a structural analysis and a roadway geometry analysis. There may also be documents or discussions that are not within the bounds of individually signed and sealed analysis.
3. Part 3 shall consist of any support documents to facilitate an understanding of Part 2. Note that Part 3 may include any supplementary documentation developed or added by the Central Office after the District submittal. This shall be considered a part of the submittal justification package and is provided only to assist the District in getting a favorable and timely review and approval. Any supplemental documents provided by the Central Office will be appended and shall not alter the Engineer of Record’s analysis or design.

The report justifying and documenting a request is to be sealed by the Responsible Engineer in accordance with ***Chapter 19*** of this volume. The Responsible Engineer then attaches a Submittal/Approval Letter (***Exhibit 23–A***) to the Sealed Report and submits them to the District or Turnpike Design Engineer. The District or Turnpike Design Engineer then approves or denies the request and notifies the Responsible Engineer. When further approvals are required the District or Turnpike Design Engineer will forward the Submittal/Approval Letter and Sealed Report to the State Roadway Design Office.

The State Roadway Design Office will assign reference numbers to each request. The request will be reviewed then forwarded for approval to the Chief Engineer, the State Roadway Design Engineer, the State Structures Design Engineer, the Planning Office and/or FHWA as appropriate.

Each request will be reviewed on a case by case basis and approved on its merits. When approval is obtained the Roadway Design Office will e-mail the District or Turnpike Design Engineer the Central Office's disposition and return the signed Submittal/Approval Letter and Sealed Report. The Roadway Design Office will keep a copy filed under the assigned reference number. Additional copies will be provided upon request.

23.7 Central Office Denial and Resubmittal

When a request is denied, the State Roadway Design Office will notify the District or Turnpike Design Engineer of the Central Office's disposition.

Denied requests can be resubmitted when all deficiencies, noted in the denial notification, have been addressed. This may require only a new Submittal/Approval Letter if the Sealed Report does not need to be amended. However, if the Sealed Report requires revision, a new Sealed Report and attached Submittal/Approval Letter must be submitted.

The State Roadway Design Office will assign the resubmittal a tracking reference number. The resubmittal will be reviewed for completeness and forwarded for approval to the Chief Engineer, the State Roadway Design Engineer, the Structures Design Engineer, the Planning Office and/or FHWA as appropriate.

23.8 Design Variations Needing District Approval Only

For Design Variations needing District approval only, the following is the minimum justification and documentation required. However, on a case by case basis the District approvers may require more or may opt for the Design Variation to follow ***Sections 23.4-7***:

A Design Variation request must address the following items:

1. Design criteria versus proposed criteria.
2. Reason the design criteria are not appropriate.
3. Justification for the proposed criteria.
4. Any background information which documents or justifies the request.

The Responsible Engineer then attaches a Submittal Approval Letter (***Exhibit 23-A***) to the sealed report and submits them to the District or Turnpike Design Engineer. The District or Turnpike Design Engineer then approves or denies the request and notifies the Responsible Engineer.

Design Variations requiring Central Office approval from the State Chief Engineer, State Roadway Design Engineer, and/or the State Structures Design Engineer (see ***Section 23.3***) follow the processes in ***Sections 23.4-7***.

23.9 AASHTO Criteria for Controlling Design Elements

As an aid to the designer, the following tables may be used as a reference for determining when a Design Exception is required based on AASHTO criteria, but are in no way intended to replace Department design criteria. The page numbers referenced are to AASHTO's ***A Policy on Geometric Design of Highways and Streets 2004*** (unless otherwise noted) and are a starting point for researching project criteria.

Criteria Tables Cross Reference

Table 23.9.1 AASHTO Design Speed (Minimum)

Type Facility	Other Factors	Design Speed (mph)	AASHTO
Freeways	Urban Rural	50 70	pg. 503
Urban Arterials	Major Other	30 30	pg. 72
Rural Arterials	Rolling terrain Level terrain	50 60	pg. 444
Urban Collectors		30	pg. 430
Rural Collectors	Level ADT < 400 ADT 400 - 2000 ADT > 2000 Rolling ADT < 400 ADT 400 - 2000 ADT > 2000	40 50 60 30 40 50	pg. 422, Exh. 6-2
CBD	Major or Minor	30	pg. 430
Ramps	Highway Design Speeds (mph) 30 35 40 45 50 55 60 65 70	 15 18 20 23 25 28 30 30 35	pg. 826
Loop Ramps	150 ft. radius	25	pg. 825
Connections	Direct Semi-Direct	40 30	pg. 825

Table 23.9.2 AASHTO Lane Widths (Minimum)

Type Facility	Lane Width (feet)	AASHTO
Freeways	12	pg. 504
Rural Arterials	11	pg. 448, Exh. 7-3
Urban Arterials	10	pg. 472
Urban Collectors	10	pg. 433
Rural Collectors	10	pg. 425, Exh. 6-5
Low Speed	10	pg. 312
Residential	9	pg. 312
Auxiliary	10	pp. 312, 433
Continuous TWLTL	10	pg. 312

Table 23.9.3 AASHTO Shoulder Widths (Minimum)

Type Facility	Other Factors	Right (feet)	Median (feet)	AASHTO
Freeways	4 lanes	10	4	pg. 505
	≥ 6 lanes	10	10	pg. 505
Rural Arterial	ADT > 2000	8		pg. 448, Exh. 7-3
	ADT 400-2000	6		
	ADT < 400	4		
	Divided highway 4 lanes	8	4 paved	pg. 455
	Divided highway 6 lanes	8	8	pg. 456
Urban Arterial	Low Type	2		pg. 314
	High Type	10		pg. 314
Heavily Traveled	High Speed (≥ 50 mph)	10		pg. 314
Rural & Urban Collectors	ADT > 2000	8		pg. 425, Exh. 6-5
	ADT 1500-2000	6		
	ADT 400-1500	5		
	ADT < 400	2		

Table 23.9.4 AASHTO Bridge Widths (Minimum)

Type Facility	Other Factors	Bridge Widths	AASHTO
Freeways	New Bridges	Approach Roadway Width	pg. 506
Rural Arterials	New Bridges (Short)	Approach Roadway Width	pg. 447
	New Long Bridges (> 200 ft.)	Travel Lanes + 4 ft. each side	pg. 447
	Remain in Place	Travel Lanes + 2 ft. each side	pg. 447
Urban Arterials	Long (> 200 ft.), where shoulders or parking lanes are provided on the arterial	Travel Lanes + 4 ft. each side	pg. 481
	All new bridges	Curb to curb width of street	pg. 481

		Bridge Widths		
Type Facility	Other Factors	New or Reconstruction	To Remain	AASHTO
Rural and Urban Collectors	Under 400 ADT	Traveled Way + 2 ft. each side (1)	22 ft. (2)	pp. 426, 427
	ADT 400-1500	Traveled Way + 3 ft. each side (1)	22 ft. (2)	pp. 426, 427
	ADT 1500-2000	Traveled Way + 4 ft. each side(1),(3)	24 ft. (2)	pp. 426, 427
	ADT > 2000	Approach Roadway Width (1),(3)	28 ft. (2)	pp. 426, 427

1. If the approach roadway has paved shoulders, then the surfaced width shall be carried across the bridge.
2. Bridges longer than 100 ft. are to be analyzed individually.
3. For bridges > 100 ft. in length, the minimum bridge width of traveled way plus 3 ft. on each side is acceptable.

Table 23.9.5 AASHTO Structural Capacity (Minimum Loadings)

Type Facility	Other Factors	Loading	AASHTO
Freeways	---	HS-20	pg. 506
Rural Arterials	---	HS-20	pg. 447
Urban Arterials	---	HS-20	pg. 447
Local Roads	New & Reconstruction Bridges	HS-20	pg. 386, Exh. 5-6
	Existing Bridges	H 15	pg. 386, Exh. 5-7
Collectors	New & Reconstruction Bridges	HS-20	pg. 426, Exh. 6-6
	Existing Bridges	H 15	pg. 427, Exh. 6-7

Table 23.9.6 AASHTO Vertical Clearance (Minimum)

Type Facility	Vertical Clearance (feet)	AASHTO
Freeways	16 (1),(2)	pp. 506, 507, 763, 764
Arterials: Rural Urban	16 (1),(2) 16 (1),(2)	pp. 447, 763, 764 472, 763, 764
Other Highways	14 (2)	pp. 385, 507
Sign Trusses	17 (2)	pg. 507
Pedestrian Overpass	17 (2)	pg. 507
Tunnels: Freeways Other Highways	16 (2) 14 (2)	pg. 355 pg. 355
Railroads	23 (2)	pg. 522

1. 14 feet allowed in highly developed urban areas if alternate route has 16 feet.
2. Minimum value that can be used without a Design Exception. An allowance of 6 inches should be added to vertical clearance to accommodate future resurfacing.

Table 23.9.7 AASHTO Grades (Minimum and Maximum)

Maximum Grades

Type Facility	Type Terrain	Grades (%) For Design Speed (mph)									AASHTO
		30	35	40	45	50	55	60	65	70	
Freeway [1]	Level Rolling	--- ---	--- ---	--- ---	--- ---	4 5	4 5	3 4	3 4	3 4	pg. 506, Exh. 8-1
Rural Arterial	Level Rolling	--- ---	--- ---	5 6	5 6	4 5	4 5	3 4	3 4	3 4	pg. 446, Exh. 7-2
Urban Arterial:	Level Rolling	8 9	7 8	7 8	6 7	6 7	5 6	5 6	--- ---	--- ---	pg. 472, Exh. 7-10
Rural Collector[2]	Level Rolling	7 9	7 9	7 8	7 8	6 7	6 7	5 6	--- ---	--- ---	pg. 423, Exh. 6-4
Urban Collector[2]	Level Rolling	9 11	9 10	9 10	8 9	7 8	7 8	6 7	--- ---	--- ---	pg. 432, Exh. 6-8

1. Grades one percent steeper than the values shown may be used for extreme cases in urban areas where development precludes the use of flatter grades and for one-way downgrades.
2. Short lengths of grade in rural and urban areas, such as grades less than 500 ft. in length, one-way downgrades, and grades on low-volume rural and urban collectors may be up to 2 percent steeper than the grades shown above.

Minimum Grades for Urban Curb & Gutter

Type Facility	Minimum %	AASHTO
Arterials	as required for adequate drainage	pg. 471
Collector Roads & Streets	0.30	pg. 431
Local Roads & Streets	0.20	pg. 391

Table 23.9.8 AASHTO Cross Slope (Minimum and Maximum)

Type Facility	Other Factors	Minimum	Maximum	AASHTO
Freeways	---	0.015	0.025 [1]	pg. 504
Arterials	Rural Urban	0.015 0.015	0.02 [1] 0.03	pg. 446 pg. 472
Divided Highways	---	0.015	0.02 [1]	pg. 455
Collectors	Rural Urban	0.015 0.015	0.02 [1] 0.03	pg. 421 pg. 431
Shoulders	Paved Gravel Turf	0.02 0.04 0.06[2]	0.06 0.06 0.08[2]	pg. 316 pg. 316 pg. 316

1. Values given are for up to two lanes in one direction. Additional outside lanes may have cross slopes of 0.03.
2. Shoulder cross slopes which meet FDOT criteria do not require a Design Exception.

Table 23.9.9 AASHTO Superelevation (Maximum)

Type Facility	Superelevation Rate	AASHTO
Highways (Rural)	0.12	pg. 144
Urban	0.06	pg. 145
Low Speed Urban w/severe constraints	None	pg. 145
Ramps and Turning Roadways at Intersections	0.10	pg. 639

Table 23.9.10 AASHTO Horizontal Alignment

Minimum Radius (feet) with Superelevation (page 147, Exh. 3-15)

Type Facility	Super-elevation e-max	Minimum Curve Radius (feet) for Design Speed (mph)											
		15	20	25	30	35	40	45	50	55	60	65	70
Rural Highways and High Speed Urban Streets	0.04	42	86	154	250	371	533	711	926	1190	1500	---	---
	0.06	39	81	144	231	340	485	643	833	1060	1330	1660	2040
	0.08	38	76	134	214	314	444	587	758	960	1200	1480	1810
	0.10	36	72	126	200	292	410	540	694	877	1090	1340	1630
	0.12	34	68	119	188	272	381	500	641	807	1000	1220	1480

Minimum Radius (feet) for Section with Normal Cross Slope (***2001 AASHTO***, page 168, Exh. 3-26)

Type Facility	Minimum Curve Radius (feet) for Design Speed (mph)											
	15	20	25	30	35	40	45	50	55	60	65	70
All	960	1700	2460	3350	4390	5570	6880	8350	9960	11720	13180	14730

Minimum Radius (feet) for Intersection Curves (***2001 AASHTO***, page 201, Exh. 3-43)

Design Speed (MPH)	10	15	20	25	30	35	40	45
Minimum Radius (feet)	25	50	90	150	230	310	430	540
Assumed Minimum Superelevation Rate	0.02	0.02	0.02	0.04	0.06	0.08	0.09	0.10

Minimum Passing Sight Distance (feet) (page 124, Exh. 3-7)

Design Speed (mph)	20	25	30	35	40	45	50	55	60	65	70
Passing Sight Distance	710	900	1090	1280	1470	1625	1835	1985	2135	2285	2480

Table 23.9.11 AASHTO Vertical Alignment

(Taken from page 272 Exh. 3-72, page 277 Exh. 3-75, and page 422 Exh. 6-2)

Design Speed (mph)	K Value [1] for Vertical Curves Rounded for Design Crest	Sag
15	3	10
20	7	17
25	12	26
30	19	37
35	29	49
40	44	64
45	61	79
50	84	96
55	114	115
60	151	136
65	193	157
70	247	181

1. Rate of vertical curvature, K, is the length of curve per percent algebraic difference in the intersecting grades.

Table 23.9.12 AASHTO Stopping Sight Distance

(Taken from page 112, Exh. 3-1)

Design Speed (mph)	Stopping Sight Distance (feet) Computed for Design
15	80
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730

Table 23.9.13 AASHTO Horizontal Clearance (Minimum)

Feature	Clearance	AASHTO
Bridges	See ***Table 23.4.4***	---
Tunnels	2.5 ft. from edge of traffic lane	pg. 354, Exh. 4-17
Underpasses	2-lane: Normal shoulder width (to edge of barrier) (1) Divided Roadway: Normal shoulder (outside or median) width (to edge of barrier) (1)	pg. 762, Exh. 10-6
Barrier Wall & Guardrail	Normal shoulder width	pg. 762, Exh. 10-6
Light Poles (2)	Rural: Outside clear zone (if non-breakaway) Urban: 1.5 ft. from face of curb	pg. 291 pg. 319
Trees greater than 4 inches in diameter measured 6 inches above the ground	Rural Arterials: Outside clear zone Collectors ≤ 45 mph: 10 ft. from traveled way Collectors > 45 mph: Outside clear zone Urban: 1.5 ft. from face of curb Freeways (Rural and Urban): Outside clear zone	pg. 399, 481 pg. 427 pg. 427 pg. 399, 437, 481 pg. 507
Sign supports	Outside clear zone (if non-breakaway)	pg. 294
Utility Poles (2)	Rural: Outside clear zone Urban: 1.5 ft. from face of curb	pg. 294 pp. 293, 319
Building Line	15 feet from elevated roadway (wall)	pg. 522
Signal Pole and Controller Cabinets	Rural: As far from the roadway as practicable Urban: 1.5 ft. from face of curb	pg. 4-13 (3) pg. 319

1. For metal guardrail, add deflection distance.
2. Exceptions for utility poles are to be in accordance with the current ***Utility Accommodation Manual*** exceptions procedure for horizontal clearance for utility poles.
3. ***2002 AASHTO Roadside Design Guide***.

Exhibit 23-A Submittal/Approval Letter

To: ______________________________ Date: ______________________
District or Turnpike Design Engineer

Financial Project ID: ______________ New Const. ( ) RRR ( )
Federal Aid Number:______________
Project Name: ____
State Road Number: ______________ Co./Sec./Sub. ______________
Begin Project MP: ______________ End Project MP: ______________
Full Federal Oversight: Yes ( ) No ( )
Request for Design Exception ( ), Design Variation ( )
(For Design Exception or Variations Requiring Central Office Approval)
Re-submittal: Yes ( ) No ( ) Original Ref# ________ - ____ - _____

Requested for the following element(s):

( ) Design Speed	( ) Lane Widths	( ) Shoulder Widths	( ) Bridge Widths
( ) Structural Capacity	( ) Vertical Clearance	( ) Grades	( ) Cross Slope
( ) Superelevation	( ) Horizontal Alignment	( ) Vertical Alignment	( ) Stopping Sight Distance
( ) Horizontal Clearance	( ) Other ____________		

1. **Include a brief statement here concerning the project and the exception or variation requested.**
2. **Attach the Sealed Report including applicable documentation as per *Section 23.5*.**

Recommended by:

________________________Date ____________
Responsible Professional Engineer

Approvals:

________________________Date ____________
District or Turnpike Design Engineer

________________________Date ____________
State Roadway Design Engineer

________________________Date ____________
State Chief Engineer

________________________Date ____________
District Structures Design Engineer

________________________Date ____________
State Structures Design Engineer

________________________Date ____________
FHWA Division Administrator

24.5 Certification Statement

A Federal Aid project certification statement by the District Director of Transportation Development (Production)for each project is no longer required. However, Districts are responsible for insuring that all Federal Aid requirements are met as described in this chapter.

