C RESURFACING

In addition to the design criteria provided in this chapter, the *2006 Americans with Disabilities Act Standards for Transportation Facilities* as required by *49 C.F.R 37.41* or *37.43* and the *2017 Florida Accessibility Code for Building Construction* as required by 61G20-4.002 impose additional requirements for the design and construction of resurfacing projects.

C.1 Accessibility Requirements

If new sidewalk and driveway construction or reconstruction is included on resurfacing projects they shall be designed to meet the requirements of ***Section C.7.d*** of ***Chapter 3 – Geometric Design*** and ***Chapter 9 – Pedestrian Facilities***. Project design should include an evaluation of existing driveways to determine if it is feasible to upgrade nonconforming driveways.

Existing detectable warnings and curb ramps shall be brought into compliance. This includes installing new detectable warnings for both flush shoulder and curbed roadway connections and signalized driveways where none exist or do not meet current requirements. New curb ramps shall be provided on curbed roadways where none exist and existing substandard curb ramps shall be replaced. Existing ramps not meeting detectable warning requirements which otherwise comply with orientation, slope and width criteria shall be retrofitted with detectable warnings.

Where existing right of way is inadequate or conflicts occur with existing features that cannot be practicably relocated or adjusted (e.g. driveways, drainage inlets, signal poles, pull boxes, utility poles, etc.), pedestrian accessibility shall be provided to the maximum extent feasible, with appropriate documentation signed and sealed by a Professional Engineer (EOR). Other than meeting detectable warning and curb ramp requirements, existing sidewalks and driveways are not required to be upgraded for the sole purpose of meeting requirements for accessibility unless included in the project scope.

C.2 Railroad-Highway Grade Crossing Near or Within Project Limits

Federal-aid projects must be reviewed to determine if a railroad-highway grade crossing is within the limits of or near the terminus of the project. If such railroad-highway grade crossing exists, the project must be upgraded to meet the requirements of the *Manual on Uniform Traffic Control Devices (2009 Edition with Revision Numbers 1 and 2, May 2012) (MUTCD)* in accordance with *Title*

23, United States Code (U.S.C), Chapter 1, Section 109(e) and *23 C.F.R. 646.214(b).* Please refer to Section C of ***Chapter 7 – Rail-Highway Crossings*** for further information.

C.3 Safety Improvements

Local agencies should strive to upgrade the safety of their facilities during scheduled maintenance intervals especially during pavement resurfacing projects. Particular attention should be paid to improving pedestrian and bicyclist safety using strategies such as crosswalks and bicycle facilities. Investments should also be made in improved guardrail end treatments and bridge-end transitions on high speed facilities.

C.3.a Pavement Safety Edge

Many low-cost strategies exist to improve the long-term safety of streets and highways. One such strategy is the pavement Safety Edge. The Safety Edge provides a higher probability of a vehicle returning safely to the travel lane when it drifts off the pavement. The Safety Edge is a wedge-shaped transition of the structural pavement to the unpaved shoulder. The wedge shape eliminates tire scrubbing against the pavement edge and improves vehicle stability as it crosses a drop-off.

The Safety Edge is particularly effective when providing a smooth transition from pavement to shoulder when vertical drop-offs exceed 2 inches. Construction of the Safety Edge typically includes initially pulling the unpaved shoulder for pavement structural course, and then backfilling onto the Safety Edge with installation of sod or turf. The Safety Edge is very effective in mitigating the severity of road-departure crashes should the unpaved shoulder erode away between maintenance intervals.

Details for the Safety Edge are included in Figures 10 – 1 Two Lane Road with Safety Edge and 10 – 2 Safety Edge Detail (No Paved Shoulder). Safety Edge should be constructed adjacent to the pavement edge on rural roadways with no paved shoulder and posted speeds 45 mph and above.

Figure 10 – 1
Two Lane Road with Safety Edge

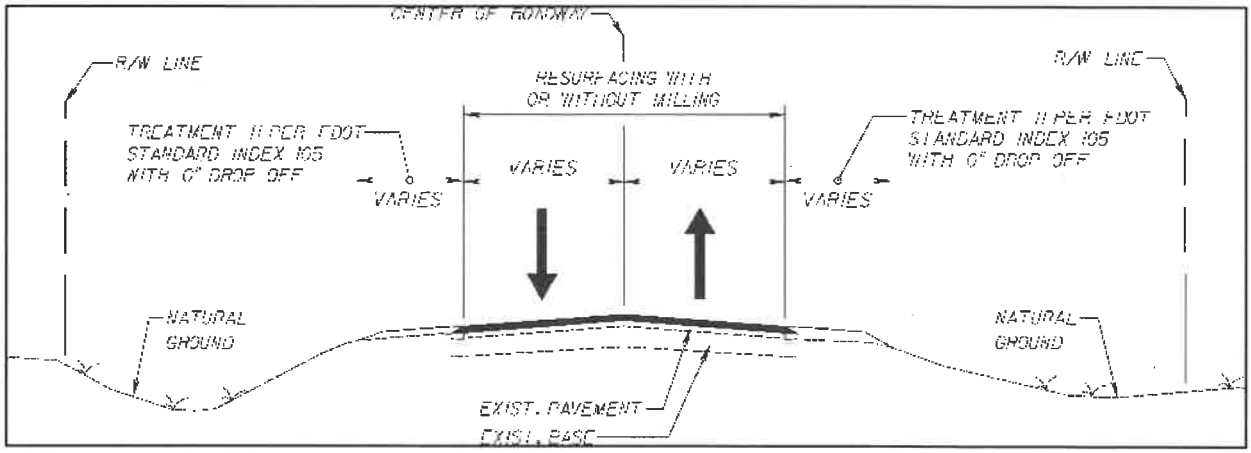
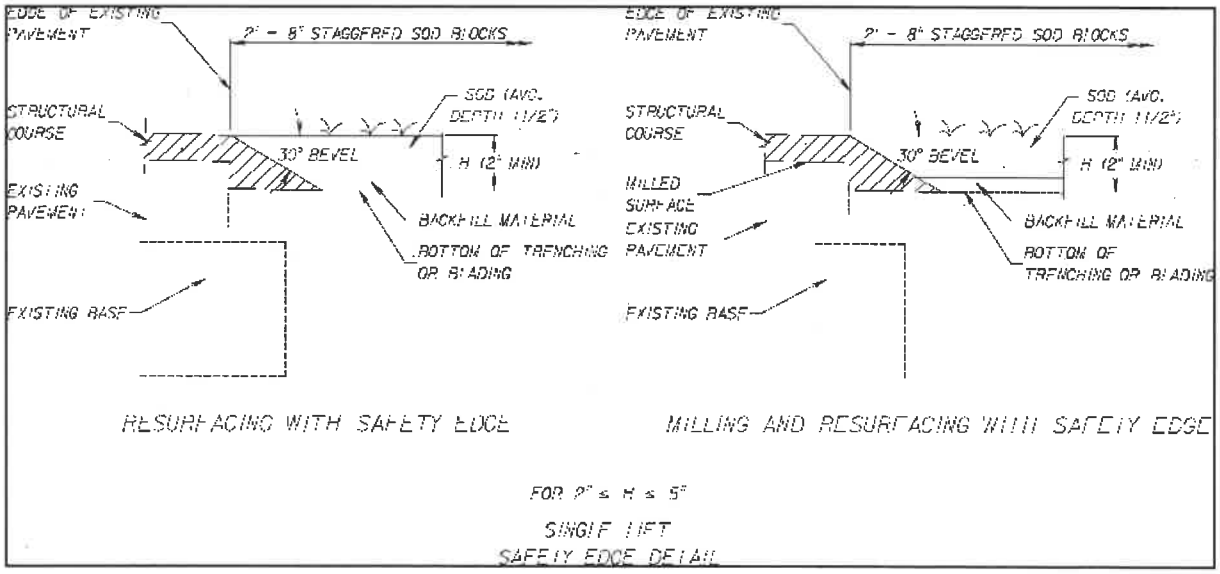


Figure 10 – 2
Safety Edge Detail (No Paved Shoulders)



C.4 Federal Aid Project Requirements

The following are the minimum requirements that a local highway resurfacing project scope must contain for federal-aid assistance including projects in the Local Agency Program (LAP):

1. Rework shoulders to be flush with the pavement and establish turf along the pavement edge.

2. Upgrade or replace existing roadside hardware (guardrail) as necessary for compliance with Federal criteria for 3R projects (as summarized in the ***Department's Design Manual, Chapter 215 Roadside Safety***).

3. Meet the latest ***Manual on Uniform Traffic Control Devices (2009 Edition with Revision Numbers 1 and 2, May 2012) (MUTCD)*** standards for signing and pavement marking.

4. Construct or reconstruct, as appropriate, curb cuts and ramps to meet current accessibility requirements.

5. Upgrade the safety of the project by mitigating the impact of crashes involving vehicles, bicycles and pedestrians.

   Note: The local agency may contact the FDOT District Safety Office and determine locations within the project with crash rates higher than average for similar facility type. The local agency may then identify the causes of the crashes from a review of crash report data provided by the FDOT District Safety Office. Based on this analysis, the local agency may then specify the appropriate crash mitigation measures (additional guardrail, signing, vibratory/audible pavement marking, designated crosswalks or other prudent safety-enhancing strategies).