Exhibit 24-A Approval and Concurrence Process

TYPICAL SECTION PACKAGE Approved: 6 Concurrence: 3 or 4 (***PPM Vol. I, Section 16.2.3***)	**PAVEMENT DESIGN PACKAGE** Approved: 6 Concurrence: 3 (***Pavement Design Manual***)
BRIDGE DEVELOPMENT REPORT Approved: 6 Concurrence: 3 4 5 or 7 (***PPM Vol. I, Chap. 26***)	**APPROVAL OF PHASE REVIEW PLANS (Roadway and Structures)** Approved: 6 Concurrence: 3 4 5 7 or District Roadway Design Engineer (***PPM Vol. I, Chap. 16***)
ACCIDENT/SAFETY REVIEW Approved: District Safety Engineer	**SPECIAL PROVISIONS** Approved: 6 Concurrence: 9
DESIGN CRITERIA DESIGN EXCEPTIONS Requested: 3 or 6 Concurrence: 8, and 7 when needed. Approved: FHWA or 11 (***PPM Vol. I, Chap. 23***)	**BRIDGE HYDRAULICS REPORT** Approved: 6 Concurrence: District Drainage Engineer (***Drainage Manual, Chap. 4***)
PLANS, SPECIFICATIONS AND ESTIMATE PLANS PACKAGE Approved: 2 SPECIFICATIONS PACKAGE Approved: 9 FHWA AUTHORIZATION ESTIMATE Approved: 10 (***PPM Vol. I, Section 20.3***)	**REVISIONS TO PS&E** Approved: 6 Concurrence: 3 4 or 5 (***PPM Vol. I, Section 20.4***) **ASSEMBLY OF PS&E & CERTIFICATION OF OTHER REPORTS AS REQUIRED** Responsibility: FA Manager
1 District Secretary 2 District Director of Transportation Development (Production) 3 District Design Engineer 4 District Structures Design Engineer 5 District Project Management Engineer 6 Responsible Professional Engineer 7 State Structures Design Engineer 8 State Roadway Design Engineer 9 District Specifications Engineer 10 District Estimates Engineer 11 State Director of Design (for exempt projects)	**NOTE:** In special cases where programs or projects are developed in the Central Office, an appropriate Central Office Manager will provide concurrence in lieu of the District Manager.

25.3.4.2 Definition of Levels of Survey Effort

1. **LEVEL 1**

   Review by District Surveyor to check for Public Land Corners. Check sections for cross slope at 1000 feet in tangents. For curves, check 50 feet before PC, at PC, 50 and 100 feet after PC and at middle of curve or 300 foot intervals. (Reverse at PT). May use assumed datum if approved by the District Location Surveyor and the Project Manager/Designer. The cross sections will have a common bench mark elevation throughout the curve. In other words, do not assume an elevation at the centerline of the highway for each cross section. A minimum of two (2) bench marks should be set off of the highway near the Right of Way (R/W) Line and may be on assumed elevations or NAVD 88 datum. If the surveyor elects to use temporary assumed bench marks, they must last throughout the life of construction and **cannot** be set in trees, power poles or concrete monuments. Establish begin and end points of project and reference.

2. **LEVEL 2**

   Minor spot improvements such as turn lane at existing crossover, turn lane on 2-lane, etc. No additional Right of Way required. Where Right of Way is adequate, establish horizontal and vertical control in the improvement area. May use assumed vertical datum if approved by the District Location Surveyor and the Project Manager/Designer. The cross sections will have a common bench mark elevation throughout the curve. In other words, do not assume an elevation at the centerline of the highway for each cross section. A minimum of two (2) bench marks should be set off of the highway near the Right of Way Line and may be based on assumed elevations or NAVD 88 datum. If the surveyor elects to use temporary assumed bench marks, they must last throughout the life of construction and **cannot** be set in trees, power poles or concrete monuments. If Right of Way is constrained, re-establish existing R/W line. Level 1 required throughout other portions of project. Cross section level to be determined by Project Manager/Designer with input from the District Location Surveyor and Resident Engineer. TOPO with supplemental elevations in area of improvement. Reference control points outside R/W. Subsurface utility locates if required.

3. **LEVEL 3**

   Continuous improvements through length of project such as widening and/or paved shoulder; or major spot improvements (structure replacement; major intersection improvement). May require Right of Way purchase. Horizontal Control baseline, centerline or network. Vertical Control on NAVD 88. TOPO with supplemental elevations (limits to be determined). Digital Terrain Model (DTM) at specified locations. Right of Way Control Survey and Maps (if Right of Way purchased). Subsurface utility locates.

4. **LEVEL 4**

   Full Digital Terrain Model (DTM) and TOPO for entire project.

25.3.5 Review Project Plans

RRR design plans are reviewed by other disciplines including a safety specialist. These reviews are detailed in ***Chapter 16*** of this volume.

25.3.6 Document the Design Process

The designer shall include in the design file all documentation that substantiates the design process and decisions made, including the following information:

1. A short paragraph which states the overall project purpose. Factors such as principal reason for the project, anticipated project cost, principal work type, general right of way needs or provisions, and any special project priorities are appropriately addressed here.
2. Documents that detail the existing conditions on the project. Findings of office reviews, field reviews and surveys are assembled here, to document existing geometric and roadside features, operating conditions, traffic volumes, posted speeds, existing pavement markings, signing, safety, etc. A brief overall summary of findings is recommended.
3. Document the selected standards based on project intent and conditions. When RRR criteria cannot be met, a design exception/variation is required.
4. A summary of safety issues that have been identified for the project and the recommended solution of those issues.
5. Reviews of the project design for safety improvements, documenting what was finally accomplished or ruled out of the project subsequent to the scope of work having been completed.
6. Those items in the original scope of work for the project which cannot be reasonably accomplished and must be deleted or delayed.

Table 25.4.14.1 Recoverable Terrain

DESIGN SPEED (mph)	TRAVEL LANES & MULTI-LANE RAMPS (feet)	AUXILIARY LANES & SINGLE LANE RAMPS (feet)
< 45	6	6
45(1)	14	8
> 45	18	8

GENERAL NOTES:

(1) May be reduced to <45 mph widths if conditions more nearly approach those for low speed (40 mph or less).

The above values are to be used in the process for determining the clear zone width as described in ***Chapter 4*** of this volume.

Table 25.4.14.2 Horizontal Clearance for Traffic Control Signs

PLACEMENT	Placement shall be in accordance with the ***Design Standards***. Placement within sidewalks shall be such that an unobstructed sidewalk width of 4' or more (not including the width of curb) is provided.
SUPPORTS	Supports except overhead sign supports shall be breakaway. When practicable, sign supports should be located behind barriers that are justified for other reasons. Overhead sign supports shall be located outside the clear zone unless shielded.

Table 25.4.14.3 Horizontal Clearance for Light Poles

CONVENTIONAL LIGHTING	Not in the median except in conjunction with barriers that are justified for other reasons. Rural and Urban Flush Shoulders: 20' from the travel lane, 14' from auxiliary lane. (may be clear zone width when clear zone is less than 20'). Urban Curb or Curb and Gutter: From right of way line to 4' back of face of curb (may be 1.5' back of face of curb when all other alternatives are deemed impractical). Placement within sidewalks shall be such that an unobstructed sidewalk width of 4' or more (not including the width of curb) is provided.
HIGH MAST LIGHTING	Outside of the clear zone unless shielded.

Table 25.4.14.4 Horizontal Clearance for Utility Installations

ABOVE GROUND FIXED OBJECTS **(Such as Poles)**	Shall not be located within the limited access right of way, except as allowed by ***Policy No. 000-625-025, Telecommunications Facilities on Limited Access Rights of Way***. Shall not be located in the median. Rural and Urban Flush Shoulders: Not within the clear zone. Install as close as practical to the right of way without aerial encroachments onto private property. Urban Curb or Curb and Gutter: At the R/W line or as close to the R/W line as practical. Must maintain 1.5 ft. clear from face of curb. Placement within sidewalks shall be such that an unobstructed sidewalk width of 4 ft. or more (not including the width of the curb) is provided. See the ***Utility Accommodation Manual, (Topic No. 710-020-001***) for additional information. Note: may be located behind barriers that are justified for other reasons.
BREAKAWAY OBJECTS **(Such as Fire Hydrants)**	Rural and Urban Flush Shoulders: Locate as close to the right of way as practical. Urban Curb or Curb and Gutter: Locate no less than 1.5 feet from face of curb.

25.4.19 Pedestrian, Bicyclist and Transit Needs

Whenever a RRR project is undertaken, pedestrian and bicyclist needs must be addressed, and transit needs should be considered. Recommendations by the District Pedestrian/Bicycle Coordinator and the District Modal Development Office shall be obtained; local government and transit agency contact in developing these recommendations is essential. This should be part of the project scoping and programming effort.

Pedestrian Needs

Sidewalks - On RRR projects with curbed facilities, curb ramps shall be brought into compliance with ADA requirements. This includes installing new curb ramps at crosswalks where none exist, replacing existing substandard curb ramps, and retrofitting truncated domes on existing ramps that otherwise comply with current ADA requirements. Pull boxes, manholes, and other types of existing surface features in the location of a proposed curb ramp should be relocated when feasible. When relocation is not feasible, the feature shall be adjusted to the new ramp to meet the ADA requirements for surfaces (including the provision of a non-slip top surface, and adjustment to be flush with and at the same slope as the curb ramp).

A Design Variation is required when compliance with ADA curb ramp requirements is determined to be technically infeasible. This may occur where existing right of way is inadequate and where conflicts occur with existing features that cannot be feasibly be relocated or adjusted, e.g., drainage inlets, signal poles, pull boxes, etc.. Copies of approved Design Variations to ADA requirements for curb ramps shall be provided to the FHWA.

Other than meeting curb ramp requirements, existing sidewalks and flared driveway turnouts are not required to be upgraded for the sole purpose of meeting ADA requirements, unless included in the project scope by the District. All new sidewalk and driveway construction or reconstruction included on RRR projects shall be designed in accordance with ADA requirements. However, even if new sidewalk is to be constructed, non-conforming driveways are not required to be upgraded.

Medians - Medians shall be evaluated to determine if modifications such as pedestrian refuge sections are necessary. 5-lane and 7-lane sections are restricted or eliminated under current policy, usually by the introduction of a raised or restrictive median, which enhances the opportunity to accommodate pedestrian needs. Traffic separators with a width sufficient to provide refuge should be used at intersections where possible. When adequate pedestrian refuge cannot be provided at the intersection, midblock islands should be provided.

Design details for disability access features including sidewalk, curb ramps and driveway turnouts are found in the ***Design Standards***. Additional standards for ADA are found in the regulations and design guidelines issued by the Secretary of the U.S. Department of Transportation.

Bicyclist Needs - For existing curbed sections where no widening is planned, consideration should be given to reducing lane widths; e.g., 11 ft. through and 10 ft. turn lanes on sections with 14 or 15 ft. wide lanes. Additional information regarding bicycle lanes is contained in ***Chapters 2, 8,*** and ***21*** of this volume.

On projects without curb, either a bike lane or a paved shoulder shall be provided as a bicycle facility.

When a project includes the addition or modification of a right turn lane, a bike lane between the through lane and the right turn lane should be provided if existing right of way is adequate. If there is an existing right turn lane without a bike lane between the through lane and the turn lane, a bike lane should be considered, but is not required, on a project-by-project basis.

Transit Needs

Sidewalks and Transit Facilities – A 5-foot wide sidewalk that connects a transit stop or facility with an existing sidewalk or shared use path shall be included to comply with ADA accessibility standards.

Chapter 26

Bridge Project Development

Exhibits

Chapter 26

Bridge Project Development

26.1 General

All structural designs for new construction for the Florida Department of Transportation (FDOT) are developed under the direction of the Structures Design Office (SDO) and/or the District Structures Design Offices (DSDO). All designs are to be developed in accordance with the ***Structures Manual*** which includes the ***Structures Design Guidelines (Topic No. 625-020-150)***, the ***Structures Detailing Manual (Topic No. 625-020-200)***, this Manual, the ***Design Standards (Topic No. 625-010-003)***, and the ***AASHTO Standard Specifications for Highway Bridges*** or the ***AASHTO-LRFD Bridge Design Specifications*** as referenced in the Structures Manual, applicable FHWA Directives, and other criteria as specified by the Department.

Designs for repair or rehabilitation of bridges are generally developed under the direction of the District Structures Maintenance Engineer (DSME) and may not include all the submittal types discussed in this chapter.

Structures for other agencies or authorities such as the Jacksonville Transportation Authority, various Expressway Authorities, etc. may be designed to meet the Department's criteria or additional criteria as specified by the authority.

For projects involving bridges over navigable water, the Project Manager must provide the District Structures Maintenance Engineer (DSME) sufficient notification prior to engaging in any action in, on, or around the bridge. Refer to ***Section 13.5.3*** of this volume for further information.

26.2 Organization

The Structures Design Office (SDO) is a subdivision of the Office of Design under the direction of the State Highway Engineer and the Assistant Secretary for Transportation Policy. The SDO is under the direction of the State Structures Design Engineer (SSDE). Each District, including the Turnpike, has a staff of structural design engineers that comprise the District Structures Design Office (DSDO), and which is under the direction of the District Structures Design Engineer (DSDE).

26.3 Definitions

All structures have been grouped into the following two categories based upon design difficulty and complexity:

26.3.1 Category 1 Structures

Category 1 Structures consist of box or three-sided culverts, short span bridges (continuous reinforced slabs and prestressed slabs), simple span bridges with spans less than 150 feet, continuous straight steel plate girder bridges with spans less than 150 feet, bridge widenings for these structure types, retaining walls, roadway signing, signalization and lighting supports, sound barriers, and overhead sign structures.

26.3.2 Category 2 Structures

A structure will be classified as a Category 2 Structure when any of the following are present: steel box girders, curved steel plate girders, span lengths equal to or greater than 150 feet, cast-in-place concrete box girder bridges, concrete segmental bridges, continuous post-tensioned concrete bridges with or without pretensioning, steel truss bridges, cable stayed bridges, movable bridges, depressed roadways, tunnels, , non-redundant foundations, straddle piers, integral caps, bridges designed for vessel collision, or any design concepts, components, details or construction techniques with a history of less than five (5) years of use in Florida.

26.4 Abbreviations Used in Structures Design

Terminology used in the area of Structures Design for the Florida Department of Transportation often is written or spoken in the form of abbreviations and/or acronyms. Following is a list of those terms frequently encountered in this manual and in other references used in structures design and include those commonly used for offices, organizations, materials, systems, features, equipment, conditions, and expertise:

AASHTO	***American Association of State Highway and Transportation Officials***
ACI	***American Concrete Institute***
ACIA	***Assigned Commercial Inspection Agency***
ADA	***Americans with Disabilities Act***
AISC	***American Institute of Steel Construction***
ANSI	***American National Standards Institute***
AREMA	***American Railway Engineering and Maintenance Association***
ASTM	***American Society for Testing and Materials***
AWS	***American Welding Society***
BBS	***Bulletin Board System***
BDR	***Bridge Development Report***
BHR	***Bridge Hydraulics Report***
BHRS	***Bridge Hydraulics Recommendation Sheet***
CADD	***Computer Aided Design and Drafting***
CEI	***Construction Engineering and Inspection***
C.I.P. (C-I-P)	***Cast-in-Place (Concrete)***
CPAM	***Construction Project Administration Manual***
CVN	***Charpy V-Notch (Impact Testing)***
DSDE	***District Structures Design Engineer***
DSDO	***District Structures Design Office***
DSME	***District Structures Maintenance Engineer***
EMO	***Environmental Management Office***
EOR	***Engineer of Record***
FDOT	***Florida Department of Transportation***
FHWA	***Federal Highway Administration***
LRS	***Low-relaxation Strands***
LRFD	***Load and Resistance Factor Design***
MHW	***Mean High Water***
MSE	***Mechanically Stabilized Earth (Walls)***
MUTCD	***Manual on Uniform Traffic Control Devices***
NHS	***National Highway System***
NHW	***Normal High Water***

NOAA	***National Oceanic and Atmospheric Administration***
OIS	***Office of Information Systems***
OSHA	***Occupational Safety and Health Administration***
PDA	***Pile Driving Analyzer***
PD&E	***Project Development and Environment***
PPD	***Plans Production Date***
PPM	***Plans Preparation Manual***
QPL	***Qualified Products List***
RDR	***Required Driving Resistance***
SDO	***Structures Design Office***
SIP (S-I-P)	***Stay-in-Place (Forms)***
SRS	***Stress-relieved Strands***
SSDE	***State Structures Design Engineer***
TAG	***Technical Advisory Group (SDO and DSDEs)***
TFE (PTFE)	***Polytetrafluorethylene (Teflon)***
TRB	***Transportation Research Board***
UBC	***Ultimate Bearing Capacity***
UV	***Ultraviolet***
VECP	***Value Engineering Change Proposal***

26.5 Responsibility

The District Structures Design Office has total project development responsibility for projects involving Category 1 Structures, upon release by the Structures Design Office. The Structures Design Office has total project development responsibility for projects involving Category 2 Structures. This responsibility for Category 2 Structures extends to rehabilitation projects and repairs of bridge components that qualify the structure as a Category 2 Structure.

The District Project Manager shall coordinate with the District Structures Design Engineer who shall review and concur with the bridge aspect of all projects during the PD&E process in accordance with ***Chapter 4*** of the ***PD&E Manual***.

The District Structures Design Engineer or the State Structures Design Engineer, as appropriate, shall concur/approve all bridge related work after location design approval is granted.

To assure a uniform approach to a project, the engineer shall coordinate with the appropriate Structures Design Office to discuss structures related phase review comments and get concurrence on how to proceed.

26.6 FHWA Oversight

See ***Chapter 24*** of this volume for FHWA requirements.

26.7 Bridge Project Development

The following sections will define, clarify and list the information necessary to produce an acceptable and reproducible set of contract documents (special provisions, bridge contract drawings, etc.) ready for advertisement and construction.

Bridge project development normally includes five phases of development. The first phase of development, bridge analysis, occurs during the Project Development and Environment (PD&E) process. After location design approval is granted, the second phase, Bridge Development Report/30%Structures Plans, is initiated. After approval of the BDR, the final phases of work will begin. The third phase is the 60% Structures Plans that consists of the substructure foundation submittal for all projects and 60% Structures Plans for most Category 2 Structures. The fourth phase includes the 90% Structures Plans and specifications. The fifth phase includes the 100% Structures Plans and specifications. For efficiency, one engineering firm (one design team) should be responsible for the BDR and the final plans and specifications.

For Category 2 bridges and some Category 1 bridges, step negotiations are suggested. Step negotiations are desirable because the final bridge type cannot be determined until the BDR is complete. Utilizing this scenario, the first step of the negotiations would include the BDR/30% Structures Plans. After submittal of the BDR/30% Structures Plans, negotiations for final three phases of work (60% Structures Plans, 90% Structures Plans and 100% Structures Plans) would begin. Negotiations should not be finalized until the BDR/30% Structures Plans are approved by the DSDO or the SDO as appropriate.

26.8 Bridge Analysis

26.8.1 General

The Bridge Analysis is performed during the PD&E phase by qualified bridge engineers. The District Structures Design Engineer must concur with the findings of the bridge analysis, which is part of the preliminary engineering report. The function of the bridge analysis is to determine the general attributes for the recommended bridge. The specific attributes of the bridge will be defined in the BDR.