6. Upgrade railroad crossings to meet the latest ***Manual on Uniform Traffic Control Devices (2009 Edition with Revision Numbers 1 and 2, May 2012) (MUTCD)*** requirements in accordance with ***Title 23, United States Code (U.S.C), Chapter 1, Section 109(e)*** and ***23 C.F.R. 646.214(b)***. Please refer to ***Section C*** of ***Chapter 7 – Rail-Highway Crossings*** for further information.

D REFERENCES FOR INFORMATIONAL PURPOSES

The following is a list of publications that may be referenced for further guidance:

- FHWA Pavement Preservation Definitions, HIAM-20, September 12, 2005, http://www.fhwa.dot.gov/pavement/preservation/091205.cfm
- NCHRP Synthesis 417: Geometric Design Practices for Resurfacing, Restoration, and Rehabilitation, http://www.nap.edu/

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CHAPTER 11

WORK ZONE SAFETY

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CHAPTER 11

WORK ZONE SAFETY

A INTRODUCTION

Construction, maintenance, and utility work, along with traffic incident management, are roadwork operations that create highway safety challenges. The changes to normal traffic flow and the introduction of unexpected travelling conditions at many work zones may generate hazardous situations and serious traffic conflicts. A comprehensive plan for work zone safety is required to minimize the risks and effects of these roadwork operations. Any activity within the highway right of way shall be subjected to the requirements of work zone safety.

B BACKGROUND

Section 316.0745, Florida Statutes, mandates the Department of Transportation compile and publish a manual of traffic control devices for use on the streets and highways of the state. To comply with this statute, the ***Federal Highway Administration's (FHWA) Manual on Uniform Traffic Control Devices (MUTCD)*** has been adopted for use in ***Rule 14-15.010, Florida Administrative Code (F.A.C.)***.

The intent of this chapter is to require conformance to the ***MUTCD, Part 6***.

C OBJECTIVES

Managing traffic during roadwork operations is necessary to complete roadwork or resolve traffic incidents in a timely manner while minimizing traffic delays, maintaining access to travelers, and most importantly maintaining an acceptable level of safety. The general objective of a program of work zone safety is to protect workers, traffic incident responders, pedestrians, bicyclists, and motorists during roadwork operations. This general objective may be achieved by meeting the following specific objectives:

- Provide adequate advance warning and information about upcoming work zones
- Provide the pedestrians, bicyclists and motorists clear information to understand how to navigate through or around the work zone
- Reduce the consequences of an out-of-control vehicle

- Provide safe access and storage for equipment and material
- Promote the speedy completion of projects (including thorough cleanup of the site)
- Promote the use of the appropriate traffic control and protection devices
- Provide safe passageways for pedestrians through, in, and/or around construction or maintenance work zones, including persons with disabilities in compliance with the *2006 Americans with Disabilities Act Standards for Transportation Facilities* as required by *49 C.F.R 37.41 – Construction of Transportation Facilities by Public Entities* or *37.43 - Alteration of Transportation Facilities by Public Entities* and the *2017 Florida Accessibility Code* as required by *61G20-4.002.*

D POLICY

Each agency with responsibilities for construction, maintenance, utility, or traffic incident management, or any roadwork operations on streets and highways shall develop and maintain a program of work zone safety, as set forth in the *MUTCD, (Chapter 6A).* Additional requirements related to all highway construction projects financed in whole or in part with federal-aid highway funds are provided in *Title 23 Code of Federal Regulations (CFR) 630 Subpart J,* more commonly known as the ***Work Zone Safety and Mobility Rule*** impose additional requirements for the design and construction of projects financed in whole or in part with federal-aid highway funds.

E PLANNING OF ROADWORK OPERATIONS

The achievement of work zone safety requires careful and complete planning prior to the initiation of any roadwork. The planning objective is to develop a comprehensive temporary traffic control plan that includes the following considerations:

E.1 Project Requirements

E.1.a Type of Operation

Roadwork operations may be further classified as routine, unplanned, or planned operations.

E.1.a.1 Routine Operations

Routine operations would involve projects such as mowing, street cleaning, and preventive maintenance operations conducted on a regularly scheduled basis.

E.1.a.2 Unplanned Operations

Unplanned operations require prompt, efficient action to restore the roadway to a safe condition. These include traffic incident management such as clearing vehicle crash or storm debris, addressing hazardous materials spills, repairing or replacing damaged highway safety components and restoring inoperative traffic control devices.

E.1.a.3 Planned Operations

Planned operations are scheduled roadwork projects, neither routine nor time-sensitive in nature, that are occasionally required to maintain or upgrade a street or highway.

E.1.b Nature of the Roadwork

The development of the temporary traffic control plan for work zone safety should include consideration of the following factors:

- Time span required
- Requirements for continuous operation or occupation of the work zone
- Capability of clearing the site during cessation of work activity
- The various construction methods, equipment, and procedures that may be utilized. Evaluation of alternate methods should be undertaken to determine the safest and most efficient procedures
- The necessity for storing equipment or material in the highway right of way
- Roadwork operations that may expose workers to hazards from through traffic

- Hazards to out of control vehicles such as excavations or unguarded structures or equipment
- Equipment inspection and preventive maintenance program

E.1.c Nature of the Work Zone

The nature of the work zone and the prevailing traffic conditions should, to a large degree, influence the procedures incorporated into the plan for work zone safety. The development of the temporary traffic control plan should include consideration of the following factors:

- Location of the work zone in relation to the proximity to side streets, driveways, bus stops, schools, parks, places of worship, etc.
- Determination of the design vehicle, normal vehicle travelling speed, and traffic volumes.
- Distribution of traffic with respect to peak traffic periods (seasonal, day of week, time of day, etc.)
- Truck percentage, frequency of transit vehicles, and direction of traffic is also important for establishing traffic control procedures.
- Presence of Intelligent Transportation Systems (ITS) such as dynamic message boards.
- Site conditions that may be confusing or distracting to the motorist, pedestrian, or bicyclist.
- Limitations on sight distance.
- Decreased visibility associated with nighttime roadwork operations.
- Impacts of detours and diversions to business and residential communities.
- Pedestrian and bicycle accommodations.
- Reasonableness of detour length and complexity.

E.2 Work Scheduling

Proper work scheduling and sequencing of roadwork operations will not only promote efficiency, but also improve the safety aspects. Where feasible, routine operations and special projects should be conducted during periods of low traffic volume to reduce conflicts. Projects that may be carried out concurrently at the same site should be scheduled simultaneously to eliminate successive disruptions of traffic. Major projects that impede or restrict traffic flow should be coordinated and sequenced with similar projects in adjacent areas, to produce a minimum of disruption to orderly traffic flow in the overall highway network. The scheduling of work at a given location should include consideration of traffic generation (including special events), as well as traffic restrictions by work activities on the surrounding highway network.

E.3 Traffic Control and Protection

Plans for traffic control around or through work zones should be developed with safety receiving a high priority. Plans should include protection at work zones when work is in progress and when operations have been halted (such as during the night). Provisions for the protection of work crews, traffic control personnel, bicyclists, pedestrians (in areas of high pedestrian use, construction of temporary facilities should be considered), and motorists shall be included in the operation plans. The plan for traffic control and protection should consider provisions for the following:

- Advance warning devices
- Work zone traffic signs
- Clear view of work zone
- Roadway delineation and channeling devices
- Clear zone (***Chapter 4 – Roadside Design***)
- Regulatory information
- High visibility safety apparel for workers
- Traffic control officers and law enforcement
- Hazard warning
- Barriers

- Pedestrian and bicyclist safety
- Access for pedestrians, bicyclists, and vehicles
- Access to adjacent properties by the public during construction
- Location of construction vehicles and equipment, including access into and out of the work zone
- Night safety (***Chapter 6 – Lighting***)
- Personnel training
- Traffic control and protective devices – including transverse rumble strips (***Chapter 18 – Signing and Marking)***
- Transit Stops – including passenger access
- Abrupt changes in geometry (lane narrowing, lane drop, transitions)
- Turning restrictions
- Temporary traffic signals

E.4 Coordination with Others

To ensure safe and efficient roadwork operations, the temporary traffic control plan should be developed and executed in cooperation with interested individuals and agencies, which may include the following:

- Highway agencies
- Police agencies
- Emergency agencies
- Contractors
- Utilities
- Building departments
- Mass transit agencies
- Traffic generators
- Local residents and businesses
- Neighboring jurisdictions
- School Boards

- Postal Services
- Media
- Trash and recycling pick ups

F WORK ZONE MANAGEMENT

Roadwork operations shall follow an appropriate temporary traffic control plan.

F.1 Public Information

All reasonable effort should be made to inform the public of the location, duration, and nature of impending roadwork operations. Transit agencies should be given advanced notice of planned operations so they can be responsible for notifying their passengers.

F.2 Contracts and Permits

For construction and reconstruction projects, the general work zone layout; traffic control and protection procedures; occupational safety and health requirements; and specific traffic control devices required should be incorporated in the contract plans and specifications.

New utility installations in public rights of way are prohibited unless a permit by the appropriate highway agency is issued. Permits for routine maintenance (e.g., deteriorated pole/equipment replacement), minor alterations (e.g., changes in cable, wire, or transformer size), service drops, or emergency work should generally not be required. ***Occupational Safety and Health Administration (OSHA)*** regulations for work zone safety should be reviewed prior to any construction by utility companies involving encroachment of the highway right of way by workers, equipment or material.

F.3 Inspection and Supervision

A regular program of inspection and supervision of all construction and maintenance projects shall be established and executed.

G EVALUATION OF PROGRAM

The entire program for work zone safety should be periodically evaluated and revised to provide the safest practicable environment for workers, pedestrians, and motorists during roadwork operations.

CHAPTER 12

CONSTRUCTION

CHAPTER 12

CONSTRUCTION

A INTRODUCTION

The purpose of this chapter is to establish guidelines for field procedures, as they pertain to control of construction projects, supervision, and contract administration. All construction projects require an inspection process to administer the contract, to certify the project has been constructed within reasonable conformance with the plans/specifications, and the materials which were incorporated into the project were properly tested/certified.

All construction projects require:

- An inspection procedure to administer the contract
- Certification

B OBJECTIVES

Construction of street and highway facilities is the result of the effort, of the engineer, the contractor, and the owner. Minimum construction standards shall be followed to provide for proper implementation of the design. The following general objectives for roadway construction should be followed to ensure proper construction:

- All construction performed and all materials utilized shall be in reasonably close conformity with the construction plans and contract documents.
- The responsibilities and obligations of the owner, engineer, and contractor should be clearly defined.
- A safe working environment shall be provided in accordance with ***Chapter 11 – Work Zone Safety***.
- Adequate procedures through established methods of sampling and testing shall be implemented to provide for the control and placement of materials.

C CONTROL OF THE WORK

C.1 Plans and Contract Documents

The Contractor will be furnished an appropriate number of copies of the plans and special provisions as required for the particular project. The Contractor shall have available at the work site, at all times, one copy each of the plans (including relevant Design Standards), Specifications, and Special Provisions.

C.1.a Plans

The plans furnished consist of general drawings showing such details which are necessary to give a comprehensive idea of the construction contemplated. Roadway plans will show, in general, alignment, profile grades, typical cross sections, and general cross sections as necessary. Structure plans, in general, will show in detail all dimensions of the work contemplated.

C.1.b Alterations in Plans

No changes shall be made on any plan or drawing after it is approved by the Engineer, except as authorized in writing by the Engineer. All authorized alterations affecting the requirements and information given on the approved plans shall be in writing.

C.1.c Working Drawings (for Structures)

C.1.c.1 General

The Contractor shall furnish such working, shop, and erection drawings, as may be required, to complete the structure in compliance with the design shown on the plans.

C.1.c.2 Submission of Working, Shop, and Erection Drawings

All working, shop, and erection drawings prepared by the Contractor or his agents (subcontractor, fabricator, supplier, etc.) shall be

reviewed, dated, stamped, approved, and signed by the Contractor prior to submission to the Engineer of Record for review. The Contractor's signed approval of drawings submitted shall confirm he/she has verified the work requirements, field measurements, construction criteria, sequence of assembly and erection, access and clearances, catalog numbers, and other similar data. Each series of drawings shall indicate the specification section and page or drawing number of the contract plans to which the submission applies. The Contractor shall indicate on the working, shop, and erections drawings all deviations from the contract drawings and shall itemize all deviations in his letter of transmittal.

C.1.c.3 Responsibility for Accuracy of Working Drawings

It is understood that approval by the Engineer of the Contractor's working drawings does not relieve the Contractor of any responsibility for accuracy of dimensions and details, or for conformity of dimensions and details. The Contractor shall be responsible for agreement and conformity of his working drawings with the approved plans and specifications.

C.2 Coordination of Plans, Specifications, and Special Provisions

The specifications, plans, special provisions, and all supplemental documents are integral parts of the contract, and a requirement occurring in one is as binding as though occurring in all. They are to be complementary and to describe and provide for a complete work.

In cases of discrepancy, the governing order of the documents shall be as follows:

- Special Provisions
- Plans
- Standard Drawings
- Specifications

C.3 Conformity of Work with Plans

All work performed and all materials furnished shall be in reasonably close conformity with the lines, grades, cross sections, dimensions, and material requirements, including tolerances, shown on the plans or indicated in the specifications.

In the event the Engineer finds the materials or the finished product in which the materials are used not within reasonably close conformity with the plans and specifications, but reasonably acceptable work has been produced, he/she shall then make a determination if the work shall be accepted and remain in place. In this event, the Engineer will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials as he deems necessary to conform to his determination based on engineering judgment.

In the event the Engineer finds the materials, or the finished product in which the materials are used, or the work performed, are not in reasonably close conformity with the plans and specifications and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by and at the expense of the Contractor.

C.4 Conformity of Work Shown in Regulatory Permits

All work shall be accomplished in accordance with special conditions of the regulatory permits.

C.5 Authority of the Engineer

All work shall be performed to the satisfaction of the Engineer.

C.6 Engineering and Layout

C.6.a Control Points Furnished

Horizontal and vertical control points are required at appropriate intervals along the line of the project to facilitate the proper layout of the work. The Contractor shall preserve all control points furnished.

C.6.b Layout of Work

Utilizing the control points furnished, all horizontal and vertical controls shall be established as necessary to construct the work in conformance with the plans and specifications. The work shall include performing all calculations required and setting all stakes needed, such as grade stakes, offset stakes, reference point stakes, slope stakes, and other reference marks or points necessary to provide lines and grades for construction of all roadway, bridge, and miscellaneous items.

C.6.c Personnel, Equipment, and Record Requirements

The Contractor shall employ only competent personnel and utilize only suitable equipment in performing layout work.

Adequate field notes and records shall be kept as layout work is accomplished. These field notes and records shall be available for review by the Engineer as the work progresses and copies shall be furnished to the Engineer at the time of completion of the project. Any inspection or checking of the Contractor's field notes or layout work by the Engineer, and the acceptance of all or any part thereof, shall not relieve the Contractor of his responsibility to achieve the lines, grades, and dimensions shown in the plans and specifications.

C.7 Contractor's Supervision

C.7.a Prosecution of Work

The Contractor shall give the work the constant attention necessary to assure the scheduled progress and shall cooperate fully with the Engineer and with other contractors at work in the vicinity.

C.7.b Contractor's Superintendent

The Contractor shall at all times have on the work site, as his/her agent, a competent superintendent capable of thoroughly interpreting the plans and specifications and thoroughly experienced in the type of work being performed, and who shall receive the instructions from the Engineer or his/her authorized representatives. The superintendent shall have full

authority to execute the orders or directions of the Engineer and to supply promptly any materials, tools, equipment, labor, and incidentals which may be required. Such superintendence shall be furnished regardless of the amount of work sublet.

C.7.c Supervision for Emergencies

The Contractor shall have a responsible person available at or reasonably near the work site on a twenty-four hour basis, seven days a week, in order that he/she may be contacted in emergencies and in cases where immediate action must be taken to maintain traffic or to handle any other problems that might arise. The Contractor shall be responsible for initiating, installing, and maintaining all traffic control devices as described in ***Chapter 11 – Work Zone Safety*** and in the plans.

C.8 General Inspection Requirements

C.8.a Cooperation by Contractor

No work shall be done nor materials used without suitable supervision or inspection by the Engineer. The Contractor shall furnish the Engineer with every reasonable facility for ascertaining whether the work performed and materials used are in accordance with the requirements and intent of the plans and specifications.

C.8.b Failure of Engineer to Reject Work During Construction

If, during or prior to construction operations, the Engineer should fail to reject defective work or materials, whether from lack of discovery of such defect or for any reason, such initial failure to reject shall in no way prevent his/her later rejection when such defect is discovered.

C.9 Final Construction Inspection Maintenance until Final Acceptance

The Contractor shall maintain all work in first-class condition until it has been completed as a whole and has been accepted by the Engineer. When all materials have been furnished, all work has been performed, and the construction

contemplated by the contract has been satisfactorily completed, the Engineer will make the final inspection.

D CONTROL OF MATERIALS

D.1 Source of Supply and Quality Requirements

D.1.a Only Approved Materials to be Used

Only materials conforming to the requirements of the specifications and approved by the Engineer shall be used in the work. Any materials proposed for use may be inspected or tested at any time during their preparation and use. No material which, after approval, has in any way become unfit for use, shall be used in the work.

D.2 Inspection and Tests at Source of Supply

D.2.a General

The Engineer may undertake the inspection of materials at the source of supply.

D.2.b Cooperation by Contractor

The Contractor shall assure the Engineer has free entry at all times to such parts of the plant as concern the manufacture or production of the materials ordered, and shall bear all costs incurred in providing all reasonable facilities to assist in determining whether the material furnished complies with the requirements of the specifications.

D.3 Control by Samples and Tests

D.3.a Materials to be Tested, Samples

The Engineer may require any or all materials to be subjected to tests by means of samples or otherwise, at production points, after delivery, or both, as he/she may determine.

D.3.b Applicable Standards

Methods of sampling and testing materials shall conform to the Engineer's requirements and should be in accordance with ***Florida Sampling and Testing Methods (FSTM)*** so far as covered therein. Otherwise, they should be in accordance with Standards of AASHTO, ASTM, or other criteria as specifically designated by the Engineer. Where an AASHTO, ASTM, or other non-Florida Method is designated, but a Florida Method which is similar exists, sampling and testing should be in accordance with the Florida Method.