For bridges over water, a location Hydraulics Report will be prepared in conjunction with the bridge analysis. General site geotechnical knowledge is also required (usually from existing bridge plans) or, in some cases, it may be desirable to obtain borings.

26.8.2 Contents

The bridge analysis shall provide conceptual guidance for the bridge design consultant. Conceptual guidance on how the bridge should fit into the uniqueness of the site should be provided. Bridge design and structure type should be left to the design team in the later phases of work. Bridge analysis shall include the following:

1. Environmental and site considerations.
2. Vertical and horizontal clearances (existing and proposed).
3. Disposition of existing structure. (Final disposition of demolished bridge debris will depend on whether or not a local, State or Federal agency has agreed to receive the debris. See ***Section 13.5.2.3***).
4. Vertical and horizontal geometry.
5. Typical section.
6. Conceptual ship/barge impact data (sample of recreational and commercial traffic).
7. Identification of historical significance of bridge and surrounding structures.
8. Aesthetic level for bridge and bridge approaches.
9. Location Hydraulics Report.
10. Bridge deck drainage considerations.
11. Stream bottom profile.
12. Conceptual geotechnical data.

13. For sites with movable bridge options, a life cycle cost comparison will be prepared and compared to a fixed bridge.
14. Phase Construction Impacts.
15. Construction time.

26.9 Bridge Development Report (BDR)/30% Structures Plans

26.9.1 General

The BDR is intended to establish all the basic parameters that will affect the work done in the Design and Plans Preparation phase. Initiation of the BDR shall occur after location design approval (For some sites only a programmatic categorical exclusion will be required before initiation of the BDR). Once approved, the BDR will define the continuing work by the Engineer of Record (EOR). It is mandatory that the EOR obtain and coordinate the information and requirements of the offices and engineering disciplines whose input is essential to the preparation of an effective BDR. Changes to the parameters after the BDR is approved could result in schedule delays and supplemental agreements; therefore, it is critical that District Offices, FHWA (if involved), the Structures Design Office and other involved agencies recognize the purpose and importance of the BDR. The BDR phase of work will contain sufficient detail for the justification of the proposed bridge type. For most projects, the 30% Structures Plans will be included as an appendix to the BDR. The BDR is developed from information outlined on the Bridge Development Report Submittal Checklist shown in ***Exhibit 26-A***, located at the end of this chapter. This information is often provided by others; however, the EOR is responsible for ensuring that all of the information is adequate and appropriate. If the data is not sufficient, the EOR must obtain the required information before the BDR can be completed and submitted.

When alternate designs are considered, consistency between the alternates is essential in ensuring equitable competition and optimum cost-effectiveness. This consistency includes uniformity of design criteria, material requirements and development of unit costs.

The BDR should contain only supportable and defendable statements. Subjective opinions or unsubstantiated statements are not acceptable. All arguments must be clearly and logically defensible with calculations, sketches or other technical data.

The quantity of work necessary to prepare the BDR depends upon the project's complexity; however, the usual work effort for bridge types normally encountered is:

1. Minor Bridge Widenings: The BDR will be a minor work effort; however, viable structural possibilities and economical options should be thoroughly investigated to determine if replacement of the bridge would be more appropriate than its widening. This is particularly true at sites where the existing bridge condition is marginal, where there has been a record of serious flooding or scouring, when the widening is part of a route improvement with a high potential for attracting traffic, if the existing

bridge has a history of structural problems (including vessel collision), or if the inventory rating is less than required by AASHTO and cannot be improved. Load rating considerations that shall be included in the BDR recommendations are provided in ***Section 7.1.1 of the Structures Design Guidelines***.

2. Minor Grade Separations or Small Water Crossings: The BDR shall be a thorough document that adequately addresses all viable structure types; however, the BDR will not usually be an extensive document since the viable types of superstructure and substructure are generally limited. Scour and vessel collision shall be considered.

3. Major Bridges (including Movable) and Major Interchanges: The BDR shall be an extensive and comprehensive document that thoroughly considers all viable structure types and considers all design parameters (such as vessel collision and scour).

26.9.2 Contents

The major items to be considered in the BDR are:

1. General: The bridge length, height and pier locations are subject to vertical and horizontal design clearance requirements such as those for clear zone, navigation and hydrology. After these considerations are met, span lengths are governed by economics and aesthetic considerations. Superstructure depths (grade separation structures in particular) shall be kept to the minimum that is consistent with good engineering practice. Recommended span/depth ratios for steel superstructures are shown in AASHTO.

   The length of the bridge will be affected by:

   a. Opening required by the Bridge Hydraulic Report.

   b. Environmental Considerations.

   c. Railroad clearances and cross sections.

   d. Width of waterway and/or width of cross section of roadway being spanned including the use of retaining walls, or fender systems.

2. Statical System: The economic and engineering advantages of both simple span and continuous spans shall be addressed.

3. Superstructure: Some superstructure types that could be considered are prestressed concrete girders, inverted-tee sections, reinforced or prestressed concrete slabs, steel rolled sections or plate girders, steel or concrete box girders, and post tensioned slabs, bulb-tees or boxes.

4. Substructures: Some substructure types that could be considered are pile bents

and multi-column or hammerhead piers. Variations of column shapes may be appropriate for aesthetic or economical requirements.

5. Foundations: Some foundation types that could be considered are steel and concrete piles, drilled shafts and spread footings.

6. Vessel Collision: Vessel collision forces will often have a major effect on the structural configuration and overall economics. See vessel collision requirements in the ***Structures Design Guidelines***.

7. Scour: The 100 year and 500 year predicted scour elevations will often have a major effect on the foundation design. See the foundations and geotechnical requirements in the ***Structures Design Guidelines***.

8. Quantity estimates: For minor bridges rough quantities (such as reinforcing steel based on weight per volume of concrete) may be sufficient. For major and complex bridges the degree of accuracy may require more exact calculations keeping in mind that the intent is to establish relative and equitable costs between alternates and not necessarily to require the accuracy of the Final Estimate. For major and complex structures it may be necessary to develop unit costs from an analysis of fabrication, storage, delivery and erection costs of the different components. For projects involving the demolition of bridges, debris volume quantities must be calculated.

9. Unit costs: Data available from the FDOT or contractors and suppliers should be used to arrive at unit costs. The sources of all price data shall be recorded for later reference. Base cost should be obtained from the ***BDR Estimating Section*** of the ***Structures Manual***.

10. Develop cost curves: For each alternative establish the most economical span arrangement, i.e., minimum combined superstructure and substructure cost.

11. Retaining Wall Study: If retaining walls are present, a retaining wall study shall be included in the BDR. This study will conform with the work as specified in ***Chapter 30*** of this volume and ***Chapter 4*** of the ***Structures Design Guidelines***.

12. Movable Bridges: For movable bridges the BDR shall include information on the type of equipment for the machinery and electrical drive systems, together with a general description of the control system to be utilized. A written description and preliminary layouts of system components shall be included.

13. Pedestrian Facilities: If pedestrian facilities are included, the report shall describe the facilities anticipated and the means to be used to comply with ADA requirements.

For rehabilitation project plans, the BDR stage shall include plans and written descriptions of those system components to be modified from the existing configuration, along with plans of the existing configuration. Submittal of information described in the previous paragraph is not required unless the electrical and mechanical configuration is modified from the existing configuration.

26.9.3 Format

The report shall use standard, letter-size pages with any larger sheets or drawings folded to fit the report size. The report shall be neatly written and the contents presented in a logical sequence with narrative, as required, to explain the section contents. An Executive Summary shall compare the relative features and costs of the alternates considered and recommend alternate(s) to be carried forward into the Final Structures Plans Preparation phase.

The BDR shall be as self-contained as possible by including all arguments that establish, justify, support, or prove the conclusions. It is acceptable to make reference to other documents that will be included in the final submittal package; however, any documentation that will help emphasize a point, support a statement, or clarify a conclusion shall be included. Such documentation may include drawings, clear and concise views, or other such illustrated information.

The BDR shall address construction time requirements and the effect that components, systems, site constraints and conditions, or other site characteristics or criteria have upon the construction time, whether additive or deductive.

For most projects, the 30% Plans shall be an appendix to the BDR.

26.9.4 Aesthetics

1. General: Any bridge design must integrate three basic elements: efficiency, economy and elegance. Regardless of size and location, the quality of the structure, its aesthetic attributes and the resulting impact on its surroundings must be carefully considered. Achieving the desired results involves:

    a. Full integration of the three basic elements listed previously.

    b. The EOR's willingness to accept the challenge and opportunity presented. A successful bridge design will then be elegant or aesthetically pleasing in and of itself and will be compatible with the site by proper attention to form, shapes and proportions. Attention to details is of primary importance in achieving a continuity of line and form. In general, the rule of "form following function" shall be used.

    The designer must consider the totality of the structure as well as its individual components and the environment of its surroundings. A disregard for continuity or lack of attention to detail can negate the best intent. Formulas cannot be established; however, the ACI's ***Aesthetic Considerations for Concrete Bridges*** and the TRB's ***Bridge Aesthetics Around the World*** as well as authors such as David P. Billington can guide the designer. A book developed by the Maryland Department of Transportation entitled ***Aesthetic Bridges*** provides excellent guidance. In bridge aesthetics the designer is dealing with the basic structure itself; not with enhancement, additions or other superficial touches. The EOR is expected to be well read on the subject of bridge aesthetics and committed to fulfilling both the structural and aesthetic needs of the site.

    The challenge differs for major and minor structures. Indeed, the challenge may be greater the smaller the project. Major structures, because of their longer spans, taller piers, or curving geometry often offer inherent opportunities not available for minor bridges.

    Some basic guidelines where aesthetics may play a more important role are:

    a. Bridges highly visible to large numbers of users (maritime and/or motorists).

    b. Bridges located in or adjacent to parks, recreational areas, or other major public gathering points.

    c. Pedestrian bridges.

    d. Bridges in urban areas in or adjacent to commercial and/or residential areas.

    e. Multi-bridge projects, such as interchanges, or corridors should attain conformity of theme and unifying appearance. Avoid abrupt changes in structural features.

Considering these guidelines, the District will determine the level of aesthetic effort warranted on a project early in its development. When significant aesthetic expense is proposed, such as is the case with Level Three (Level of Aesthetics), Federally funded projects require legitimate written justification.

2. Levels of Aesthetics:

Normally the District will establish one of the following three general levels of aesthetic consideration and effort at each structure's site:

a. **Level One:** Consists of cosmetic improvements to conventional Department bridge types, such as the use of color pigments in the concrete, texturing the surfaces, modifications to facia walls, beams, and surfaces, or more pleasing shapes for columns and/or caps.

b. **Level Two:** The emphasis is on full integration of efficiency, economy and elegance in all bridge components and the structure as a whole. Consideration should be given to structural systems that are inherently more pleasing, such as hammerhead or "T" shaped piers, oval or polygonal shaped columns, integral caps, piers in lieu of bents, smooth transitions at superstructure depth change locations, box-type superstructures, etc.

c. **Level Three:** The emphasis in this level applies more to the overall aesthetics when passing through or under an interchange or at other sites such as historic or highly urbanized areas where landscaping or unique neighborhood features must be considered. The bridge itself shall comply with Level Two requirements. This level of work may require, at the District's option, a subconsultant (architect to consider adjacent building styles, and landscape themes) with the necessary expertise and credentials to perform the desired work.

These aesthetic levels are not exclusive. For example, where the EOR believes a specific landscape feature might significantly enhance bridge site elegance, even on a Level 1 design, the recommendation should be offered for the Department's consideration. For aesthetic Levels 2 and 3, public input into this issue may be appropriate. The EOR may recommend particular public involvement to the Department for consideration or the district might specify such efforts at specific times during the BDR and/or final plan development phase of the project.

The BDR shall include a summary of aesthetic considerations for the structure and the site. The summary shall consist of sketches, drawings, etc. of recommended treatment as well as the options considered in the aesthetic study but not recommended as appropriate. It shall also include an estimate of cost to implement the recommended aesthetic treatment.

26.9.5 Construction and Maintenance Considerations

All viable structure concepts shall be evaluated for constructability. Items such as member sizes, handling, fabricating, and transporting members as well as maintenance of traffic, construction staging, equipment access, equipment requirements, etc. must be considered. Special evaluation shall be made to insure against potential problems that may occur in obtaining permits and equipment to transport long and/or heavy members from point of manufacture to the project site. The Department's Road Use Permits Office shall be contacted for questions concerning the feasibility of transporting long and/or heavy structural components. Also, considerations for future maintenance inspection shall be taken into account in the structure's design. Such considerations shall include those described in ***Section 26.14*** of this Chapter and the bearings and joint requirements of the ***Structures Design Guidelines***, or the need for 6'-0" minimum headroom inside steel or concrete box girder superstructures. All special construction and maintenance requirements should be identified and appropriately considered in any concepts recommended for design. A design is properly inspectable when it permits safe inspector access to all portions of the structure using equipment available to District Structures Maintenance personnel.

26.9.6 Historical Significance Considerations

When an older bridge is considered for rehabilitation or replacement, the Environmental Management Office will evaluate the historical significance of the structure. A structure may be historically significant due to some of the following characteristics:

1. The structure may be an historic example in the development of engineering.
2. The crossing may be historically significant.
3. The bridge may be associated with an historical property or area.
4. The bridge might be associated with significant events or circumstances.
5. National Register of Historic Places or on a state or local historical register. If it is determined that the structure is historically significant, then the project should be developed to preserve the historic character of the structure.

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26.9.7 Bridge Security

Perform a refined evaluation of all new Category 2 bridges identified in a PD&E study as critical, landmark or signature bridges to determine if anti-terrorist countermeasures must be included as part of the design. Contact the State Structures Design Office and the State Maintenance Office for guidance and assistance. Alternative designs developed in the BDR shall minimize the bridge vulnerability. Countermeasures shall be designed to minimize the effectiveness of explosives. Vulnerability to shape charges and vehicle bombs shall be minimized. The use of structural redundancy and continuity shall be maximized to limit structural damage.

Countermeasures designed into the bridge alternatives shall meet one or more of the following objectives:

1. Maximizing explosive standoff distance;
2. Denial of access;
3. Minimizing time-on-target;
4. Selective protection of the structural integrity of key members:
5. Structural redundancy.

Use one or more of the following countermeasure strategies in the design:

1. Deter attacks by the possibility of exposure, capture or failure of the attacker due to visible countermeasures;
2. Detect potential attacks before they occur and provide the appropriate response force;
3. Defend the bridge by delaying and distancing the attacker from the bridge and protecting the bridge from the effects of weapons, fire and vehicle and vessel impacts;
4. Design the bridge to minimize the potential effects of Weapons of Mass Destruction (WMDs) and conventional explosives, fire and vehicle and vessel impacts.

Structural members that are fracture critical and/or are cable stays, cable stay pylons, hollow boxes, single columns, twin wall columns and thin wall columns require design modification to reduce the potential impact of explosions. Access into cable stay pylons, box superstructures and movable bridge machinery require heavy doors with secure lock systems. Bridges with essential communication utilities and or gas lines require the design to minimize risk to the utility.

26.9.8 Alternative Designs

The use of alternative designs for some larger or complex projects may result in more competitive bids and lower costs. Accordingly, the EOR shall evaluate benefits from alternatives for the particular structure being developed and provide a recommendation for or against preparing alternative designs. The alternative designs recommended shall be supported by the evaluations included in the BDR. As a guide, consider the following in evaluating justification for alternative designs:

1. Alternative designs shall be considered for all structures that cost more than $25 Million and a difference in alternate material (steel versus concrete) construction costs that are within twice the cost of producing the alternate plans. For example, alternative designs would be warranted if the additional preliminary engineering cost for final plans preparation is $1.5 million per alternate and the difference between the construction cost estimates utilizing FDOT estimating practices in the BDR was less than $3 million.
2. For bridges that cost less than $25 million consider alternative designs when project issues reflect possible advantages (i.e., MOT, A+B) from competitive bids.
3. For bridges estimated to cost more than $10 million consider evaluation of alternative designs whenever a unique design concept is proposed until such time that a bid history is established for the unique design.
4. Projects containing multiple bridges with a reasonable mixture of concrete and steel designs do not require alternate designs.

Steel box structures and steel plate girders should be evaluated including the differences in corrosion potential. Box Girders are preferred over plate girders when located in extremely aggressive environments.

26.9.9 Conclusions and Recommendations

With due consideration for all applicable data, the engineer shall recommend the final bridge design system for the site. Thorough justification for the selection will be presented which examines each element of data, and the total estimated construction cost of the recommended design shall be indicated in the BDR. For most projects, the recommended design shall be supported by thirty percent plans (preliminary) as an appendix to the BDR.

The following sections will define, clarify and list the information necessary to produce an acceptable and reproducible set of contract documents (special provisions, bridge contract drawings, etc.) ready for advertisement and construction. The production of a bridge project commences with the Bridge Development Report (BDR) and ends with complete Contract Documents.

26.9.10 30% Structures Plans

The 30% Structures Plans should be submitted with the Bridge Development Report for most structures. The consultant's scope of services should clearly state at what point are the 30% plans to be submitted. If the 30% Structures Plans are submitted separately, the BDR shall contain enough information and drawings to depict the information needed to properly determine the type, size and location of the bridge. The Phase 1 Geotechnical Report and the Hydraulic Report shall be included with the submittal containing the BDR.

The 30% Structures Plans should show, as a minimum, the following information:

1. General Notes Sheet: As many general notes as possible should be included on this sheet at this stage. Subsequent additions shall be made, when necessary, as the design progresses (for example of General Notes, see ***Chapter 3*** of the ***Structures Detailing Manual***).
2. Plan and Elevation Sheet: provide contents as required by the ***Structures Detailing Manual***.
3. Substructures: For piers or intermediate bents, show substructure elements and sizes including all deviations from the typical dimensions, foundation type including element spacing and the arrangement of piles or drilled shafts.
4. Superstructure: Include cross section showing lanes, shoulders, railings, slab thickness, beam type and spacing and web depth for steel girders. If applicable, show geometric changes in shapes of various components. Also show construction phases and maintenance of traffic data, outline of the existing structure and portions to be removed, and utilities (existing and proposed as available).
5. Retaining Walls: Preliminary control drawings shall be submitted when proprietary or standard cast-in-place walls are proposed. Include control drawings for all critical temporary walls.
6. Bridge Hydraulics Recommendation Sheet.
7. Report of core borings.
8. Preliminary bearing type(s).
9. Proposed construction sequence and methods, indicate construction easements and methods of construction access.
10. Preliminary aesthetic details.
11. Preliminary post-tensioning layouts.
12. Preliminary foundation layouts and installation table.

13. Sidewalks: If provided, show preliminary accessible elements.
14. Any other special details required by the Engineer or details which are not normally used on Department projects.

In addition to these requirements, the following items will be included for moveable bridges: preliminary electrical and mechanical equipment layouts in plan and elevation, submarine cable routing, and single line electrical diagrams including service voltage. All equipment shall be rough sized and supporting calculations shall be submitted.

Requests for design exceptions and/or variations for structural design criteria, shall be included in the 30% Structures Plans Submittal. Design exceptions and design variations shall be approved in accordance with ***Chapter 23*** of this volume with concurrence of the DSDO or SDO as appropriate.

26.10 Bridge Development Report (BDR) Submittal Checklist

The Bridge Development Report (BDR) Submittal Checklist (***Exhibit 26-A***) contains a list of the key supporting elements that are required for the preparation, submittal and review of a BDR. This Checklist must be included with the BDR when submitted for review and consists of the following items:

1. Typical Sections for Roadway and Bridge

   The approved typical sections for both the bridge and roadway are required.

2. Roadway Plans

   Preliminary roadway plans covering the bridge vicinity are required.

3. Maintenance of Traffic Requirements

   The Maintenance of Traffic Plan must show the number of required lanes as well as lane widths of all affected roadways.

4. Bridge Hydraulics Report and Bridge Hydraulics Recommendation Sheet

   The Bridge Hydraulics Report (BHR) shall be prepared in accordance with the FDOT Drainage Manual. It shall include the Bridge Hydraulic Recommendations Sheet (BHRS) and address the required hydraulic opening, clearances, scour and deck drainage requirements. In addition to design water elevations normally shown, the BHRS shall include the Mean High Water (MHW) elevation for tidal crossings and Normal High Water (NHW) for non-tidal crossings. Concurrence of the BHR by the District Drainage Engineer with the District Structures Design Engineer for Category 1 Structures and State Structures Design Engineer for Category 2 Structures is required.

5. Geotechnical Report

   The Bridge Geotechnical Report (Phase I) shall be prepared in accordance with ***Chapter 4*** of the ***Structures Design Guidelines*** and the Department's ***Soils and Foundation Handbook***. The report shall document a thorough investigation of all viable foundation types for the bridge and retaining walls. Concurrence of the District Geotechnical Engineer is required for Category 1 Structures and of both the State and District Geotechnical Engineers for Category 2 Structures.

6 Bridge Corrosion Environment Report

A Bridge Corrosion Report shall be prepared to determine the environmental classifications for the structure in accordance with the ***Structures Design Guidelines*** and must be approved by the District Materials Office.

7. Existing Bridge Plans

A set of prints of the existing (preferably as-built) bridge plans should be included for replacement structures and widenings. This is of particular importance for widenings and phase construction. These plans are not usually necessary for completely separate alignments or new interchanges unless the existing structures either will be used for new construction activities or will infringe upon the Contractor's allowed work zone.

8. Existing Bridge Inspection Report

A copy of the latest existing Bridge Inspection Report and Structures Inventory and Appraisal Form is required for all widenings and rehabilitations and may be required for new structures. The existing paint system(s) on all significant metal elements of existing structures shall be identified. The presence of lead-based paint and/or asbestos shall be clearly delineated.

9. Utility Requirements

All proposed utility attachments to the structure as well as all existing and proposed utilities in the vicinity of the structure shall be identified. The requirements of the Department's ***Utility Accommodation Manual (Topic No. 710-020-001)*** shall be followed regarding attachments to the structure.

10. Railroad Requirements

Existing as well as future railroad requirements must be identified. This will include all clearances as well as crash wall or other construction parameters. Copies of correspondence with the Railroad Agency shall be included.

11. Retaining Wall and Bulkhead Requirement

All permanent and temporary retaining wall requirements shall be identified and the proposed type of wall shall be shown. The type, location and extent of temporary walls to accommodate phased construction and/or maintenance of traffic must be identified.

For water crossings where erosion and/or wave action is anticipated, the type, location and extent of bulkhead production shall be identified. The tie-back and anchor system proposed for use shall be included in the submittal.

12. Lighting Requirements

All proposed lighting on or under the structure shall be identified.

13. ADA Access Requirements

Any ADA access requirements that affect the structure shall be identified.

26.11 Final Plans and Specifications Preparation

26.11.1 General

Within this phase of work, for both Category 1 and 2 Structures, there are three phases of work; viz., 60% Substructure submittal or 60% Structure Plans, 90% Structure Plans and 100% Structures Plans and Specifications. For projects where preapproved proprietary wall systems cannot be used and fully designed proprietary wall plans are required, approved control drawings shall be submitted to the appropriate proprietary wall companies as soon as possible and no later than the 60% substructure submittal. A copy of this submission shall be sent to the DSDO or SDO as appropriate. At any time during the project development, the reviewer may require submittal of design calculations.

After each of the phases, except the 100% Structures Plans Phase, review comments from the FDOT are sent to the EOR by letter and/or a marked-up set of prints. The EOR must address each of the comments in writing and resolve each comment prior to the next submittal. The FDOT 100% Structures Plans review comments are to be handled in the same manner; except that unresolved comments may be handled by telephone, in some instances, if confirmed in writing. Also, for any phase, items and drawings from a preceding phase must be included. These drawings shall reflect the comments resolved from the previous phase as well as the accumulated design and drafting effort required of the current phase.

26.11.2 60% Substructure Submittal / 60% Structures Plans

This submittal phase is divided into two distinct parts; viz., the 60% Substructure Submittal (required for all projects) and the 60% Structures Plans for Category 2 Structures and some Category 1 Structures.

1. 60% Substructure Submittal:

   This submittal is required for every project and should be made a part of the 60% Structures Plans phase when that phase is part of the project. The submission is only a partial plans set. The purpose of this submittal is to communicate essential project information to the Geotechnical and Hydraulic Engineers so that all remaining calculations can be performed using actual structural shapes, loads, and dimensions. Plan sheets required for this submittal include: Plan & Elevation, Bridge Hydraulics Recommendation Sheet, Boring Logs, Foundation layout, Substructure Plans, and draft technical specifications.

60% Substructure Submittal Contents:

a. Foundation Layouts
b. Foundation Installation Notes
c. Pile/Drilled Shaft Installation Table
d. Footing Concrete Outlines (All Variations)
e. Pier Concrete Outline (All Variations)
f. Wall Plans - Control Drawings
g. Pile Details
h. List of Pay Items
i. Lateral Stability Analysis Completed
j. Phase II Geotechnical Report
k. Draft Technical Specifications
l. Reinforcement of Footing and Column
m. Post-Tensioning Details
n. Plan and Elevation Sheet
o. Bridge Hydraulics Recommendation Sheet
p. Boring Logs

2. 60% Structures Plans:

When a 60% Structures Plans submittal is required, all comments from earlier reviews shall have been resolved. At this phase, the design should be 90% complete and the plans, 60% complete. In addition to the documents required for the 60% Substructure Submittal, the 60% Structures Plans shall include a list of pay items to be used and plans containing the following details as applicable: final concrete outlines of all individual components, major reinforcing steel, final post-tensioning layouts, steel box/I-girder details, segmental concrete box details, bearing details, seismic details, details of congested areas, details of unique features, accessible pedestrian facilities details, and other details as required. For moveable bridges the following additional information is required: electrical calculations (for generator size, service voltage drop, short circuit, service size, automatic transfer switch, etc.), single line diagram showing equipment sizes and utilities, conduit and wire sizes, panelboard schedules, and light fixture schedules.

26.11.3 90% Structures Plans

Upon approval of the BDR/30% Structures Plans or 60% Structures Plans, as applicable, 90% Structures Plans shall begin. At this stage of plans development, the EOR shall have resolved the 30% and/or 60% Structures Plans review comments and developed the plans for completion. The design and plan production shall be 100% complete. This submittal shall include prints of the completed plans, Summary of Pay Items (complete with quantities), design calculations, Final Phase II Geotechnical Report, Addendums to Hydraulic Report and, if appropriate, Technical Special Provisions. No sheet or detail should be missing at this stage.

26.11.4 100% Structures Plans and Specifications

After resolution of the 90% Structures Plan comments, the EOR shall make all authorized changes necessary to complete the plans and Technical Special Provisions. The EOR shall provide a list of all changes made to the Plans or Specifications that were not directly related to the 90% Structures Plans review comments. The intent is to help minimize the Department's review time and to help the Department's review office to focus on only those new items or details proposed by the EOR. This will, in turn, help to expedite the project's authorization.

The 100% Structures Plans submittal is divided into two distinct phases. First, prints of the original drawings and technical special provisions are submitted 30 days prior to the District's Plans Production Date (PPD). Secondly, once notified by the FDOT, the original drawings and all other documents are submitted to the District.

Within the 30-day period allotted, the EOR will receive notification either of additional changes/corrections to be made or to submit the Final Plans as they are. If at anytime during the 30-day period the EOR finds additional changes/corrections that should be made, the Structures Design Office responsible for plans approval (either the District Structures Design Engineer (DSDE) or the Structures Design Office (SDO) as appropriate) must be notified for discussion and resolution.

Once all changes/corrections are made, or if no changes/corrections are necessary, the EOR shall submit all his work to the District prior to or on the PPD. Submittal of this stage of the work shall include the original drawings, one record set of prints with each sheet sealed in accordance with ***Chapter 19*** of this volume, quantities book assembled as specified in the Department's ***Basis of Estimates Handbook***, sealed Technical Special Provisions (if required), and sealed Summary of Pay Items with estimated bridge quantities.

If included in the Scope of Services, original documents in electronic media such as CADD diskettes may also be required.

26.12 Plans Assembly

Consult the ***Structures Detailing Manual*** for plans assembly, materials, content of plans, and other drafting information.

26.13 Plans Submittal

26.13.1 Schedule

The District Project Manager is responsible for establishing the schedule of submittals with input from the EOR and either the District Structures Design Engineer for Category 1 or Structures Design Office for Category 2 projects.

26.13.2 Submittal Schedule

1. BDR/30% Structures Plans
2. 60% Substructure Submittal/60% Structures Plans
3. 90% Structures Plans
4. 100% Structures Plans

26.14 Review for Constructability and Maintainability

26.14.1 Purpose

The purpose of this review is to provide reasonable and practical use of fabrication and construction techniques and equipment without overloading and/or overstressing components, provide for proper material handling and transportation, provide safe maintenance of traffic and provide an appropriate construction sequence. Additionally, provide features which will retard bridge deterioration, permit reasonable access to all parts of the bridge for inspection and performance evaluation and provide features to facilitate replacement of damaged and/or deteriorated bridge components.

26.14.2 Responsibility

For Category 1 and 2 Structures, it will be the responsibility of the project manager or his designee to coordinate a review of both the 30% and 90% Structures Plans submittals by the appropriate District Construction and Maintenance personnel for constructability and maintainability. For Category 1 Structures, technical issues shall be resolved by the appropriate DSDE. For Category 2 Structures, technical issues shall be resolved by the SDO.

The Construction and Maintenance Offices should be given adequate time to perform these reviews. All comments from these reviews shall be addressed prior to the next submittal and its subsequent review.

26.15 Review for Biddability

26.15.1 Purpose

To prevent construction problems, the District Construction Office will review the plans to make certain the plans are clearly understandable, contain all pertinent notes and have sufficient and correct pay items. During the biddability review, the Construction Office will check for the interface with the roadway segment of the project, utility agreements and environmental permits.

26.15.2 Responsibility

For Category 1 and 2 Structures, it will be the responsibility of the project manager to coordinate a review of the 90% Structures Plan submittal. This review should occur at the same time as the Phase III Plans submittal for the roadway segments of the project.

Additionally, for Category 2 Structures, it will be the responsibility of the Structures Design Office to coordinate a review of the 90% Structures Plans submittal.

The Construction Offices should be given adequate time to perform these reviews. All comments from these reviews shall be addressed prior to the 100% Structures Plans Stage submittal.

26.16 Bridge Load Rating

Load rating analysis of new or existing bridges shall be performed in accordance with the ***AASHTO "Manual for Condition Evaluation and Load Resistance Factor Rating (LRFR) of Highway Bridges"*** as amended by the ***FDOT "Structures Manual", Volumes 1 and 8***. Load rating procedural matters can be found in the ***"Bridge Load Rating, Permitting and Posting Manual (Topic 850-010-035-b)***.

For new bridges the Engineer of Record shall load rate the bridge(s) and submit the calculations with the 90% plan submittal.

Prior to developing the scope-of-work for bridge widening and/or rehabilitation projects, the FDOT or their consultant will determine the suitability of the bridge project using the load rating. If the existing load rating is inaccurate or was performed using older methods (e.g.

load Factor), perform a new load rating using the procedures outlined in the ***"FDOT Structure Manual", Volume 1 - Structures Design Guidelines, Chapter 7***. Load rating calculations for the entire structure (existing and new) shall be submitted with the 90% plan submittal for the project.

26.17 Review of Non-FDOT Funded Projects (New Construction)

FDOT review will be required whenever a privately funded structure crosses over Department owned right of way or when such work otherwise affects such a route; i.e., lane closures, access, R/W changes, etc. FHWA review will be required whenever a privately funded structure crosses over an interstate route, or when such work otherwise affects such a route; i.e., lane closures, access, R/W changes, etc. The extent of FDOT and FHWA review is that:

1. Plans must meet all current clearance requirements (vertical and horizontal).
2. Maintenance of traffic scheme for construction must be reviewed and approved.
3. All attachments to the structure over the highway must be securely fastened.
4. Design must be sealed by a licensed professional engineer.
5. Design must be in accordance with a nationally recognized code such as AASHTO, ACI, AISC, etc.
6. Plans must meet all District permit requirements and procedures.
7. Only projects over or affecting a NHS facility shall be submitted to FHWA for approval.
8. FDOT review for these structures shall be performed by the District Structures Design Office for Category 1 and State Structures Design Office for Category 2 Structures.

Exhibit 26-A Bridge Development Report (BDR) Submittal Checklist

Project Name ____

Financial Project ID____________________________

FA No. ____________________ FHWA Oversight (yes no) NHS (yes no)

Date _______________________ FDOT Project Manager ________________________

	ITEMS	STATUS[b]
1.	Typical Sections for Roadway and Bridge [a].........................	P NA C
2.	Roadway Plans in Vicinity of Bridge [a]..................................	P NA C
3.	Maintenance of Traffic Requirements [a]................................	P NA C
4.	Bridge Hydraulics Report [c]..	P NA C
5.	Geotechnical Report [c]..	P NA C
6.	Bridge Corrosion Environmental Report [c]............................	P NA C
7.	Existing Bridge Plans..	P NA C
8.	Existing Bridge Inspection Report...	P NA C
9.	Utility Requirements...	P NA C
10.	Railroad Requirements...	P NA C
11.	Retaining Wall and Bulkhead Requirements........................	P NA C
12.	Lighting Requirements...	P NA C
13.	ADA Access Requirements...	P NA C
14.	Other...	P NA C

(a) Must be approved by District before BDR submittal.

(b) Circle appropriate status:
P - Provided NA - Not Applicable C - Comments attached

(c) See approval requirements for these documents elsewhere in this chapter.

28.5 Scheduling of Submittals

Review of the submittal requirements and procedures at the outset of the construction contract is of benefit both to the Contractor and the Department. Therefore, the Contractor may have been requested by the Department to provide a Working Schedule for Shop/Erection Drawing submittals.

The preparation of a Working Schedule will bring to the attention of the Contractor the number of submittals required and at times may denote items about which the Contractor may wish the Department's advice as to the manner in which the design is to be implemented. Adherence to the Working Schedule will make for a smoother working relationship between all parties involved in the project, and proper planning should reduce the possibility of a large number of submittals being forwarded for review concurrently.

The Contractor is generally required to schedule submissions such that a minimum of 45 calendar days is allowed for review by the Department for routine work of which the first 30 calendar days are allotted to prime review by the Engineer of Record. However, for most routine submittals, a time period of 14 to 21 calendar days should be adequate. For work of more complexity, the review time may be adjusted proportionately to the complexity of the work. Allowance must also be made for potential resubmittals, and the Contractor normally is advised by the Department to consider a 75 to 90 calendar days total lead-time for submittals prior to the need for fabrication or construction work.

The Contractor must make submittals for approval with such promptness as to cause no delay in his fabrication and construction schedules. Only in emergency cases should special consideration be requested. If a submittal requires resubmission, an approximate additional 30 calendar days should have been scheduled by the contractor for approval of the resubmittal of which the first 15 calendar days are allotted to prime review by the Engineer of Record.

28.6 Transmittal of Submittals

Submittal of Shop/Erection Drawings shall be made to the designated office, as applicable, <u>only by the Contractor for the project</u>. In that the Department's legal contracts and documents are with the Contractor, submittals shall not be accepted directly from a subcontractor or fabricator. Situations may occur when a subcontractor or fabricator is allowed to make an advance submittal for review; however, the actual submittal to be stamped and approved must follow from the Contractor with the Contractor's stamp. Subcontractors and fabricators are encouraged to contact the appropriate Department Review Office for guidance or advice at any time. ***Exhibits 28-A*** thru ***28-C*** show the flow of submittals during the review process. All transmittals of submittals between parties shall be accomplished by <u>OVERNIGHT DELIVERY</u>.

The Special Provisions for the project may denote the amount of drawings, etc. to be submitted and the procedure to be followed. Furthermore, the office to which the Contractor shall transmit his submittal and the procedure to be followed may also be defined during the preconstruction conference for the project. In the absence of such instructions, the following generally applies:

28.6.1 General Submittal Requirements

On projects where the Engineer of Record is a Consultant to the Department, and unless otherwise directed at the project's preconstruction conference, the Contractor shall have submitted two (2) sets of xerographic reproducibles directly to the consulting Engineer of Record. On projects where the Department is the Engineer of Record, the Contractor shall have submitted two (2) sets of xerographic reproducibles directly to the appropriate Department Review Office. For design calculations, four (4) complete sets, including computer printouts, shall be submitted with the drawings. All drawings shall be on sheets not larger than 11” x 17”. The Contractor's letter of transmittal should always accompany the drawings and a copy should always have been sent to the Department's Resident Engineer. On those projects where the Engineer of Record is a Consultant to the Department, and the Department will be reviewing the shop drawings, a second copy of the Contractor's letter should also have been sent to the Department's Review Office.