Whenever in these Specifications, FSTM, AASHTO, ASTM, or other standards are referenced without identification of the specific time of issuance, the reference should be construed to mean the most current issuance, including interims or addendums thereto, at the time of advertisement for bids for a project.

D.4 Quality Control System

D.4.a General Requirements

The Contractor shall furnish and maintain a quality control system that will provide reasonable assurance that all materials and products submitted for acceptance conform to the contract requirements, whether manufactured or processed by the Contractor or procured from suppliers or subcontractors. The Contractor shall perform or have performed the inspection and tests required to substantiate product conformance to contract requirements and shall also perform or have performed all inspections and tests otherwise required by the contract.

D.4.b Documentation

The Contractor shall maintain adequate records of all inspections and tests. The records shall indicate the nature and number of tests made, the number and type of deficiencies found, the quantities approved and rejected, and the nature of corrective action taken, as appropriate.

D.4.c Corrective Actions

The Contractor shall take prompt action to correct any errors, equipment malfunctions, process changes, or other assignable causes which have resulted or could result in the submission of materials, products, and completed construction which do not conform to the requirements of the specifications.

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CHAPTER 13

PUBLIC TRANSIT

FIGURES

CHAPTER 13

PUBLIC TRANSIT

A INTRODUCTION

All modes of transportation (autos, trucks, transit vehicles, rails, aircraft, water craft, bicyclists, and pedestrians) should be considered when planning, designing, and constructing the surface transportation system. Where there is a demand for highways to serve vehicles, there could also be a demand for public transit or public transportation. Public transit should be considered in all phases of a project, including planning, preliminary design and engineering, design, construction, and maintenance. Coordination with the appropriate public transit provider(s) will help determine the need for transit related infrastructure on a project-by-project basis. The integration of public transit street side facilities along with pedestrian and bicycle facilities furthers the implementation of this goal.

Planning and designing for public transit is important because it is an integral part of the overall surface transportation system. Public transit is defined as passenger transportation service, local or regional in nature, which is available to any person. It operates on established schedules along designated routes or lines with specific stops and is designed to move relatively large numbers of people at one time. Public transit includes bus, light rail, street cars, bus rapid transit and paratransit.

With rising levels of congestion resulting in the use of new strategies to effectively and efficiently manage mobility, there is an increased demand for accessible and user friendly public transit. New strategies include increased emphasis on public transit and new emphasis on Transportation System Management (TSM), as well as Transportation Demand Management (TDM). TSM is the use of low cost capital improvements to increase the efficiency of roadways and transit services such as retiming traffic signals or predestinating traffic flow. TDM focuses on people reducing the number of personal vehicle trips, especially during peak periods. TDM includes the promotion of alternatives to the single occupant vehicle, including public transportation, carpooling, vanpooling, bicycling, walking, and telecommuting, as well as other methods for reducing peak hour travel.

Federal and State legislation provide the stimulus for planning, designing, and constructing a fully integrated transportation system benefiting the traveling public and

the environment. Examples of legislation include ***Fixing America's Surface Transportation Act (FAST Act)***, ***Americans with Disabilities Act of 1990 (ADA)***, and ***Clean Air Act Amendment of 1990 (CAAA)***. In response to this legislation, the surface transportation system should provide for concurrent use by automobiles, public transit and rail, bicycles and pedestrians.

B OBJECTIVE

There are a number of methods to efficiently develop a coordinated surface transportation system. Coordination among agencies is necessary during the planning and design stages to:

- incorporate transit needs and during the construction phase for re-routing bus (and complementary pedestrian) movements, and
- for actual transit agency specific requirements (e.g., bus stop sign replacement, shelter installations, etc.).

For planning purposes, the state and local Transportation Improvement Program (TIP) should be referenced. Additionally, individual transit authorities have ten-year Transit Development Plans (TDPs) that are updated annually. The TDP can be used as a guide for planned transit needs along existing and new transportation corridors so transit consideration and transit enhancements can be incorporated where appropriate.

C TRANSIT COMPONENTS

C.1 Boarding and Alighting (B&A) Areas

Boarding and Alighting (B&A) areas help to create an accessible bus stop by providing a raised platform that is compatible with a bus that kneels or extends a ramp. A B&A area has a firm, stable and slip-resistant surface with a minimum clear length of 8.0 feet (measured perpendicular to the curb or roadway edge), and a minimum clear width of 5.0 feet (measured parallel to the roadway). Firm, stable, and slip resistant B&A areas are required if amenities such as benches or shelters are added to a bus stop. B&A areas are not required at bus stops on flush shoulder roadways where only a bus stop sign is provided. Coordinate with the appropriate public transit provider(s) to determine compatibility with equipment and transit vehicles.

The slope of the B&A area parallel to the roadway shall to the extent practicable, be the same as the roadway. For water drainage, a maximum slope of 1:50 (2%) perpendicular to the roadway is allowed. Benches and other site amenities shall not be placed on the B&A area. The B&A area can be located either within or outside the shelter, and shall be connected to streets, sidewalks, or pedestrian circulation paths by an accessible route.

On flush shoulder roadways, a B&A area may be constructed at the shoulder point (or edge of shoulder pavement on roadways with a design speed of 45 mph or less) as shown in Figures 13 – 1 and 13 – 2 Boarding and Alighting Area for Flush Shoulder Roadways. A Type "E" curb (5" curb height) should be used.

A sidewalk and/or ramp provided with the B&A area shall be a minimum of 5 feet in width, and the ramp shall not exceed a slope of 1:12. A detectable warning is required where a sidewalk associated with a B&A area connects to the roadway at grade. Except for the area adjacent to the 5" curb, the areas surrounding the B&A area shall be flush with the adjacent shoulder and side slopes and designed to be traversable by errant vehicles. On the upstream side of the platform, a maximum slope of 1:12 should be provided, and may be grass or a hardened surface. The B&A area (and ramp and level landing if needed) should be constructed with 6" thick concrete.

Figure 13 – 1 Boarding and Alighting Area for Flush Shoulder Roadways with Connection to the Roadway

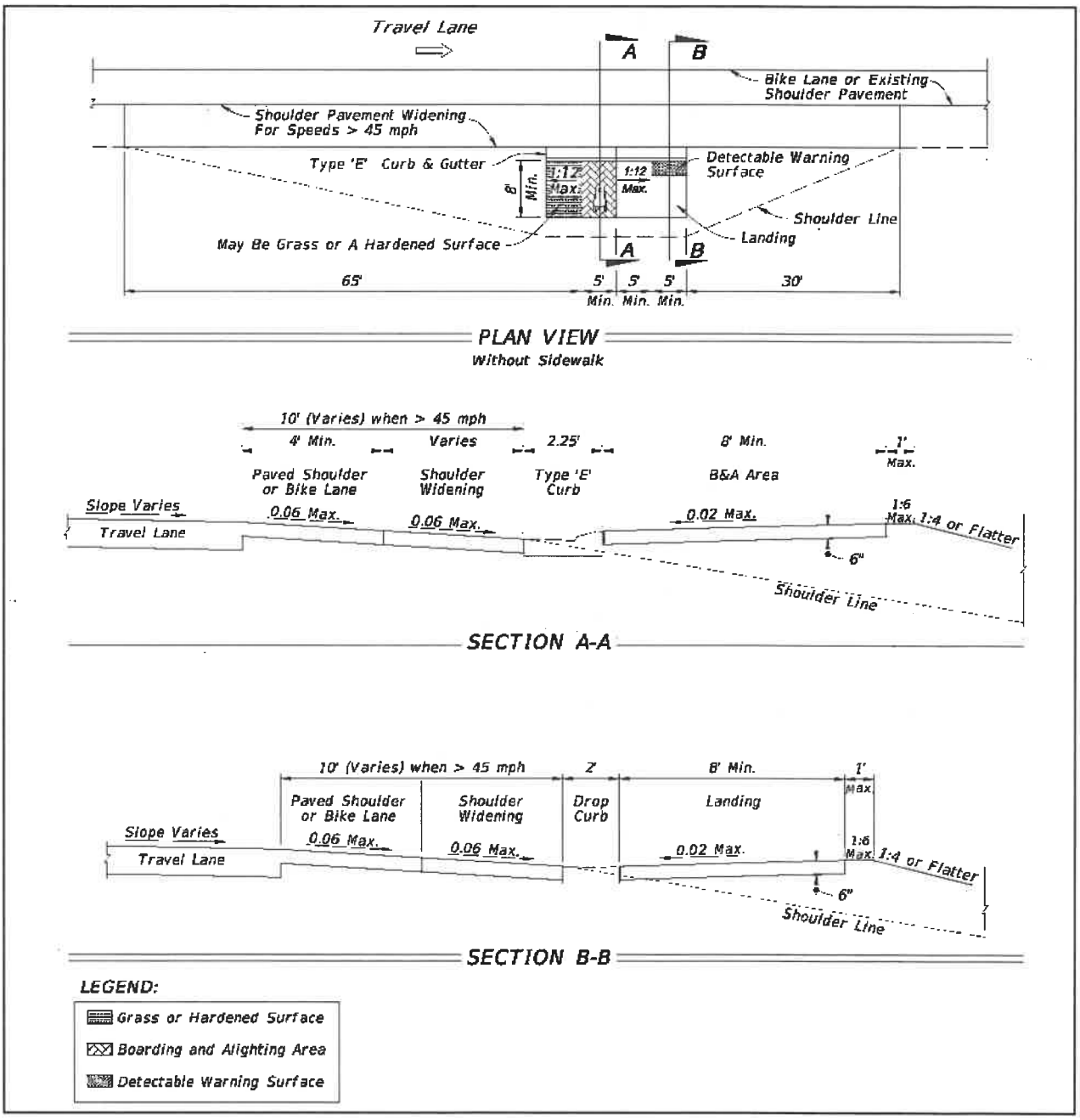
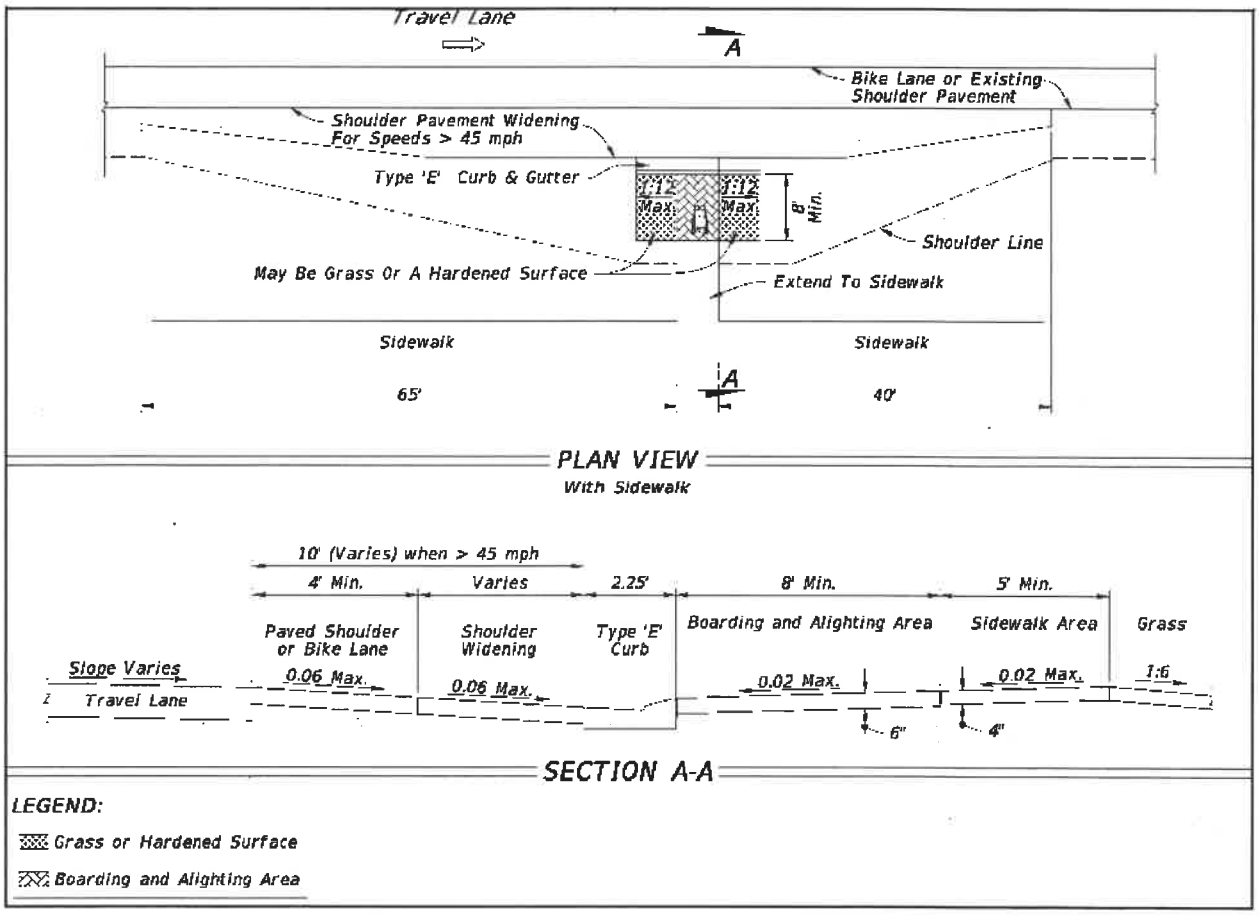


Figure 13 – 2 Boarding and Alighting Area for Flush Shoulder Roadways with Connection to the Sidewalk

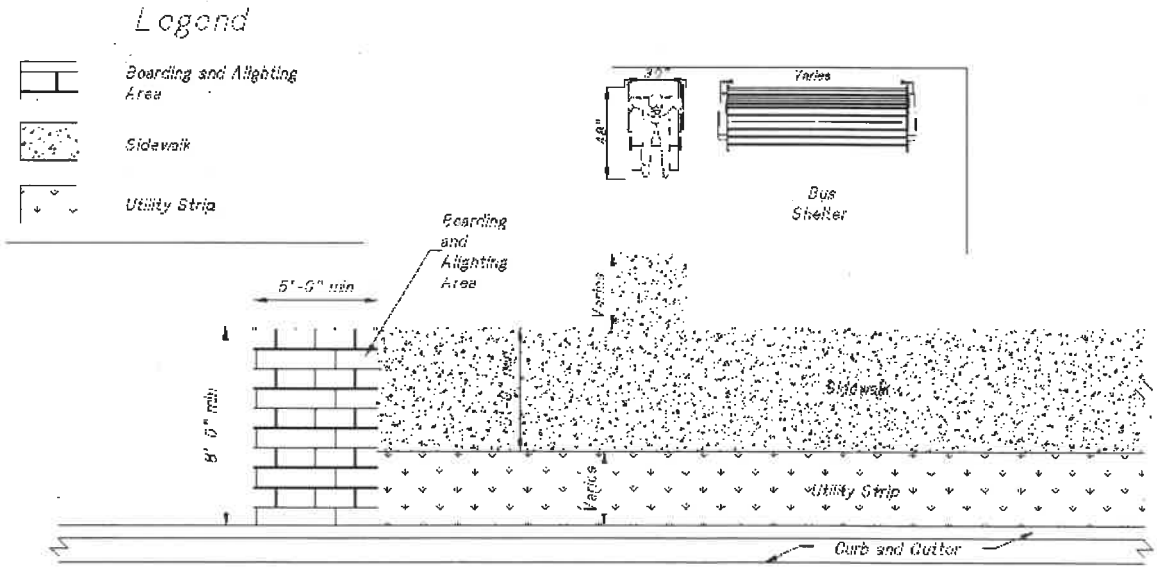


C.2 Shelters

Every public transit system has different needs with regards to shelters and corresponding amenities (e.g., benches, information kiosks, leaning posts, trash receptacles, etc.). Shelter foundation and associated pad size vary from stop to stop based on right of way availability, line of sight, and facility usage. New or replaced bus shelters shall be installed or positioned to provide an accessible route from the public way (sidewalk or roadway) to reach a location that has a minimum clear floor area of 30 inches by 48 inches, entirely within the perimeter of the shelter.

Shelters shall be connected by an accessible route to a B&A area. Coordinate with the appropriate public transit provider(s). Where feasible, shelters should provide a location for a bicycle rack. Shelters should be installed at locations where demand warrants installation and in accordance with clear zone criteria in ***Chapter 3 – Geometric Design, Section C.10.e*** Bus Benches and Transit Shelters and Chapter 4 – Roadside Design, Table 4 – 1 Minimum Width of Clear Zone of this Manual.

Figure 13 – 3 Bus Shelter Location



C.3 Benches

If a bench is provided, it should be on an accessible route, out of the path of travel on a sidewalk. Benches shall have an adjacent firm, stable and slip-resistant surface at least 30 inches wide and 48 inches deep to allow a user of a wheelchair to sit next to the bench, permitting the user shoulder-to-shoulder seating with a companion. Connection between the bench, sidewalk and/or bus B&A area shall be provided. Coordinate with the local public transit provider(s).

C.4 Stops and Station Areas

Transit stops should be located so that there is a level and stable surface for boarding vehicles. Locating transit stops at signalized intersections increases the usability for pedestrians with disabilities.

C.5 Bus Bays (Pullout or Turnout Bays)

Bus bays for transit vehicles may be necessary (e.g., extended dwell time, layover needs, safety reasons, high volumes or speed of traffic.). Bus bays can be designed for one or more buses. Coordinate with the local public transit provider(s) to determine the need for bus bays. When possible, bus bays should be located on the far side of a signalized intersection. The traffic signal will create the critical gap needed for bus re-entry into traffic. There are several publications available which provide additional design information for transit system applications. The Department District Public Transportation Office(s) maintains a library of these publications.

D PUBLIC TRANSIT FACILITIES

When a project includes a public transit route, curb-side and street-side transit facilities for bus stops should be considered in the roadway design process. Transit facilities shall comply with ***Chapter 14-20, Florida Administrative Code.***

The "Accessing Transit: Design Handbook for Florida Bus Passenger Facilities" provides guidance relating to provisions for curb-side and street-side facilities.

D.1. Curb-Side Facilities

Curb-side facilities are the most common, simple and convenient form of facilities at a bus stop. These include bus stop signs, shelters, bus stop B&A areas, benches, bike racks, leaning rails, and shelter lighting. "Accessing Transit" provides additional details and guidelines for each type of transit facility. Coordinate with the appropriate public transit provider(s) to determine the appropriate type and placement of amenities.