Chapter 29

Structural Supports for Signs, Luminaires, and Traffic Signals

Figures

Chapter 29

Structural Supports for Signs, Luminaires, and Traffic Signals

29.1 General

The design criteria for the structural design of all sign, signal, and lighting structures shall be in accordance with AASHTO's ***2001 Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals***, with current addenda and the ***FDOT Structures Manual Volume 9***.

Use standard sign structures unless site conditions or other considerations require a custom design.

For overhead sign structures, mast arm signal structures and steel strain poles; indicate in the Plans whether a grout pad is or is not to be installed.

29.2 Sign Structures

29.2.1 General

FDOT assigns identification numbers to overhead sign structures. See the ***Structures Detailing Manual, Chapter 2***, for instructions.

29.2.2 Standard Single Column Ground Signs

Refer to ***Design Standards, Index No. 11860***.

29.2.3 Standard Multipost Ground Signs

Refer to ***Design Standards, Index No. 11200*** and ***FDOT Multi-Post Sign Program***.

29.2.4 Standard Span Overhead Sign Structures

The EOR is responsible for the design of all overhead sign structures whether ground mounted or supported on a structure (including bridge structures), unless otherwise directed by the Department. This responsibility is for the entire sign structure, including the supports and foundations, as well as all details necessary to fabricate and erect the sign structures. The EOR is also responsible for the shop drawing review in accordance with ***Chapter 28*** when sign structure shop drawings are required by the Contract Documents.

In general, however, the designer may refer to the ***Design Standards, Index Nos. 11310 and 11320***.

29.2.5 Standard Cantilever Overhead Sign Structures

The EOR is responsible for the design of all cantilevered overhead sign structures whether ground mounted or supported on a structure (including bridge structures), unless otherwise directed by the Department. This responsibility is for the entire sign structure, including the supports and foundations, as well as all details necessary to fabricate and erect the sign structures. The EOR is also responsible for the shop drawing review in accordance with ***Chapter 28*** when sign structure shop drawings are required by the Contract Documents.

In general, however, the designer may refer to the ***Design Standards, Index Nos. 11310 and 11320***.

29.2.6 Custom Designs

The Structures Engineer of Record is responsible for the design of the attachment system for signs mounted on bridge structures.

If custom design is required, during the design process include with the 30% submittal, a brief written justification.

For signing or lighting structures mounted on bridge structures, include their plans in the structures plans. Otherwise, include design details in the signing or lighting plans.

29.3 Luminaire Structures

29.3.1 General

Luminaire Structures may be Standard Aluminum Light Poles, Standard High-Mast Lighting or Custom Designs.

29.3.2 Standard Aluminum Light Poles

Standard, QPL listed, aluminum light poles must comply with the detail requirements shown on ***Index No. 17515*** of the ***Design Standards***.

For additional design information, see ***Chapter 7*** of this volume.

Selection Procedure

1. Use an Importance Factor (I_r) = 0.80 (25-year recurrence interval.)
2. Determine the height difference between the top of foundation and the top of roadway used to set the fixture mounting height, round as necessary.
   a. Determine the design mounting height (40, 45, or 50 feet) and fixture arm length (8, 10, 12, or 15 feet) required.
   b. The wind height at fixture equals the design mounting height for poles not on fill. For poles on fill, determine the height of the roadway above the surrounding terrain. The wind height at fixture will equal the design mounting height plus the fill height, rounded up to the next highest 5-foot increment.
   c. Determine the pole design variables for each light pole.

Limitations

1. Fixture Arm Length of 8-feet, 10-feet, 12-feet or 15-feet. Single arm only.
   a. Design Mounting Height of 40-feet, 45-feet or 50-feet. (May differ from Fixture Mounting Height, see Selection Procedure item 2).
   b. 25-feet maximum height above adjoining ground surface.
   c. Design weight of luminaire assumed to be 51 lbs.
   d. Equivalent projected area of luminaire for design is 1.5 square feet.
2. No bridge or wall mounting permitted.
3. Maximum fill slope at the pole of one vertical to four horizontal. Steeper slopes can be accommodated provided the face of the slope on a horizontal projection from the

foundation base is no closer than it would be if a 1:4 slope were projected from the top of the foundation.

4. Unique site circumstances where poorer soil conditions are encountered than shown on ***Index No. 17515*** may require the foundation variables to be modified from those shown. If special designs are required, the Geotechnical Engineer will provide the soil information to be used by the District Structures Design Engineer during the design phase of the project.

For additional design information, see ***Chapter 7*** of this volume.

29.3.3 Standard High-Mast Lighting

Refer to ***Design Standards, No. 17502***.

29.3.4 Custom Designs

When special aluminum light poles are required, or otherwise specifically designated in the contract documents, the Contractor's Specialty Engineer is responsible for the structural design of the roadway light poles and foundations and the EOR is responsible for the review of the Shop Drawings.

29.4 Traffic Signal Structures

29.4.1 General

Mast Arm Assemblies may be Standard Mast Arm Signal Structures, Standard Mast Arms for Site-Specific Loadings, or Custom Designs.

29.4.2 Standard Mast Arm Signal Structures

Design the arm to pole connections on mast arm structures as “through-bolted” (tapped connections are not permitted).

Regardless of the design wind speed for the pole and arm, base the torsional resistance of foundations for all mast arm Assemblies on a service wind speed of 85 mph with a safety factor of 1.0.

For signals, design all mast arm assemblies with backplates unless the Maintaining Agency for a County has a written policy that prohibits the use of backplates in that County. The prohibiting policy must be on file with the Department's District Office in which the County is located, and the policy must be included in the Scope of Services of both the Signal and Structures Design Engineers.

Design and detail mast arm assemblies using one of the following three methodologies:

1. Standard Mast Arm Assemblies: Mast arms that utilize all pre-approved components listed on the Department's Qualified Products List (QPL) and that have been pre-designed for the selected Load Trees shown in ***Figure 29.2***.
2. Standard Mast Arm Assemblies for Site-Specific Loadings: Mast arms for unique loadings but which utilize all pre-approved QPL components.
3. Custom Designs: Special Mast arms for unique loadings and/or geometric constraints that contain any component (arm or pole) that is outside the range of those listed on the QPL.
4. For additional design information, see ***Chapter 7*** of this volume.

The standard mast arm assemblies must comply with all the requirements and design criteria shown on ***Index Nos. 17743*** and ***17745*** of the ***Design Standards***, and the “Standard Mast Arm Assemblies Data Table”.

Standard Mast Arm assemblies are limited to 110,130 or 150 mph design wind speeds with one of the load tree configurations shown in ***Figure 29.2***, and either single arm, single arm with luminaire, or double arms with arm orientations of 90° or 270° only.

Foundations and base plates for standard mast arm assemblies are pre-designed based on the following conservative soil criteria:

Classification:	Cohesionless (Fine Sand)
Friction Angle:	30 Degrees
Unit Weight:	50 lbs./cubic foot (assumed saturated)

When the designer considers soil types at the specific site location to be of lesser strength properties than shown above, an analysis is required. Auger borings, SPT borings, or CPT soundings may be used as needed to verify the assumed soil properties, and at uniform sites, a single boring or sounding may cover several foundations. Borings in the area that were performed for other purposes may be used to confirm the assumed soil properties. Unique site circumstances may require the foundation variables to be modified from those shown on ***Index 17743***. Accomplish this by completing the “Special Drilled Shaft Data” in the “Standard Mast Arm Assemblies Data Table”. The Geotechnical Engineer must justify the differing foundation criteria to the District Structures Design Engineer during the design phase of the project.

To use standard mast arm assemblies:

1. Confirm that the information furnished by the signal designer in the "Mast Arm Tabulation Sheet" meets the geometric and load tree limitations shown in ***Figure 29.2***.
2. Follow the procedure described in the design examples in ***Volume 2, Chapter 24,*** complete the necessary information required in the "Standard Mast Arm Assemblies Data Table" and include in the Traffic Plans.

29.4.3 Standard Mast Arms for Site-Specific Loadings

The Department's mast arm computer program will select component parts from those shown on ***Index No. 17743*** for site specific load configurations differing from those shown in ***Figure 29.2***.

In order to be eligible for utilization of QPL component parts, the mast arm assemblies must utilize only arms and poles from the components listed in the tables on ***Index No. 17743***. As for standard mast arm assemblies, the foundation design is included with the pole selection and needs no further information.

Design and detail standard mast arm assemblies utilizing QPL component parts in the plans in the same manner as for standard mast arm assemblies by use of the "Standard Mast Arm Assemblies Data Table". Similarly, because all QPL component parts are used, shop drawings are not required.

29.4.4 Custom Designs

The Department's mast arm Computer Program will provide the necessary variables to be shown in the "Special Mast Arm Assemblies Data Table".

Show special mast arm assemblies and foundations in the plans. Refer to ***Index No. 17745***. Require shop drawings for all special mast arm assemblies.

29.4.5 Anchor Bolt Installation on Existing Foundations

Ensure that anchors used in the installation of a traffic signal mast arm on an existing foundation conform to ***Structures Design Guidelines 1.6 – Adhesive Anchor Systems*** and ***Sections 416 & 937*** of the ***Standard Specifications***.

Verify that the foundation and strength of the anchors are adequate for mast arm applied loads.

Verify the existing condition of the drilled shaft.

Anchors may be offset from center but all anchors must be within the foundation reinforcing cage. Note the desired offset in the plans.

Figure 29.1 Flowchart for Designing and Detailing Mast Arm Assemblies

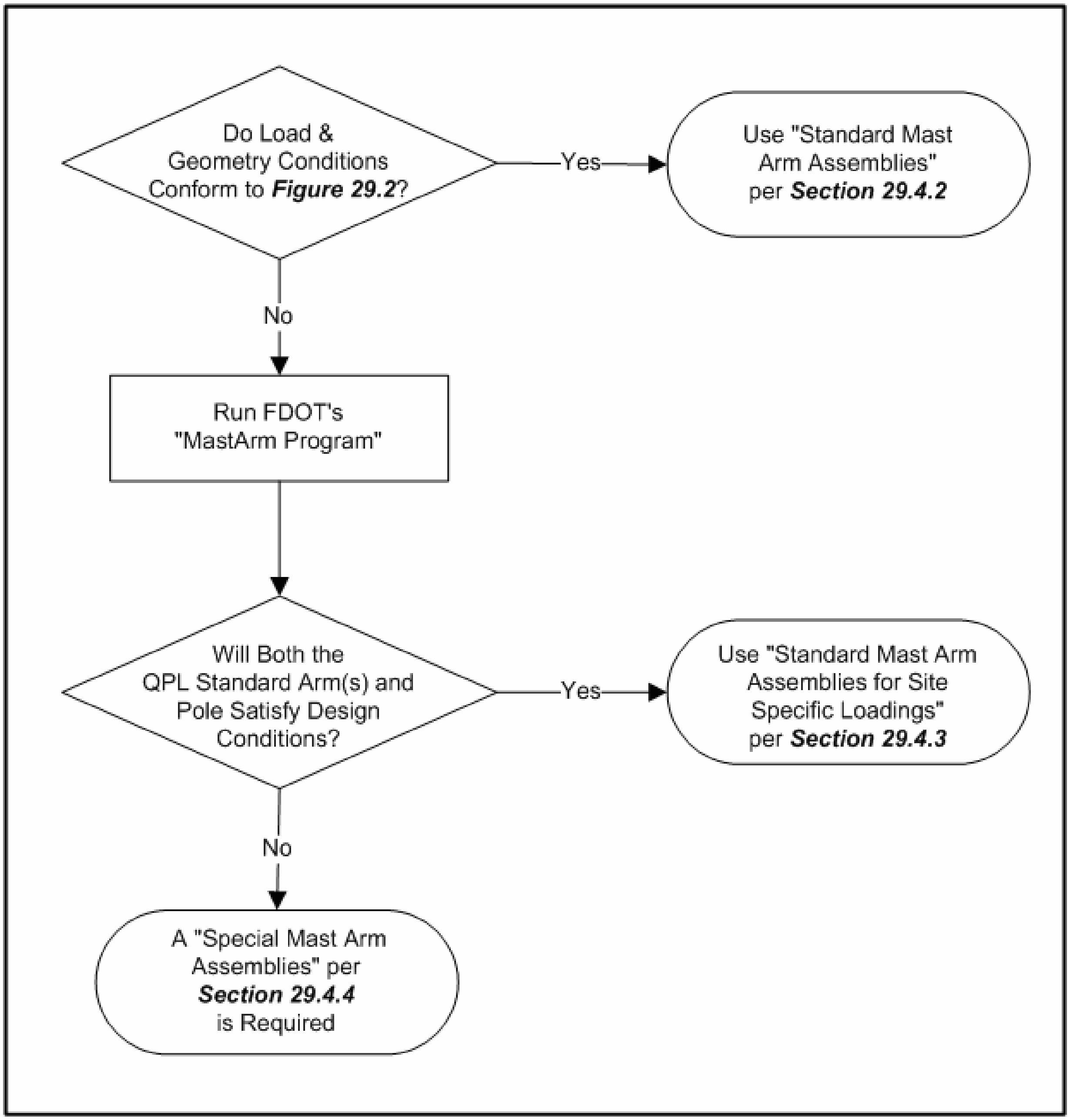
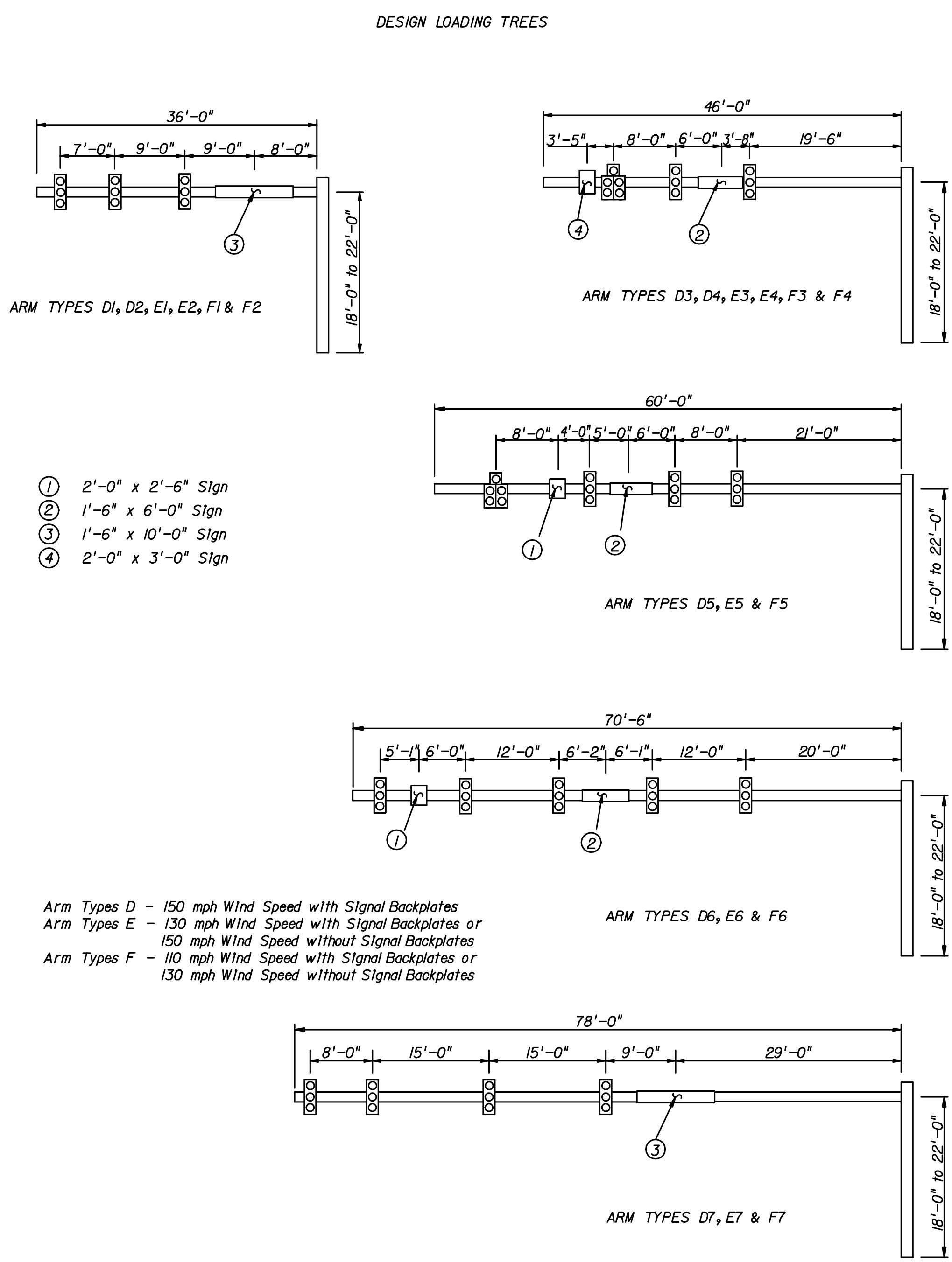


Figure 29.2 Standard Mast Arm Design Loading Trees



29.4.6 Standard Span Wire with Concrete Strain Poles

Refer to ***Design Standards, Index No. 17725***.

29.4.7 Standard Span Wire with Steel Strain Poles

Refer to ***Design Standards, Index No. 17723***.

Chapter 30

Retaining Walls

Figures

Exhibits

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Chapter 30

Retaining Walls

30.1 Purpose

The purpose of this chapter is to give the designer an understanding of the procedure to develop retaining wall plans. A step-by-step method to develop and organize the retaining wall plans is presented. An example of retaining wall plans is included. This chapter should be used in conjunction with the ***Structures Design Guidelines (SDG)***.

If the difference in height between the ground levels to be supported is 5 ft. or less, a gravity retaining wall is generally the most efficient structure to be used. For details of gravity retaining walls see the ***Design Standards, Index No. 520***.

When the difference in height between the ground levels to be supported exceeds 5 ft., then either a reinforced cast-in-place (C.I.P.) concrete cantilever retaining wall or a proprietary retaining wall is required.