D.2 Street-Side Facilities

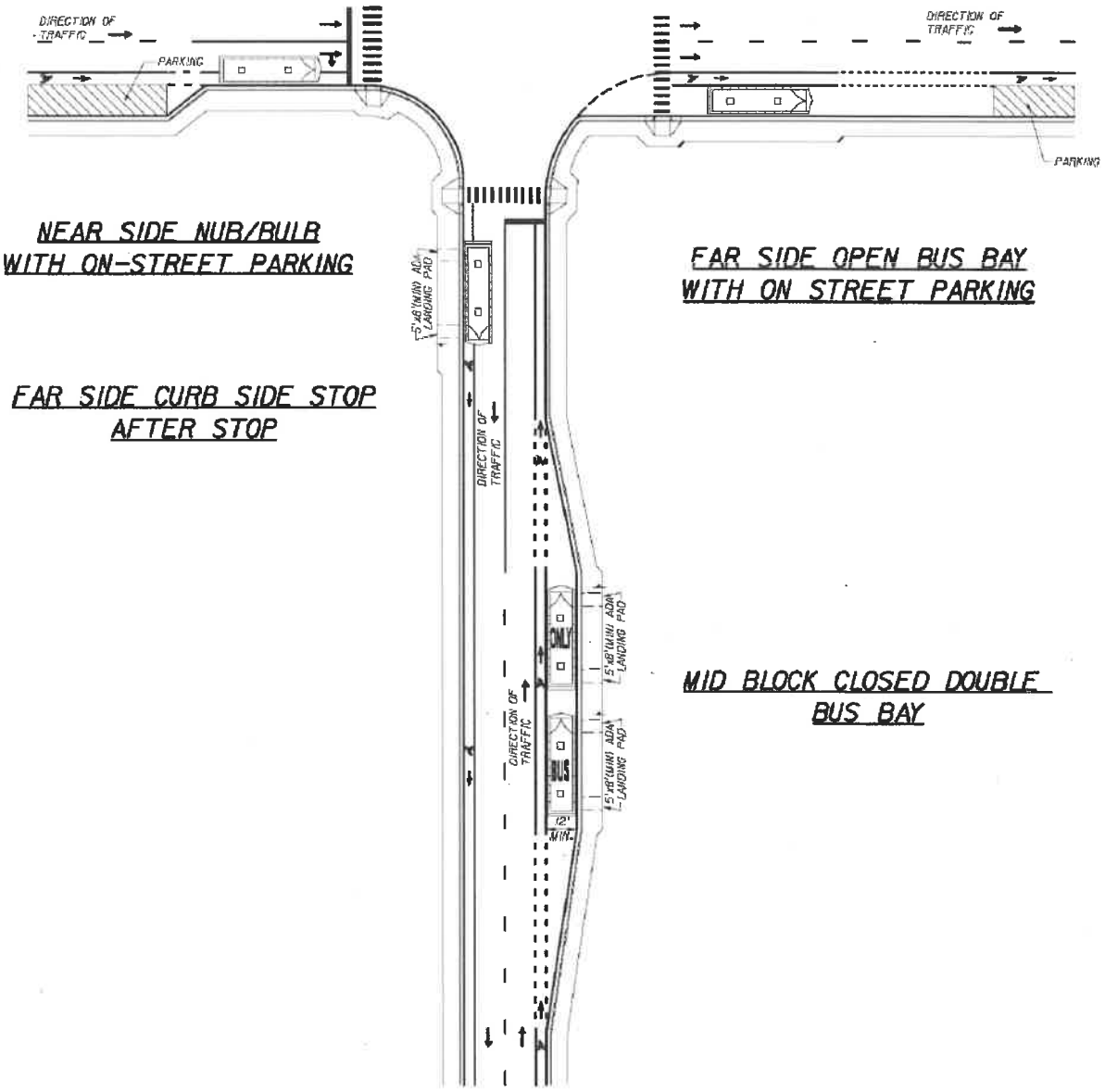
Bus stop locations can be categorized as far side, near side and mid-block stops. Bus stops may be designed with a bus bay or pullout to allow buses to pick up and discharge passengers in an area outside of the travel lane. This design feature allows traffic to flow freely without the obstruction of stopped buses. Far side bus stops and bays are preferred. See ***Accessing Transit, Version 3(2013)*** for a more detailed discussion of the location of the bus stop or bay.

Bus bays can be closed-ended, open-ended, or nubs/bulbs, and can be positioned near-side, far-side, or mid-block in relation to an intersection, as illustrated in Figure 13 – 3 Bus Shelter Location. The total length of the bus bay should allow room for an entrance taper, a stopping area, and an exit taper as a minimum. However, in some cases it may be appropriate to consider providing acceleration and deceleration lanes depending on the volume and speed of the through traffic. This decision should be based upon site specific conditions. "Accessing Transit" provides detailed bus bay dimensions for consideration with various right of way and access conditions.

D.3 Bus Stop Lighting

Lighting design for bus stops should meet the same criteria for minimum illumination levels, uniformity ratios and max-to-min ratios that are being applied to the adjoining roadway based on ***Chapter 6 – Lighting*** of this Manual. If lighting is not provided for the adjoining roadway, coordinate with the transit agency to determine if lighting should be provided for the bus stop area, particularly when night transit services are provided. A decision to install lighting for the adjoining bus stop area may include illumination of the bus bay pavement area. The use of solar panel lighting for bus stops is another option that should be considered.

Figure 13 – 4 Bus Stop Locations



E REFERENCES FOR INFORMATIONAL PURPOSES

The following is a list of publications that may be referenced for further guidance:

- FDOT's Accessing Transit, Design Handbook for Florida Bus Passenger Facilities, Version III, 2013
  http://www.fdot.gov/transit/

- TCRP Report 155 – Track Design Handbook for Light Rail Transit, Second Edition
  http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_155.pdf

- Central Florida Commuter Rail Transit Project, Design Criteria – Phase 2 South RFP http://corporate.sunrail.com/wp-content/uploads/2015/06/P2S-RFP-Design-Criteria-06-15-15.pdf

- Transit facilities shall comply with Chapter 14-20, Florida Administrative Code, Private Use of Right of Way
  https://www.flrules.org/gateway/ChapterHome.asp?Chapter=14-20

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CHAPTER 14

DESIGN EXCEPTIONS AND VARIATIONS

EXHIBITS

CHAPTER 14

DESIGN EXCEPTIONS AND VARIATIONS

A GENERAL

Uniform minimum standards for design, construction, and maintenance for streets and highways are contained in this Manual and meet or exceed the minimum values established by AASHTO. Consequently, the values given govern the design process. When it becomes necessary to deviate from the Manual's criteria, early documentation and approval are required.

Design Exceptions are required when proposed design elements are below both the criteria in this Manual and AASHTO's new construction criteria for the following Controlling Design Elements.

The 10 Controlling Design Elements for high speed (Design Speed ≥ 50 mph) roadways are:

- Design Speed
- Lane Width
- Shoulder Width
- Horizontal Curve Radius
- Superelevation Rate
- Stopping Sight Distance
- Maximum Grade
- Cross Slope
- Vertical Clearance
- Design Loading Structural Capacity

The 2 Controlling Design Elements for low speed (Design Speed < 50 mph) roadways are:

- Design Speed
- Design Loading Structural Capacity

When proposed design elements other than the Controlling Elements do not meet the criteria contained in this Manual, sufficient detail and justification of such deviations must be documented by the Responsible Professional Engineer as a Design Variation and submitted to the municipality or county.

This chapter provides the process for documentation and approval of Design Exceptions and Variations. The approved Design Exception or Variation submittal should be included in the project file to clearly document the action taken and the approval given.

Projects that comply with design criteria for local subdivision roads and/or residential streets adopted by ordinance do not require a Design Exception or Variation.

B RECOMMENDATIONS FOR APPROVAL

Design Exceptions and Variations are recommended by the Professional Engineer responsible for the project design element (Responsible Professional Engineer). All Design Exceptions and Variations require approval from the Maintaining Authority's Professional Engineer or Designee.

Any Design Exception or Variation that involves a state facility or on the National Highway System (NHS) must be processed through the Department's district that has jurisdiction over the facility. The District Design Engineer will then follow the Department's process, as specified in *the Department's* ***Design Manual, Chapter 122 Design Exceptions and Design Variations*** This process also includes the requirements for concurrence and approval by FHWA, when needed.

C COORDINATION

In order to allow time to research alternatives and begin analysis and documentation activities, it is critical that Design Exceptions and Variations be identified as early in the process as possible. This is preferably done during the planning phases of projects or as soon as possible during initial design.

When the need for a Design Exception or Variation has been determined, the Responsible Professional Engineer must coordinate with the Maintaining Authority's Professional Engineer or Designee and the Department (if applicable), to obtain conceptual concurrence and provide any requested documentation.

The Department will be involved only if the proposed design on the local (Non-State Highway System (SHS)) roadway is part of a Department project. For example, a Department project for a roadway on the SHS includes work on the adjacent local roads, or a Department project is exclusively on a local (Non-SHS) roadway. In these cases, the District Design Engineer will be listed for "concurrence" in the Design Exception or Variation request letter.

D JUSTIFICATION FOR APPROVAL

Sufficient detail and explanation must be given in order to justify approval to those reviewing the request. The 10 Controlling Design Elements are considered safety related and the strongest case possible must be made to lower these requirements. All deviations from criteria and standards in this Manual must be uniquely identified, located, and justified.