Roadside barriers are generally required to shield vertical drop-offs created by retaining walls in fill sections. See ***Chapter 4*** of this volume for guidance on roadside barrier requirements.

Handrails or fences for bicyclists and pedestrians are also generally required when retaining walls are located within the right of way. This requirement must be addressed for retaining walls in fill sections as well as at the top of retaining walls in cut sections. In cut sections, the character and use of the adjoining property shall be considered when selecting the type of protection required. See ***Chapter 8*** of this volume for pedestrian and bicycle rail requirements.

In general, proprietary retaining walls should be utilized for projects when the exposed surface area of the walls exceed 1000 square ft. and sufficient room for the earth reinforcement system is available; however, site specific conditions must always be considered when determining the type(s) of wall to be designed. Proprietary precast walls other than MSE walls should be used as an alternate to C.I.P. walls when sufficient room for soil reinforcement is not available.

The following sections refer to the structures submittal procedure. For projects where there are no bridges, the roadway designer shall adjust the procedure as required for the roadway project.

30.2 Conventional (C.I.P.) Retaining Walls and Proprietary Retaining Walls (Permanent Walls)

The Department's policy is to provide either a set of conventional retaining wall plans or the "preapproved standard details" for all the proprietary walls that are technically appropriate for the site for all projects where walls are not supported on piles. Projects where walls are supported on piles only require a conventional pile supported wall design or a pile supported proprietary wall design. Omission of conventional retaining walls is possible if adequate justification is provided.

Proprietary retaining wall design plans are not required in the contract plans for normal uncomplicated wall projects. If the proprietary walls are experimental, exceed 40 ft. in height, are subject to unusual geometric or topographic features or, by the geotechnical report, will be subjected to excessive settlement, or environmental conditions, they may be required to have fully detailed design plans in the contract set.

The success of this method of producing and letting wall plans is highly dependent on complete, accurate and informative Control Plans. The importance of the Geotechnical Engineer's role in this scheme cannot be emphasized enough and shall include the following responsibilities:

1. Borings.
2. Soils Report.
3. Wall Type recommendation.
4. For Proprietary Walls: external stability analysis, minimum soil reinforcement length vs. wall height for external stability, maximum bearing pressure for each wall height and soil reinforcement length for each different wall height (1.5 ft. increments).
5. Review of internal stability design as provided by the wall companies.
6. Establishment of allowable bearing pressures.

The normal failure modes to be investigated are shown in ***SDG, Figure 3-1***.

Step-by-step procedures for developing retaining wall plans follow.

30.2.1 Retaining Walls (Conventional Design)

1. Bridge Development Report (BDR) / 30% Plans

   The BDR shall discuss and justify the use/non-use of conventional retaining walls. If the use of conventional retaining walls is applicable to the site and economically justified, it may be the only design required or it may be an alternate to a proprietary design. The 30% Plans submittal shall contain a location plan, plan and elevation of walls showing vertical and horizontal alignment, cross sections and details. The plans shall denote location of drainage inlets, utilities, sign structures, lights and barrier joints. Specifically the submittal package shall include:

   a. Plan:

      A plan view of the wall and footings which indicate pertinent dimensions, boring locations and horizontal alignment.

   b. Elevation:

      A front view of the wall which indicates pertinent dimensions and elevations, sign and lighting structures locations, drainage structure locations and flow line elevations, location of section views and vertical alignment.

   c. Sections:

      Sections taken through the wall to better indicate dimensions and elevations.

   d. General Notes including:

      1) Design Toe Pressure
      2) Environmental Classification
      3) Concrete - (Strength and Class)
      4) Reinforcing Steel - (Grade)
      5) Design Method
      6) Soil Design Parameters for both the in situ and backfill materials
      7) Load and Resistance Factors

2. 30% Plans:

   The 30% Plans shall be submitted for approval and development of the plans continued towards the 90% Plans submittal.

3. 90% Plans:

   The 90% Plans submittal shall be further developed to include, in addition to the information required for the 30% Plans, the following:

a. Plan:

A plan view of the wall and footings which indicates pertinent dimensions; reinforcing steel locations, cover and spacing in footings; and boring locations, back of wall drainage details and horizontal alignment.

b. Elevation:

A front view of the wall which indicates pertinent dimensions and elevations; location of section views; reinforcing steel location, cover and spacing; back of wall drainage and flow lines; vertical alignment; and locations of construction and expansion joints.

c. Sections:

Sections taken through the wall to better indicate dimensions, reinforcing steel locations, concrete cover for rebars and elevations.

d. Estimated Quantities:

Estimated quantities for items incorporated in the wall, reinforcing bar list and standard bar bending sheet.

The Structures Design Office has prepared ***Index No. 5100*** of the ***Design Standards*** for use in conventional cantilever retaining wall designs. This Design Standard is to be used in conjunction with the Retaining Wall computer program available on the Structures Design Office web site. Design assumptions used in the development of ***Index No. 5100*** are in the "Retaining Wall Notes" in the program.

30.2.2 Retaining Walls (Proprietary Design) (Design Required in Contract Plans)

The following procedure for plans preparation should be followed if the walls are required to be fully detailed in the contract plans.

1. BDR/30% Plans

   The BDR shall discuss and justify the use of proprietary retaining walls. The 30% Plans shall contain preliminary Control Plans. It will not be necessary for these Plans to contain pay items and standard drawings; however, they shall include, but not be limited to, the following information:

   a. Key Sheet

   b. General Notes Sheet

      1) General notes

      2) In situ soil characteristics

      3) Design parameters

      4) Applicable wall systems

   c. Plan and Elevation Sheet:

      1) Horizontal and vertical alignment

      2) Limits of wall

      3) Utility locations

      4) Plan view of wall

      5) Elevation view of wall (showing existing and proposed ground lines, elevations at 30 ft. intervals at top of wall, wall embedment (maximum elevation at top of leveling pad) and beginning and end of wall stations)

      6) Boring locations

      7) Quantity (pay area of walls)

      8) Table showing soil reinforcement length vs. wall height (for external stability)

      9) Design parameters - Load and Resistance Factors

      10) Sections thru wall showing offset control point, pay area, ditches, sidewalks, superelevation and other unusual features

11) Ranges of wall systems applicable to the portion of the project defined by the plan and elevation sheet.

d. Soil Profile Sheet

e. General Details showing:

1) Wall/end bent cap interface

2) Barrier and coping to wall interface

3) Pile, inlets and pipe conflicts with soil reinforcement and slip joint details

f. Preapproved Standard Drawings:

Note: Through the June 2006 letting, standard drawings for each of the alternate companies will be included in the ***Design Standards***. As of the July 2006 letting, only general notes and common details for the proprietary retaining wall systems will be included in the ***Design Standards***. Vendor drawings with wall specific details for each approved wall company will be relocated on the State Specifications Office QPL website.

2. Control Plans/Invitation Package

The Control Plans shall be reviewed by the Department and, upon approval, sent to all the appropriate wall companies. The companies shall be provided with a set of control plans, roadway plans and foundation report. The Control Plans shall be sent to the wall companies as soon as they are approved. This action shall be accomplished as soon as possible but not later than the 60% Plans. A copy of the transmittals to the wall companies shall be sent to the DSDO or SDO as appropriate. The proprietary companies shall acknowledge receipt of the invitation package. If they choose to participate they shall provide design plans for the retaining walls and submit the plans for review as prescribed in the invitation letter.

3. 90% Plans

Upon receipt of the proprietary design plans, the designer shall review the design and incorporate the wall plans into the contract set. The plans from the wall companies, control plans and wall company standard drawings shall constitute the 100% Plans.

30.2.3 Retaining Walls (Proprietary Design - Control Plans only; Full Design not Required in Contract Plans)

Use the following procedure in preparing plans for wall projects.

1. BDR/30% Plans

   Discuss and justify the use of proprietary retaining walls and FDOT Wall Types (see ***Index 5300***) in the BDR. Provide documentation of all the site-specific geotechnical information and wall system considerations in the Retaining Wall Justification portion of the BDR. Include the Retaining Wall System Data Tables and Preliminary Control Plans with the information shown in ***Section 30.2.2*** for the Plan and Elevation Sheets.

2. 90% Plans

   Include the Control Plans into the 90% Plans submittal.

   General notes, common details, and the Table of FDOT Wall Types are shown in the ***Design Standards***. Approved proprietary retaining wall system drawings and details are listed, with FDOT Wall Type, on the State Specifications Office QPL website. The Data Tables are available on the FDOT Structures SiteMenu as MicroStation CADD cells.

   The site-specific wall design details are submitted as shop drawings for each project.

30.2.4 Wall System Selection

Using the site-specific geotechnical information, the Engineer of Record (EOR), in cooperation with the geotechnical engineer, will determine all wall system requirements. Design considerations include short term and/or long term settlement, differential settlement (both longitudinal and from front of wall to end of concrete stems or soil reinforcement (rotation)), and global stability. Use the Flow Chart ***Exhibit 30-A*** for Permanent Retaining Wall Design to determine:

1. Plan requirements
2. Concrete Class, Concrete Cover, and FDOT Wall Type

For all walls, place notes on the General Notes sheet of the Control Plans in accordance with the Plan Requirements listed in the Flow Chart ***Exhibit 30-A***.

During construction on projects with a FDOT Wall Type listed in the plans, the contractor will submit, for approval by the engineer, a QPL approved wall system allowed in accordance with FDOT Wall Type Table. The July 2006 ***FDOT Standard Specifications Section 548, Retaining Wall Systems*** will state: Unless otherwise detailed and/or shown in the plans, choose a wall system from the Qualified Products List (QPL) in accordance with the FDOT Wall Type listed in the plans.

On projects with non-QPL Walls (non-proprietary walls, complex walls, two phase walls, total settlement > 6 inches, differential settlement > 0.5%, etc), the complete wall design and details are included in the plans.

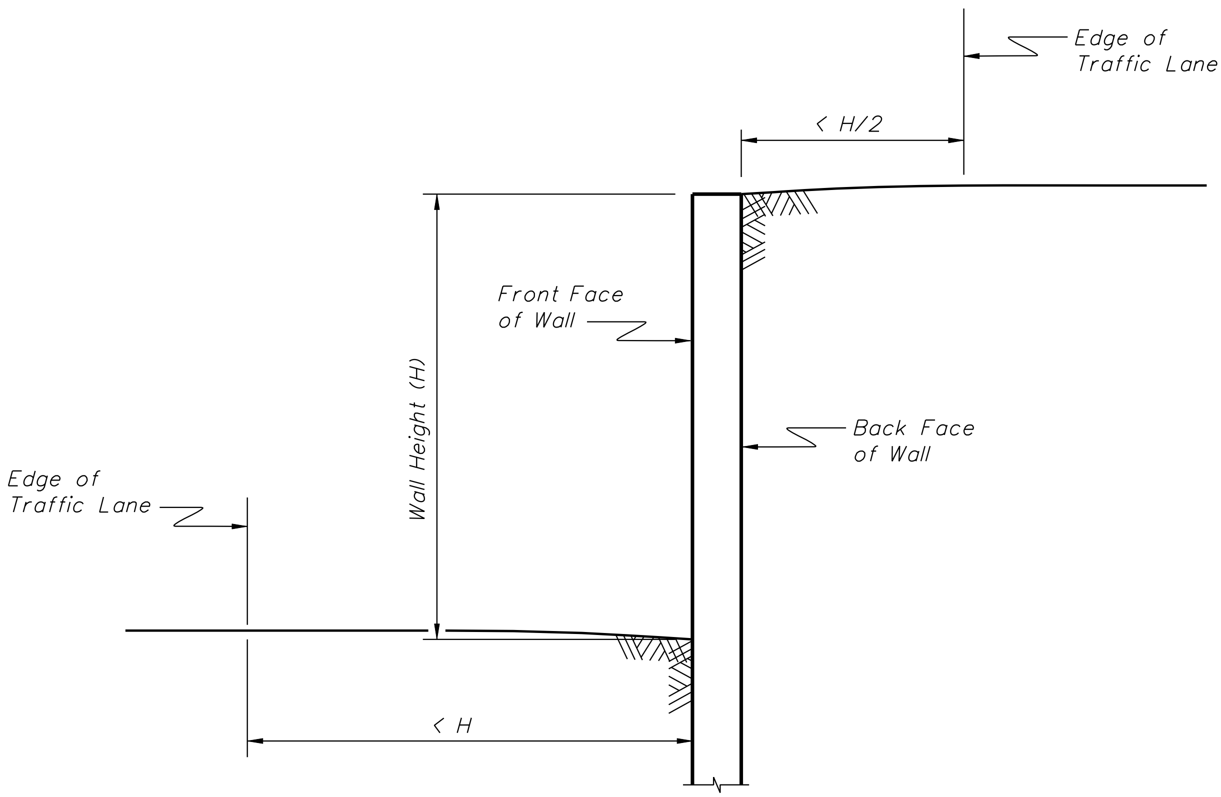
30.3 Critical Temporary Walls

A critical temporary wall is one that is necessary to maintain the safety of the traveling public, or structural integrity of nearby structures and utilities for the duration of the construction contract. Traffic lanes located either above or below a grade separation and within the limits shown in ***Figure 30.1***, will require the design of a critical temporary wall. Critical temporary walls shall be designed in accordance with this chapter, the ***AASHTO LRFD Bridge Design Specifications***, and the ***Structures Design Guidelines***. Generally temporary walls should be either mechanically stabilized earth (MSE) walls or steel sheet pile walls.

Critical temporary proprietary MSE walls shall comply with ***Design Standard Index No. 5301*** and require generic design details in the contract plans. The plans format shall be in accordance with ***Section 30.2.2*** and ***30.2.3***. Include control drawings and the completed Temporary Retaining Wall System Data Tables (See FDOT Structures SiteMenu for the MicroStation CADD cell). The final design details shall be submitted in the shop drawings.

Critical temporary sheet pile walls require complete design details in the contract plans. Include control drawings or tables with wall limits, minimum section modulus per foot, minimum moment of inertia per foot, minimum material properties, and minimum tip elevations. Provide a construction sequence and appropriate details if tiebacks are required, including anchors, wales, and deadmen or pullout resistance for grouted anchors.

Figure 30.1 Location of Critical Temporary Wall with Respect to Traffic Lanes



30.4 Experimental Wall Projects

Proprietary wall companies must comply with the Department's ***Guidelines for Selection and Approval of Proprietary Retaining Wall Systems, Topic No. 625-A20-118*** (available in Central Office Structures Design) and prepare standards to be approved and adopted by the FDOT. One of the requirements is to build a wall that may, at the discretion of the Department, be instrumented and monitored. Special instruction for design and plans preparation shall be obtained from the State Structures Design Office.

30.5 Shop Drawing Review

Conventional C.I.P. retaining walls do not require shop drawings; however, proprietary retaining walls require shop drawings in accordance with ***Chapter 28***.

The shop drawing reviewer (EOR) shall be experienced in the requirements, design and detailing of proprietary wall plans. The EOR shall review but not be limited to the following items:

1. Verify vertical and horizontal geometry with contract plans.
2. Verify details with MSE wall suppliers standard details in contract plans.
3. Soil reinforcement placement in acute corners shall be detailed.
4. Slip joints shall be at all bin wall and standard MSE wall interface locations.
5. Soil reinforcement shall be detailed at all obstructions. Cutting or kinking of soil reinforcement shall not be allowed. Connection of soil reinforcement to piles or bearing against piles shall not be allowed.
6. Corner panels shall be used at all locations where walls are deflected horizontally 5 degrees or more.
7. Compare proposed reinforced fill characteristics with design fill characteristics. In-place moist density of backfill may vary by $\pm$ 5 pcf, and the internal friction angle may be 1° less than the design values (as shown in control plans) before a check of the wall design is required. If the internal friction angle is greater than the design value then a redesign is not required.
8. Review proprietary wall internal stability design calculations.
9. Verify soil reinforcement lengths for conformance to the ***Structures Design Guidelines***, the external stability table on the plans, and the internal stability design calculations.
10. Confirm wall embedment.
11. Verify panel types and thickness are consistent with contract plans.
12. Soil reinforcement lengths shall be the same from top to bottom of wall at any section. The diameters of the longitudinal and transverse bars of any given mesh reinforcement shall be equal. The cross section of any soil reinforcement shall not vary along its length (i.e., "2WII" reinforcement shall not be spliced to "4WII").
13. Check stress level in soil reinforcement and connections.

30.6 Bidding Procedure

The conventional C.I.P. walls shall be bid as Concrete (Retaining Wall) and Reinforcing Steel (Retaining Wall). Conventional walls may be bid as an alternate to proprietary walls if the site conditions justify conventional walls.

Proprietary Walls shall be bid with Pay Item numbers;

548-___ Retaining Wall System (Permanent)

548-___ Retaining Wall System (Temporary)

Exhibit 30-A Permanent Retaining Wall Design

Flowchart for Retaining Wall Design*

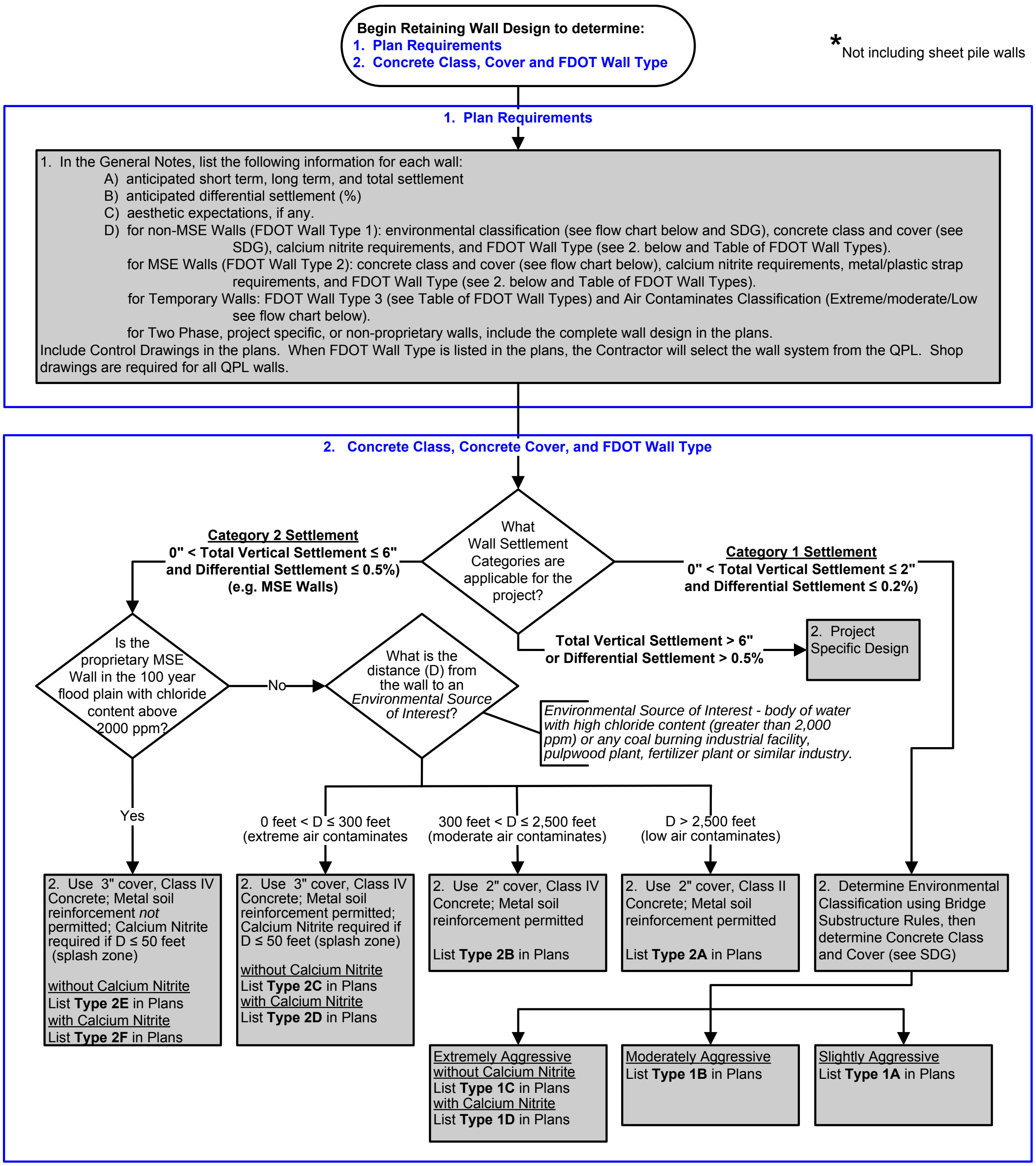


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Exhibit 30-A Permanent Retaining Wall Design (Continued)

Table of FDOT Wall Types

			Design Settlement Limitations					Durability Factors				Other Allowable Wall Types[7]									
Wall Type[1]	Proprietary QPL Item	Settlement Category	Total Settlement[2]		Differential Settlement[3]	Typical Wall Construction	Durability Category	Concrete Cover	Concrete Class	Calcium Nitrate	Soil Strap Type	1A	1B	1C	1D	2A	2B	2C	2D	2E	2F
Type 1	No	1	≤ 2"	and	≤ 0.2%	Cantilever, Gravity, and Counterfort Walls	Project Specific				n/a	Project Specific									
Type 1A	Yes						A	2"	II	No			✓	✓	✓	✓	✓	✓	✓	✓	✓
Type 1B							B	2"	IV	No				✓	✓		✓	✓	✓	✓	✓
Type 1C							C	3"	IV	No					✓		✓	✓	✓	✓	✓
Type 1D[4]							D	3"	IV	Yes											✓
Type 2	No	2	≤ 6"	and	≤ 0.5%	MSE Walls	Project Specific					Project Specific									
Type 2A	Yes						A	2"	II[5]	No	metal						✓	✓	✓	✓	✓
Type 2B							B	2"	IV[5]	No								✓	✓	✓	✓
Type 2C							C	3"	IV[5]	No									✓	✓	✓
Type 2D							D	3"	IV[6]	Yes											✓
Type 2E							E	3"	IV[6]	No	plastic										✓
Type 2F[4]							F	3"	IV[6]	Yes											
Type 3	Yes	3	n/a		≤ 2.0%	Temporary Walls	n/a				metal/plastic	n/a									

1 - Listed in the Plans; Wall Type combines both Settlement Limitations and Durability Factors.
2 - Amount of wall settlements that the will occur in its design life and includes both short and long term settlements. Short term settlements occur during wall construction and may contain elastic deformation and densification settlement. Long term settlements continue after the completion of the wall and may include consolidation and secondary consolidation/creep settlements.
3 - Settlements along the alignment of and perpendicular to the wall face; usually are not uniform. Expansion joints for the cast-in-place walls and slip joints for MSE walls are provided to control wall and wall panel cracks, respectively.
4 - Includes all underground walls and walls submerged in water.
5 - For concrete requirements, see Specification Section 346 using slightly aggressive environment.
6 - For concrete requirements, see Specification Section 346 using extremely aggressive environment.
7 - "Other Allowable Wall Types" listed with an "✓", have Settlement Limitations and Durability Factors greater than those required by the "Wall Type" (Column 1).

If steel pile foundation is considered suitable for the project, determine the environmental classification for corrosion rate evaluation.

Unless approved by the Department, the maximum post spacing for sound barrier panels shall not exceed 20'-0".

On flush shoulder roadways, sound barriers shall be located outside the clear zone unless shielded, and as close as practical to the right of way line. On urban curbed roadways, sound barriers shall be a minimum of 4 feet back of the face of curb. However, additional setbacks may be required to meet minimum sidewalk requirements. Sound barriers may be combined with traffic railings on a common foundation if the combination meets the crash test requirements of NCHRP 350 Test Level 4 criteria.

Besides the structural integrity of the sound barrier, the structural engineer should also be concerned with aesthetics, maintainability, constructability, cost and durability.

Sound barriers should not be located on bridge structures where feasible alternative locations exist. Sound barriers on bridge structures cause a disproportionate increase in bridge cost because of strengthening of the deck overhang and exterior girder. In addition, sound barriers on bridges interfere with normal maintenance inspection access and detract from the aesthetic quality of the structure. Where feasible alternative locations do not exist and sound barriers must be located on bridges or retaining walls, they shall not be taller than 8 ft. unless specifically approved in writing by the State Structures Design Engineer. See ***Design Standards, Index Nos. 5210 and 5212*** for acceptable crash tested 8 ft. bridge and retaining wall mounted sound barriers.

On bridges or on the top of retaining walls, where the sound barrier does not meet crash test requirements of NCHRP 350, Test Level 4, sound barriers shall be placed a minimum of 5 feet beyond the gutter line of a FDOT approved standard bridge railing, and the sound barrier shall be limited to 8 feet in height unless authorized by the State Structures Design Engineer due to reasons stated in the previous paragraph. Sound barriers may be combined with the traffic railing as long as the structural system meets the crash test requirements of NCHRP 350, Test Level 4 criteria.

32.7 Geotechnical Investigation

Once the barrier location, alignments, height and minimum thickness are determined, the soil exploration should be undertaken. The geotechnical engineer should follow the Department's ***Soils and Foundations Handbook*** for exploration.

32.8 Preparation of Control Drawings

The initial set of drawings to be prepared by the EOR is referred to as Control Drawings. By preparation of these drawings, the EOR shall provide all control parameters such as alignments, limits, notes, etc., and shall provide all the information which is common to all wall types including but not necessarily limited to:

1. Barrier alignments (horizontal and vertical)

2. Barrier limits (beginning and ending)

3. Location of all existing utilities (overhead and/or underground in the vicinity of the proposed barrier)

4. Location of fire-access openings

5. Location of drainage openings

6. Sound barrier graphics details

7. General Notes

8. "Report of Core Borings" (Soil Information Data)

9. Quantities (barrier area as described below for payment purposes only; the itemized quantities such as concrete volume, etc., shall be provided in the specific drawings)

10. All other information that may be construed to be of general nature

11. NOTE: The barrier area for bidding purposes shall be the area bounded by the barrier limits (beginning and ending), the top of the barrier, and the bottom of the lowest panel between posts. This is the vertical surface area that can be seen on an elevation view plus the portion of the lowest panel which is buried.

32.9 Detail Drawings

The EOR shall prepare Detail Drawings showing the specific details required for the implementation of the selected Design Standard barrier type. All barrier components such as: foundations, posts, panels, etc. shall be fully detailed for construction. All sound barriers shall include the FDOT Design Standard (non-proprietary) design. The FDOT Structures Sitemenu CADD cell tables shall be included in the plans depicting which QPL proprietary barrier designs are compliant with project specific requirements. These drawings shall provide the specific information as shown in the applicable drawings (see the ***Design Standards***).

Manufacturers of proprietary sound barrier products may have their products evaluated by the Department in accordance with the FDOT Sound Barrier Acceptance Criteria. Approved products will be listed on the Qualified Products List (QPL). The designer or project manager shall establish the project requirements for sound barriers and include commitments made during the PD&E phase or during the design phase public involvement. Project requirements may include color, textures, graphics, post spacing (10 feet or 20 feet), absorptive vs. reflective surface, flush vs. recessed panels, etc. The project requirements shall be listed in the plans.

The designer should refer to options outlined in the ***Structures Detailing Manual, Chapter 15***.

In addition to the Department's Design Standard for concrete sound barriers, the plans shall list proprietary sound barrier products that meet the project requirements and are listed in the QPL. Specify the environmental classification in the plans (for corrosion rate evaluation), if steel pilings can be considered for the project. Characteristics and details of each approved proprietary sound barrier product included in the QPL are listed in the Specification Office's web page.

Chapter 33

Reinforced Concrete Box and Three-Sided Culverts

Tables

Chapter 33

Reinforced Concrete Box and Three-Sided Culverts

33.1 General

This chapter presents the minimum requirements for selection and designing reinforced concrete culverts. The Department recognizes two types of reinforced concrete culverts other than reinforced concrete pipe. These are concrete box culverts (four-sided) and three-sided concrete culverts. Both of these culvert types are classified as Category 1 structures in accordance with ***Chapter 26***. It is not possible to provide prescriptive requirements for all conditions so guidance provided in this chapter is for typical designs. Each location will usually have some unique character (floods, scour, surroundings, salt water, historic character, etc.). Unique environments need to be thoroughly evaluated and all environmental requirements satisfied.

Structures with a span greater than or equal to 20 feet are technically not culverts, however, for simplicity all structures in this chapter are referred to as culverts. The procedures for designing culverts and bridges maybe different due to the differing risks associated with the size of the structure. Safety and economic issues and technical complexity can vary significantly with differing site conditions which will dictate the size and type of the most appropriate structural solution. Bridge-size culverts ($\geq$ 20 feet span) warrant more complex hydraulic and foundation treatments, which require the expertise of a bridge engineer. Simpler, less complex and smaller culvert-size structures ($\leq$ 12 feet span) may be designed with minimal oversight of a bridge engineer. Any questions on who should design a specific-size structure should be discussed with the District Structures Engineer.

The procedure for the hydraulic analysis of culverts differs based on whether the culvert is located at a riverine or tidal crossing. Refer to ***Chapter 4*** of the ***Drainage Manual*** for the appropriate hydraulic analysis and documentation requirements.

Definitions of terms used in this chapter include the following:

Bridge-size culverts are defined as any structure, whether of single-span or multiple-span construction, with an interior width greater than or equal to 20 feet when measured horizontally along the centerline of the roadway from face-to-face (inside) of the extreme abutments or sidewalls.

Culverts are defined as any structure, whether of single-span or multiple-span construction, with an interior width less than 20 feet when measured horizontally along the centerline of the roadway from face-to-face (inside) of the extreme abutments or sidewalls.

Concrete box culverts (four-sided) typically have rectangular cross sections. An arch or arch-topped culvert is considered a box culvert if the “sidewalls” are built monolithic with the bottom (invert) slab. Two-piece (four-sided) box culverts are permitted with a simply supported top slab, which is keyed into a monolithic three-sided bottom section. Concrete box culverts are typically used where the streambed is earth or granular soil and rock is not close enough to the streambed to directly support the structure.

Three-sided concrete culverts may be rectangular in shape or a frame with varying wall and/or slab thickness or an arched or arch-topped structure. These structures have separate foundations with spread footings supported by earth, rock or piles. The largest culverts are typically not boxes; rather they are frames or arches. Use of three-sided concrete culverts where rock is not at or near the streambed requires pile support for the footings or some other form of positive scour protection. Three-sided concrete culverts on spread footings may be used for railroads, wildlife crossings, bicycle/pedestrian/ equestrian/golf cart paths, and other uses that do not convey water or have scour vulnerability.

Clear span is the perpendicular distance between the inside face of the sidewalls. The maximum clear span recommended for a concrete box culvert is 24 feet.

Design span for non-skewed culverts is the perpendicular distance between the centerline of the sidewalls. For culvert units with skewed ends, the design span of end sections is the distance between the centerlines of the sidewalls measured parallel to the skewed end.

33.2 Structure Type Selection

The designer must determine the most appropriate type of short-span structure. The basic choices are a corrugated metal structure, concrete box culvert, concrete frame or arch, and a short-span bridge. While the site conditions are the primary deciding factor for structure selection, aesthetics, constructability and economics are also very important.

Proper selection of the feasible structure alternatives is based on site and project-specific parameters, including but not limited to:

1. Vertical and horizontal clearance requirements.
2. Available “beam” (top slab) depth.
3. Maintenance and protection of traffic requirements (e.g., phase construction).
4. Construction constraints (e.g., water diversion requirements).
5. Foundation requirements.
6. Environmental concerns (e.g., natural streambed).
7. Desired aesthetic treatments (e.g., arch appearance).
8. Geometric limitations (e.g., skew angle, R.O.W. restrictions, utilities, etc.).

Concrete culverts are usually more expensive in initial cost than corrugated metal structures. However, concrete culverts are the preferred alternative when considering suitability to the site and life-cycle cost estimates. The advantages of concrete culverts are superior durability for most environmental conditions, greater resistance to corrosion and damage due to debris, greater hydraulic efficiency, and typically longer service life (i.e., potentially lower life-cycle costs).

At sites with limited headroom, concrete culverts are generally the least expensive option. Smaller corrugated metal structures typically require a minimum height of soil cover of 2 feet and for some structures the soil cover increases to 4 feet or more depending on size and shape. Concrete culverts, frames, and arches can have the least amount of cover by placing a minimum of 3 inches of asphalt pavement directly on the top slab. Corrugated metal structures will also typically require taller structures than concrete box culverts, to provide adequate waterway area below design high water due to their arched shapes. If a corrugated metal structure is a viable option, an engineering evaluation and cost analysis should be performed in consultation with the District Drainage Engineer.

Single-cell and multi-cell concrete box culverts with barrel spans less than 15 feet, are often the most cost effective structural solution where debris collection and aesthetics are not a major concern. Three-sided culverts may be appropriate for single spans exceeding 20 feet where scour is not a concern.

Before a final determination is made to use a large concrete culvert, the use of a short-span bridge should be investigated. Possible advantages of a bridge may be minimized work in the stream, speed of erection, minimized interference with the existing structure foundation, and easier phased construction. For procedural steps on planning short-span bridges, see ***Chapter 26***.

Information on corrugated metal structures (steel and aluminum) is available in the ***Drainage Manual***. When corrugated metal structures are more cost efficient and they may be considered for off-system routes where there will be no major risk of corrosion or by utilizing concrete pedestal walls to ensure there is infrequent water contact with the metal portion of the structure.

33.2.1 Precast Concrete Culverts

Precasting permits efficient mass production of concrete units. The advantages often offset the cost of handling and transporting the units to the site. Precast units are often limited to certain sizes and skews due to forms, transportation and handling concerns. Skewed units may need more reinforcement and thicker slabs and/or sidewalls. The use of skewed units will increase the cost of the culvert due to increased fabrication costs.

Skewed precast culvert units should be avoided, if practical. Precast concrete culverts should have square ends, whenever possible. Skewed end units are sometimes required to satisfy right of way constraints and/or phased construction requirements for skewed alignments. In the event they are necessary, skewed precast culvert units shall be designed for the skewed-end design span. Large skews may lead to units that require additional reinforcement and/or greater wall and slab thickness than typical square units with the same clear opening. Manufacturers should be contacted for information on maximum skews available when only precast culverts are shown in the contract plans.

Precast culverts may occasionally need to be placed on moderate or steep grades. No maximum slope is recommended for box culverts because of the need to match the slope of the streambed. Three-sided box culverts and the frames and arches should be limited to a maximum slope of 2%. If matching a steeper slope is necessary, the ends of the precast units should be beveled to create vertical joints and the footings may be stepped and/or the length of the sidewall varied. Precast manufacturers should be contacted for the maximum grade that can be fabricated if the designer is proposing a grade larger than 2%.

When two or more single-cell, precast concrete culverts are placed side-by-side, it is usually not possible to place the walls of adjacent cells tightly together. The standard detail is to provide a 2 to 4 inch gap between the walls of adjacent cells. This gap should be filled with Class I (non-structural) concrete, non-excavatable flowable fill or non-shrink grout.

All manufacturers must have approved precast drainage product facilities in accordance with ***Section 6.3*** the ***Materials Manual***.

33.2.2 Concrete Box Culverts

When a concrete box culvert is selected as the appropriate structure for the site, a cast-in-place culvert must be designed and detailed in the contract plans. A precast concrete box culvert alternative is usually permitted during construction unless specifically excluded in the contract plans. Speed of erection, maintenance of traffic, stream diversion problems, and site constraints can be minimized when the Contractor utilizes precast culverts.

33.2.3 Three-Sided Concrete Culverts

There are various types of proprietary, precast concrete frames, arch topped units, and arches available. These units are typically used when larger culverts (spans ≥ 20 feet) are required. They can be considered when scour protection can be adequately provided and/or aesthetics are a consideration. They may be placed on spread footings with an invert slab, footings on rock, or pile-supported footings. The advantages of the precast concrete arches and frames are the same as for the precast concrete box culverts, except that longer spans (up to 48 feet) are possible.

When a three-sided concrete culvert is selected as the appropriate structure for the site a precast culvert should be the preferred option. A cast-in-place reinforced concrete foundation and the channel lining must be designed and detailed in the contract plans. The final design of the precast three-sided culvert structure and any necessary foundation modifications should be completed by the Contractor's Engineer of Record (usually the manufacturer).

Sizes of precast units that are common to more than one manufacturer should be selected. Dimensions of the sidewalls and top slab, reinforcement size and spacing should not be shown on the plans, unless necessary. If sidewall or top slab dimensions are dictated by site conditions, show only the affected dimensions and indicate if they are minimums, maximums, or specifically required dimensions. The assumed top slab dimension used to determine fill limits should be shown in the contract plans.