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 required for documentation are:

- Safety and Operational performance
- Level of Service
- Right of Way impacts
- Community impacts
- Environmental impacts
- Costs
- Usability by all modes of transportation
- Long term and cumulative effects on adjacent sections of roadway

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.

E DOCUMENTATION FOR APPROVAL OF DESIGN EXCEPTIONS

Supporting documentation that is generated during the approval process is to accompany each submittal. Design Exceptions should include the following documentation:

1. Submittal/Approval Letter (Example shown in Exhibit 14-A)

2. Project Description:

   a) General project information, location map, existing roadway characteristics, project limits (mileposts), county section number, work mix, objectives, and obstacles.

   b) Associated or future limitations that exist as a result of public or legal commitments.

3. Project Schedule and Lifespan:

   a) Letting date and other important production dates associated with the project.

   b) Discussion of whether the deficiency is a temporary or permanent condition.

   c) Future work planned or programmed to address the condition.

4. Exception Description:

   a) Specific design criteria that will not be met (AASHTO, Florida Greenbook) and a detailed explanation of why the criteria or standard cannot be complied with or is not applicable.

   b) Proposed value for the project or location and why it is appropriate.

   c) Plan view, plan sheet, or aerial photo of the location, showing right of way lines and parcel lines of adjacent property.

   d) Photo of the area of the deficiency.

   e) Typical section or cross-section.

   f) Milepost or station location.

5. Alternative Designs Considered:

   a) Meeting AASHTO or Florida Greenbook criteria, partial correction, and the no-build (existing) condition.

6. Impacts of the Exception:

a) Safety Performance:

- Anticipated impact on safety, long and short term effects and of any anticipated cumulative effects.
- Summary of the most recent 5-year crash history including any pertinent crash reports.

b) Operational Performance:

- Description of the anticipated impact on operations (long and short term effects) and any anticipated cumulative effects.
- Summary of the amount and character of traffic using the facility.
- Compatibility of the design with adjacent sections of roadway.
- Effects on capacity and Level of Service (proposed criteria vs. AASHTO)

c) Right-of-way

d) Community

e) Environment

f) Usability by all modes of transportation

7. Anticipated Costs:

a) Description of the anticipated costs (design, right of way, construction, maintenance).

8. Mitigation Measures:

a) Practical mitigation measures or alternatives that were considered and any selected treatments implemented on the project.

9. Summary and Conclusions

When preparing a Design Exception, the Responsible Professional Engineer should consider potential mitigation strategies that may reduce the adverse impacts to highway safety and traffic operations. Please refer to the FHWA ***Mitigation Strategies for Design Exceptions*** ***(July 2007)*** for examples of mitigation strategies. The ***Highway Safety Manual (HSM)*** and ***Highway Capacity Manual*** provide information on quantifying and evaluating highway safety performance.

Benefit/Cost Analysis:

Calculate a benefit/cost analysis which estimates the cost effectiveness of correcting or mitigating a substandard design element. The "benefit" is the expected reduction in future crash costs and the "cost" is the direct construction and maintenance costs associated with the design. These costs are calculated and annualized so that direct comparison of alternate designs can be made.

A benefit/cost ratio equal to or greater than 1.0 indicates it may be cost effective to implement a particular design; however, the final decision is a management decision which considers all factors and applies sound engineering judgement. Key factors in the analysis are:

a) Evaluation of crashes by type and cause

b) Estimate of crash costs (based on property damage and severity of injuries)

c) Selection of a crash reduction factor based on proposed mitigation strategy

d) Selection of a discount rate (typically 4% for roadway projects)

e) Estimate of construction and maintenance costs

f) Selection of service life of the improvements

NOTE: The Department's ***Design Manual, Chapter 122 Design Exceptions and Design Variations*** provides guidance for the benefit/cost analysis, and may be used. The Department provides a useful tool, called ***Benefit Cost Analysis Spreadsheet Tool*** (BCAnalysis.xlsm), to aid in determining the benefit/cost ratio.

Conclusion and Recommendation:

a) The cumulative effect of other deviations from design criteria

b) Safety mitigating measures considered and provided

c) Summarize specific course of action

F DOCUMENTATION FOR APPROVAL OF DESIGN VARIATIONS

When proposed design elements other than the Controlling Elements do not meet the criteria contained in this Manual, sufficient detail and justification of such deviations must be documented by the Responsible Professional Engineer as a Design Variation and submitted to the municipality or county. The documentation, submittal and approval requirements for Design Variations are similar to that for Design Exceptions described in this chapter.

Design Variations should include:

a) Design criteria versus proposed criteria.

b) Reason the design criteria are not appropriate.

c) Justification for the proposed criteria.

d) Review and evaluation of the most recent 5 years of crash history where appropriate.

e) Background information which documents or justifies the request.

G FINAL PROCESSING OF DESIGN EXCEPTIONS AND VARIATIONS

After receiving conceptual approval from the designated Professional Engineer representative of the municipality or county, the documentation justifying the Design Exception or Variation shall be signed and sealed by the Responsible Professional Engineer and delivered to the municipality or county. ***Exhibit 14-A Sample Request Letter for Design Exception or Variation*** provides an example of an appropriate format and should be included with the signed and sealed supporting documents. The Design Exception or Variation will be reviewed for completeness and adherence to the requirements of this Chapter.

If the Design Exception satisfies all requirements, the acknowledgment of receipt will be signed by the Maintaining Authority's Professional Engineer or Designee; and, if applicable, forwarded to the Department's District Design Engineer for concurrence.

When all signatures are obtained, the Design Exception or Variation will be returned to the Responsible Professional Engineer. The original will be retained by the municipality or County and a copy kept by the Department, if applicable.

Exhibit 14-A Sample Request Letter for Design Exception or Variation

TO: _____ DATE: _____

SUBJECT: **DESIGN EXCEPTION or DESIGN VARIATION**

Local road number or street name: _____
Project description (limits): _____
Type construction (new, rehabilitation, adding lanes, resurfacing, etc.) _____
Design Speed _____
State and/or Federal road number (if applicable): _____
FDOT Financial Project ID No. (if applicable): _____

DESIGN EXCEPTION OR VARIATION FOR THE FOLLOWING ELEMENT:

( ) Design Speed	( ) Stopping Sight Distance	( ) Other (explain):
( ) Lane Width	( ) Maximum Grade	
( ) Shoulder Width	( ) Cross Slope	
( ) Horizontal Curve Radius	( ) Vertical Clearance	
( ) Superelevation Rate	( ) Design Loading Structural Capacity	

Include a brief statement concerning the project and items of concern.

Attach all supporting documentation to this exhibit in accordance with Chapter 14.

Recommended by: _____
(Responsible Professional Engineer)

Approval: _____
(Maintaining Authority's Professional Engineer or Designee)

Concurrence: _____
FDOT (if applicable)

Concurrence: _____
FHWA (if applicable)

CHAPTER 15

TRAFFIC CALMING

TABLES

FIGURES

CHAPTER 15

TRAFFIC CALMING

A INTRODUCTION

As Florida continues to grow, more and more of the major highways in its communities are becoming congested. This has caused many drivers to seek less crowded local residential streets as alternatives to get to their destinations. In many cases, this has meant the use of local residential streets as bypasses. The increase in traffic intrusion, volume, and speeds on residential streets has degraded the livability standards of various neighborhoods in Florida and as a result many residents complain about their environment (noise, air pollution), livability (quality of life, traffic intrusion, excessive volume, and speed of traffic), safety (as well as safety of their children, pets, and property) and physical characteristics (absence of sidewalks, etc). This chapter provides some guidance to Florida roadway planners, designers, and traffic engineers on how to address concerns about maintaining or enhancing the quality of life in residential neighborhoods by balancing the need for safety for all roadway users and adjacent property owners of the street network and maintaining the integrity of the highways networks as a whole.

B PLANNING CRITERIA

Traffic calming is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior, and improve conditions for non-motorized street users.

Communities undertaking a traffic calming program shall have a procedure for planning which neighborhoods and roadways qualify for participation in the program. Specifics of these methods shall be developed by the local jurisdictions. The methods will likely vary from locality to locality. However, some issues should be addressed in all communities:

- Through the public involvement process, adjacent residents and road users who are impacted by the situation should be included in identifying the concern(s).
- The need for traffic-calming measures should be confirmed by appropriate studies (license plate survey, speed, volume, crash analyses) studied.
- Once the concerns are clearly identified and confirmed by traffic studies, and documented, it will provide the focus for possible solution, prioritizing, and development of appropriate traffic calming measures. It will also help determine the best approach to address the concerns.
- When developing traffic calming measures, in addition to the affected property owners, emergency response, transit, school, and sanitation officials and any other entities impacted by the installation of such devices should be included in the review process.

Traffic calming may not be the appropriate method in all cases to address vehicle speeds, volumes, and safety. Alternative solutions or educational tools may be considered, as well as coordinated effort with law enforcement.

The application of traffic calming measures should consider possible network and access issues. A system impact analysis should be performed as part of the development process. Vehicular and pedestrian counts, speed data, and crash history of the streets under evaluation should be reviewed. Storm water and environmental impacts also need to be addressed, as well as facility type, urban and rural design factors, and driveway densities.