A note in the contract plans shall require the Contractor to provide all design details not included in the contract plans. This method should result in the most economical culvert design.

33.2.3.1 Precast Arch and Arch-Topped Units

The following guidelines should be considered when selecting a precast arch or arch-topped culvert:

1. Aesthetics concerns may make the use of arch-shaped units desirable. The use of arch-shaped facade panels is not recommended, especially for hydraulic openings due to snagging of debris.

2. The amount of skew that can be fabricated varies. Some manufacturers prefer to produce only 0° skew units. The maximum skew at which a precast unit should be fabricated is 45°. The culvert orientation to the centerline of the highway may be at a skew greater than 45°.

3. An arch unit is preferable for a grade separation for highway vehicles or railroads, when a dry conveyance environment is necessary. The arch shape eliminates any ponding problems above the culvert without special fabrication or field adjustments that would be required for flat-topped culverts.

4. Arch units are preferred in cases where fills above the precast units exceed 20 feet.

5. Precast arch-topped units are currently available in spans up to 48 feet.

6. Arched units have been used as liners for old masonry or concrete arches in other States. After the construction of a pedestal wall at the base, the units are slid into place. The void between the existing arch and the liner is filled with grout installed through fittings cast into the liner units.

7. Large arch units may be shipped in two pieces and assembled on site. Three-piece units are not permitted.

33.2.3.2 Precast Frame Units

The following guidelines should be considered when selecting a precast frame (rectangular) culvert:

1. Many of precast frame-type units can be fabricated with skew angles up to 45°. This characteristic is useful when phased construction is proposed. When used for phased construction with shallow highway pavements, no temporary shoring is needed at the phase construction joint to support the fill or pavement.
2. Frame units provide a simpler traffic railing/headwall connection than arch-topped units.
3. Frame units provide a hydraulic opening greater than arches of equivalent clear span when flowing full.
4. Precast frame units can be fabricated by some manufacturers with any increment of span length up to 40 feet, although typical span length increments are 2 feet.
5. Maximum rise of the units is normally limited to 10 feet due to shipping and handling considerations. If a larger rise is necessary, the designer should investigate the need for a pedestal wall.

33.3 Foundation Design

All structures discussed in this chapter, regardless of span and height of fill, are considered buried structures in regard to foundation design. Thus, there is no requirement for seismic analysis. This may change in the future as more research is completed.

For culverts with spans greater than or equal to 20 feet, foundation recommendations are provided to the designer in the Bridge Geotechnical Report (Phase I) and included in the Bridge Development Report (BDR). Foundation design parameters for culverts with spans less than 20 feet are provided by the District Geotechnical Engineer or the Department's Geotechnical Engineering consultant.

The District Geotechnical Engineer or the District Structures Design Office should be consulted to determine the proper foundation treatment.

33.3.1 Rock Foundations

In the unusual case where sound rock is at or near the surface of a streambed, an invert slab is not required and a three-sided culvert would generally be the appropriate structure selected. Concrete footings are either keyed or doweled into rock based on consultation with an Engineering Geologist and the District Geotechnical Engineer.

If the elevation of the rock surface varies by 2 feet or less, the wall height should be constant and the footing height varied. If the variation in rock surface elevation exceeds 2 feet, the height of the culvert wall may be varied at a construction joint or at a precast segment joint. In some cases, it may be necessary to use walls of unequal heights in the same segment, but this should generally be avoided.

33.3.2 Earth or Granular Soil Foundations

In most cases a concrete culvert will not be founded on rock, so a box culvert (four-sided) with an integral invert slab should be the preferred foundation treatment. However, in areas of compact soil and low stream velocities, three-sided concrete culverts may be used if they have positive scour protection such as piles or channel lining with concrete-filled mattresses, gabions or riprap rubble, and spread footings founded below the calculated scour depth. Three-sided concrete culverts located in stream beds, with spans equal to or exceeding 20 feet, must have pile supported footings when the structure is not founded on sound rock.

To avoid differential settlement, concrete box culverts should never be founded partially on rock and partially on earth. If rock is encountered in a limited area, it should be removed to a minimum depth of 12 inches below the bottom of the bottom slab and backfilled with either select granular material or crushed stone. Concrete culverts are rigid frames and do not perform well when subjected to significant differential settlement due to a redistribution of moments. All concrete box culverts located in streambeds should have a designed undercut and backfill. The standard undercut and backfill by ***Section 125*** of the ***Specifications for Road and Bridge Construction*** is 4 feet. The District Geotechnical Engineer should be consulted to determine the depth of the undercut and type of backfill material required for sites not located in streambeds or where significant settlement is anticipated.

A concrete box culvert can be considered if settlement is expected and the foundation material is fairly uniform. However, the culvert should be designed to accommodate additional dead load due to subsequent wearing surface(s) which may be needed to accommodate the settlement of the box. Precast culverts may require mechanical connections between units when significant differential settlement is anticipated. ***Design Standards Index No. 291*** provides criteria for cast-in-place bond beams to satisfy this requirement when joint openings are expected to exceed 1/8 inch. A Geotechnical Engineer should provide the anticipated differential settlement, which should be included in the contract plans.

If the foundation material is extremely poor and it is desirable to limit settlement, the problem should be referred to the District Geotechnical Engineer to determine the best course of action. A typical remedy might be removal of unsuitable or unstable material and replacement with suitable material.

33.3.3 Three-sided Culvert Foundation Design

When a three-sided structure is selected for a site, a cast-in-place footing design must be included in the contract plans. There are several types of culverts that may meet the project specifications. The designer must decide which specific type of unit would best fit that particular application and use those vertical and horizontal reactions for design of the foundations. The designer may contact known fabricators for design reactions. If no specific type of unit is determined as most appropriate, a conservative estimate of the design reactions for all types should be used and the reactions included in the contract plans.

33.4 Wingwalls

A wingwall is a retaining wall placed adjacent to a culvert to retain fill and to a lesser extent direct water. Wingwalls are preferably cast-in-place, but precast wingwalls may be considered on a project by project basis. Wingwalls are generally designed as cantilevered retaining walls however precast counterfort and binwalls may also be considered. Cast-in-place wingwall designs are provided by the Department's standard box culvert computer program.

Wingwall alignment is highly dependent on site conditions and should be evaluated on a case-by-case basis. The angle(s) of the wall(s) on the upstream end should direct the water into the culvert. It is also desirable to have the top of the wall elevation above the design high water elevation to prevent overtopping of the wall.

When precast wingwalls are permitted the designer should be aware of potential conflicts with ROW limits and utilities. The footprint of the footing and excavation, especially for bin type walls, can be extensive. Notes should be placed on the plans alerting the Contractor to these requirements when they exist. Due to skew and/or grade differences between the cast-in-place or precast culvert units and precast wingwalls it is necessary to provide a cast-in-place closure pour between the culvert end unit and precast wingwalls. A closure pour is not required if cast-in-place wingwalls are used.

When precast wingwalls are permitted the, cost shall be included in the cost of the culvert barrel. No separate item is required but the estimated concrete and reinforcing steel quantities for a cast-in-place design should be included in the contract plans.

33.5 Headwalls/Edge Beams

Headwalls are normally used on all culverts. In deep fills a headwall helps retain the embankment. In shallow fills the headwall may retain the subbase and/or highway pavement and provide the anchorage area for the railing system.

Headwalls should be cast-in-place and attached to precast culvert end segments in accordance with ***Design Standards Index No. 291***. Headwalls one foot or less in height with no railing attachment for single barrel precast culverts may be precast. If a curb must be placed on a culvert without a sidewalk, the headwall must be cast-in-place to allow for the tie-in of the curb's anchor bar, unless the curb is also cast at the precast facility.

The typical maximum height of headwalls is 3 feet. Greater heights are attainable but are only used in special cases. Headwall heights greater than 2 feet above the top slab require an independent transverse analysis, which is not provided by the FDOT box culvert program.

Concrete culverts with skewed ends may require additional stiffening of the top and bottom slabs by what is most commonly called an "edge beam". An edge beam is similar to a headwall or cutoff wall. The headwall may be used to anchor guardrail posts and traffic railings or retain earth fill, as well as stiffening the top slab of culverts that lose their rigid frame action as a result of having a skewed end.

When additional strength is required in the concrete edge beam, the following criteria shall be used:

1. If there is a 1-on-2 slope to the edge beam, it will be more economical to increase the depth of the edge beam in order to meet the required design.

2. When the edge beam is at shoulder elevation (anchoring guard rail and traffic railing), the edge beam height should be maintained and the width of the edge beam should be increased.

33.6 Cutoff Walls

A cutoff wall is required in all culverts with invert slabs to prevent water from undermining the culvert. The cutoff wall should be a minimum 24 inches below the bottom of the invert slab or to the top of sound rock if the rock is closer. For culverts founded on highly permeable soils or with significant hydraulic gradients, the designer should investigate the need for deeper cutoff walls. The cutoff wall may also act to stiffen the bottom slab for skewed box culverts.

Cutoff walls shall always be specified at each end of the barrel. When a concrete apron is provided, an additional cutoff wall shall also be shown at the end of the apron. For three-sided culverts, where the apron is made continuous with the barrel invert slab, the cutoff wall is only required at the end of the apron. The wingwall footings should have toe walls extending close to the bottom of the cutoff wall to prevent scour around the edges of the cutoff wall.

When a precast culvert is specified, the cutoff wall must cast-in-place and the cost should be included in the cost of the culvert barrel. No separate item is required but the estimated concrete and reinforcing steel quantities should be included in the contract plans.

33.7 Aprons

Box culverts can significantly increase the stream flow velocity because the concrete has a roughness coefficient significantly lower (i.e., smoother) than the streambed and banks. To dissipate this increase in energy and to prevent scour, a riprap rubble or other type of revetment apron may be required at the ends of some culverts. The District Drainage Engineer should be consulted to determine the appropriate apron requirements.

When a precast culvert is specified with a concrete apron, the apron must be cast-in-place and the cost should be included in the cost of the culvert barrel. No separate item is required but the estimated concrete and reinforcing steel quantities should be included in the contract plans.

33.8 Subbase Drainage

Draining surface and ground water away from the culvert through the subbase is almost as important as the conveyance of water through the culvert. All flat-topped or nonarched culverts should have a minimum longitudinal slope of approximately 1%, if possible, to drain the water that permeates through the pavement and subbase, away from the top of the culvert.

In situations where there is low fill (< 12 inches below the base coarse) ***Design Standards Index No. 280*** and ***Index No.289*** requires additional friable base or coarse aggregate material above the top and along the sides of the culvert to eliminate maintenance problems.

For deeper culverts, if a longitudinal slope is not possible, a 1% slope (wash), perpendicular to the centerline of the culvert, can be used. The wash can be from the centerline to each side or all in one direction. The wash can be formed into a cast-in-place culvert but is difficult to form on precast culverts. On precast culverts, the wash can be added after the culvert is in place by placing a shim course of asphalt or concrete.

An alternate solution in low fill conditions is to place a concrete pavement on top of the culvert. The minimum depth of concrete required is 6 inches. The concrete pavement is less susceptible to potholes than asphalt but is more costly and should have a longer service life. Contact the District Structures Design Engineer for guidance when considering the use of a concrete pavement section. Exclude precast units in the contract plans if there is concern about movement of units cracking the concrete pavement. Post-tensioning to connect precast units is not recommended.

33.9 Joint Waterproofing

Culverts will occasionally be used to allow the passage of things other than water, including but not limited to pedestrians, bicycles, trains, golf carts, wildlife, or farm animals. In cases where it is desirable to have a dry environment, a waterproof joint wrap should be used to cover the joints between precast culvert units or to cover the construction joints in cast-in-place culverts.

Even though a joint sealer is always placed between individual precast concrete culvert units and the units are pulled tightly together, water may seep through the joint. The minimum requirement for waterproofing these joints is to provide an external sealing band in accordance with ***ASTM C 877***, centered on the joints, covering the top slab, and then extending down the sidewalls to the footing. The purpose of the waterproofing membrane is to restrict seepage of water or migration of backfill material through the joints in the culverts and it is not intended to protect the concrete.

The external sealing band is mandatory for precast three-sided culverts under ***Section 407*** of the ***Specifications for Road and Bridge Construction*** but will need to be included as a note in the contract plans when required for box culverts.

33.10 Traffic Railings

The Department has set policy that requires highway rail to meet NCHRP 350 Test Level-3 (TL-3) and requires bridge traffic railings to meet AASHTO LRFD TL-4 in most situations. See ***Chapter 6*** of the ***Structures Design Guidelines*** for more information. Concrete culverts may be highway-size or bridge-size by definition, and therefore, the guardrail requirements can theoretically vary by the span of the structure.

Any roadside protection placed at a culvert should be provided as highway guardrail or as bridge traffic railing. Highway guardrail should be used whenever it meets applicable safety standards since it is the most cost-efficient barrier type.

The anchorage/support of the guardrail or traffic railing is determined by the amount of fill over the top of the culvert. If there is more than a minimum of 4 feet of fill, a zero offset or greater (from the face of guardrail to shoulder break) and a 1:2 or flatter slope, use highway guardrail with standard length posts. When the embankment slopes exceed 1:2 for zero offset or there is less than 4 feet of fill, the preferred option for guard rail depends upon the amount of fill and the size of the culvert as described below:

1. Culverts with less than 5 feet outside widths (railing length) and less than 4 feet of fill should have the posts straddle the outside of the culvert. This assumes the use of standard post spacing of 6.25 feet and W-beam guard rail posts.
2. Culverts between 5 feet and 20 feet outside width (railing length) and less than 4 feet of fill may have posts attached to the top of the box or posts shortened. See ***Design Standards Index No. 400*** for guidance on the appropriate option.
3. Culverts with more than 20 feet outside widths (railing length) and less than 4 feet of fill should have guardrail anchored into the headwall or individual concrete pedestals. When the guardrail is anchored to a headwall or pedestal, either thrie-beam or a concrete traffic railing shall be used.

Concrete traffic railing is generally not recommended due to the short length of culverts unless it is being connected to barrier along the highway. The transition of the thrie-beam guardrail onto the traffic railing face will use up most of the length of traffic railing on the culvert. For example, 32” F-Shape traffic railing has a 16 feet transition from the end of traffic railing to the end of the thrie-beam terminal connector.

Designers should note that the location of the first and last posts is critical on culverts. Headwalls under guardrail should be a minimum of 18 inches wide and the base plate must be located so that it is located at least 12 inches away from any construction joint or free end of the concrete headwall. Placement of base plates and bolts in the top slab should be avoided due to anchor embedment length problems and potential damage to the top of the culvert barrel.

33.11 Design Requirements for Concrete Culverts

Refer to the ***Chapter 3*** of the ***Structures Design Guidelines*** for design and analysis requirements.

33.12 Design Details

When a box concrete culvert is proposed for a site, the designer is required to provide a complete cast-in-place design for the contract plans. Standard details for concrete box culverts are provided in the ***Design Standards Index No. 289*** (LRFD). The contractor is usually permitted to substitute precast concrete box culverts for cast-in-place box culverts in accordance with ***Section 410*** of the ***Specifications for Road and Bridge Construction***. The contractor may select a standard precast box culvert design in accordance with ***Design Standards Index No. 292*** or provide a custom design. Design and fabrication details for precast box culverts, including calculations for custom designs, must also comply with the requirements of ***Design Standards Index No. 291*** and be submitted to the Engineer of Record for approval.

When a three-sided concrete culvert is proposed for a site, the designer is required to provide either a complete cast-in-place design or a conceptual precast barrel design with a complete foundation and wingwall design, for the contract plans. The contractor is permitted to substitute precast three-sided culverts for cast-in-place three-sided culverts in accordance with ***Section 407*** of the ***Specifications for Road and Bridge Construction***. Design and fabrication details for precast three-sided culverts, including calculations, must be submitted to the Engineer of Record for approval.

The bar designations in ***Table 33.1*** should be used for box culvert reinforcement:

Table 33.1 Bar Identification Schedule

BAR IDENTIFICATION SCHEDULE		
C.I.P (LRFD) Index No. 289	**Precast (LRFD) Index No. 292**	**Description / Bar Location**
105	As1	Top Corner Bars
106	As1	Bottom Corner Bars
102	As2	Top Slab, inside face transverse bars
103	As3	Bottom Slab, inside face transverse bars
101	As1/As7	Top Slab, outside face transverse bars
104	As1/As8	Bottom Slab, outside face transverse bars
108	As4	Exterior wall, inside face vertical bars
105/106	As1	Exterior wall, outside face vertical bars
107	-	Interior wall, vertical bars both faces
110/111	As9	Top Slab longitudinal bars (temperature reinf.)
109/112	As9	Bottom Slab longitudinal bars (temperature reinf.)
113/114		Exterior wall longitudinal bars (temperature reinf.)
115/ 116…		Interior wall longitudinal bars (temperature reinf.)
109	As6	Bottom Slab inside face longitudinal bars (design distribution reinforcement)
111	As5	Top Slab inside face longitudinal bars (design distribution reinforcement)

Additional reinforcing bars and designations should be added as required. No standardized bar designations are provided for three-sided culverts.

33.13 Computer Design and Analysis Programs

For LRFD designs the Department's ***LRFD Box Culvert Program*** (Mathcad) is available from the Structures Design Office website. This program analyses monolithic single of multi-barrel box culverts with prismatic members and integral bottom slabs only. The program requires input by the designer for all member thicknesses, material properties and reinforcing area utilizing a trial and error design methodology.

Other computer programs are available for design of reinforced concrete culverts such as BOXCAR and CANDE. Generally these other computer programs should only be used for preliminary designs or independent quality assurance checks. Designers should consult with the State Structures Design Office before using one of these other programs in lieu of the FDOT box culvert program.

33.14 Design and Shop Drawing Approvals

The Engineer of Record for the contract plans has design and shop drawing approval authority for precast concrete box and three-sided culverts. All calculations and shop drawings require a quality assurance review for general compliance of contract requirements and for suitability of the design for the given design conditions.

Standard precast concrete box culvert designs are available in ***Design Standards Index No. 292*** for a limited number of box culvert sizes. Modification of FDOT standard box culverts or design of special size box or three-sided culverts is delegated to Contractor's Engineer of Record in accordance with the ***Section 407*** and ***Section 410*** of the ***Specifications for Road and Bridge Construction***. The Contractor shall be responsible for providing all design computations and details for these units.

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