Design details for each traffic calming measure may vary depending on local conditions. Factors to be considered include both horizontal and vertical deflection, ease of use, emergency vehicle accessibility, ease of maintenance, and facility type. Operational considerations and geometrics are critical factors to consider as well. A list of references and resources to consider in providing more detailed design factors and information can be found at the end of this section. It may be desirable to begin with less restrictive measures and progress to more restrictive ones in stages.

Listed below are some "Do's" and "Don'ts" of the planning process for traffic calming which may be helpful in working through the design process.

Do's and Don'ts of the Planning Process

Do the following:

- Install temporary traffic calming features and monitor them for a period of time before installing the permanent features. Testing features on site prior to permanent installation will relieve resident anxiety about the impact on their own driving patters and driving behaviors will adjust to the new route circumstances.
- Have an organized program including public involvement. Plans and policies should be approved and supported by the local government. Emphasize the selected treatments(s) will be initially in a "test" mode, with permanency pending the outcome measurement. Be able to describe what is being done to keep traffic off residential streets.
- Channel public resources by prioritizing traffic calming request according to documentable criteria, setting thresholds of volume, speed, etc., to merit treatment.
- Involve the local service agencies, including fire, police, and emergency medical services personnel, from the start.
- Consult with fire department and EMS personnel to develop the preferred design, particularly with speed humps and traffic circles. Set up traffic circles with cones and have fire trucks and other emergency vehicles drive around them; this will help determine what radius is best for the vehicles used in a given area. The same process can be used in the design of speed humps.
- Review traffic patterns in the neighborhood as a whole. Avoid solving the problem on one neighborhood street by just shifting the traffic to another neighborhood street.
- Consider appropriate landscape treatments as part of the traffic calming design and implementation.

- Make certain that all signing, pavement markings, and channelization is in accordance with the ***Manual on Uniform Traffic Control Devices (MUTCD)***, the ***AASHTO Policy on Geometric Design of Highways and Streets***, and ***Roundabouts: An Informational Guide, Second Edition, National Cooperative Highway Research Program (NCHRP 672)***.
- Check sight distances for vehicles, pedestrians, and bicyclists. Sight distance should be consistent with the dimensions shown in ***Chapter 3 – Geometric Design*** or ***Chapter 16 – Residential Street Design***.
- Become familiar with the traffic calming features used in other communities and assemble references so that residents can be directed where to see them.
- Decide on a safe design speed beforehand and in consultation with neighborhood residents.
- Check sight distances by visiting the site before and after installation. Do parked cars obstruct sight distances? Do landscaping or other features obstruct sight distance?
- Review the illumination at night. Are additional street lights needed? Does landscaping block the light? Is there a shadow on one side of a median or traffic circle that might hide pedestrians from view?
- Review the channelization during the day and night. Is it a clear approach from all directions? Can it be seen at night? Watch the traffic: Is the driving public confused by the signing and channelization? Make adjustments as needed.
- Review the site for utility conflicts. Is there a fire hydrant? Does it need to be moved? Are there existing utilities in the way?
- Check the storm water drainage. Will the storm drain system need to be moved or revised? Can the runoff flow through or around the device?
- Review on-street parking. Will parked cars block the access of emergency vehicles through or around the proposed neighborhood traffic control devices? Add additional no parking zones where needed. Additional enforcement of parking restrictions may be required to keep the traveled path clear.
- Include weekends in traffic counts, as residential streets may have unique travel patterns and high use periods.

Don't do the following:

- Install neighborhood traffic calming features without a well-engineered program supported by the local government and public.
- Install neighborhood traffic calming features on arterial streets (See Section 1.C.2 for a discussion of roadway classifications). Typically, physical devices are not installed on streets with volumes greater than 3,000 vehicles per day, or with posted or operating speeds of greater than 30 MPH.
- Install neighborhood traffic calming features on streets without curbs unless supplemental features or other design considerations are included to keep vehicles within the traveled way.
- Install neighborhood traffic calming features on street with grades of greater than 10 percent.
- Install neighborhood traffic calming features on major truck routes.
- Install neighborhood traffic calming features on primary emergency routes. Contact local fire, emergency service, and police departments to determine these routes. Secondary access routes should be considered on a case-by-case basis.
- Install neighborhood traffic calming features on curving or winding roads with limited sight distance, unless reduced speed limits and adequate warning signs are used in conjunction with the devices.
- Place neighborhood traffic calming features in front of driveways.
- Neglect to check for conflicting utilities or drainage considerations.
- Install physical features on adjacent parallel routes, unless feasible design alternatives have been agreed upon, as this prevents or hinders emergency response.

C INAPPROPRIATE TRAFFIC CALMING TREATMENTS

C.1 Stop Signs

Unwarranted stop signs should not be used for traffic calming for the following reasons:

- Increase midblock speeds along the street because of drivers trying to make up for lost time
- Increase noise because of quick accelerations and decelerations
- Increase pollution
- Reduce drivers' expectation of a uniform flow
- Relocate the problem
- Cause disrespect for stop signs by drivers and bicyclists

Stop signs shall be used only when warranted per the ***MUTCD.***

C.2 Speed Bumps

Speed bumps shall not be used on public streets. Speed bumps are severe treatments 3 to 6 inches high and 1 to 2 feet long that slow drivers to speeds of less than 10 mph. Due to their abrupt rise and required low speed they can be a hazard to motorists and bicyclists. Speed *humps*, as described in Section D under vertical deflection, should not be confused with speed *bumps*.

C.3 Other Inappropriate Treatments

There are some other treatments that have been shown to be ineffective at reducing the speed and volume of traffic on local roadways. While a temporary improvement may result, long-term improvement is not likely; consequently, their use is discouraged. These treatments include the following:

- Novelty signs -While signs such as CHILDREN AT PLAY, SENIORS CROSS HERE and SLOW DEAF CHILD may make an infrequent roadway user aware of a specific local population, most regular users of the roadway are unaffected by the signs.

- Odd speed limit - NEIGHBORHOOD SPEED LIMIT 23 MPH and other odd speed limit signs place a high dependence on police to monitor speeders and are not consistent with the national practice required by the ***MUTCD*** of posting speeds limits in 5 mph increments.
- Crosswalks – Standard crosswalks marked only with signs and pavement markings do not affect motorists' speeds and should not be used by themselves as traffic calming treatments.
- Bicycle lanes – Standard bicycle lanes are not traffic calming treatments. They can be used to provide space for bicyclists between the sidewalk and travel lanes but should not be used by themselves for traffic calming.
- Speed trailers – While speed trailers can be used as part of a traffic calming program for educational awareness, they have no lasting effect on motorists' behavior.
- Reduced speed limit signs – Reduced speed limits without physical traffic calming measures do not slow drivers and should not be used for traffic calming.
- Rumble strips – These applications have high maintenance requirements and can cause severe noise problems. Also, they can be an obstacle to bicyclists.

D APPROPRIATE TRAFFIC CALMING TREATMENTS

The following sections describe some of the available traffic calming strategies. This list is not exhaustive, nor do the treatments necessarily fall exclusively into only one category.

In a typical traffic calming plan various types of treatments will be used. These plans will be based upon neighborhood preferences combined with engineering judgment.

Design details for traffic calming treatments will vary with application. Specific designs will need to be determined based upon the objective of the installations.

D.1 Vertical Treatments

Vertical treatments are those that depend upon a change in vertical alignment to cause drivers to slow down. When properly used, these treatments can be effective in reducing speeds and crashes. However, consideration should be given to impacts on emergency responders, buses, and, to some extent, bicyclists and motorcyclists.

Traffic calming features that alter the vertical alignment should not be installed near fire hydrants or mailboxes.

Information on signing and pavement markings for vertical deflections can be found in the ***Manual on Uniform Traffic Control Devices (MUTCD)***.

Table 15 – 1 Vertical Treatments

Treatment	Description	Effect	Concerns	Cost
Raised Intersection	A raised plateau where roads intersect. Plateau is generally 4 inches above surrounding street.	Slows vehicles entering intersection and improves pedestrian safety.	Increases difficulty of making a turn.	Medium to High
Raised Crosswalk	Raised pedestrian crossing used in mid-block locations. Crosswalks installed on flat-top portion of speed table. See Figure 15 - 1	Reduces speed and is an effective pedestrian amenity makes pedestrians more visible.	May be a problem for emergency vehicles and vehicles with trailers.	Low to Medium
Speed Humps	Speed humps are parabolic, curved, or sinusoidal in profile, 3 to 4 inches in height and to 14 feet long. Comfortable speeds limited to 15 to 20 mph. See Figure 15 - 2.	Reduces speed.	May cause delays for emergency vehicles and impact patient comfort. May have greater impacts on longer wheelbase cars.	Low
Speed Tables	Speed tables are flat-topped speed humps, also 3 to 4 inches high but with a sloped approach taper on each side of a flat top. They are generally 20 to 24 feet long. Comfortable speeds limited to 20 to 25 mph.	Reduces speed.	May cause delays for emergency vehicles and impact patient comfort.	Low
Speed Cushions/ Pillows	Signed speed humps as described above.	Reduces speed.	May not slow all vehicles.	Low

Figure 15 – 1 Raised Crosswalk

Suwannee Street, Tallahassee, Florida

Figure 15 – 2 Speed Hump

Inside Loop Road, Orange County, Florida

D.2 Horizontal Treatments

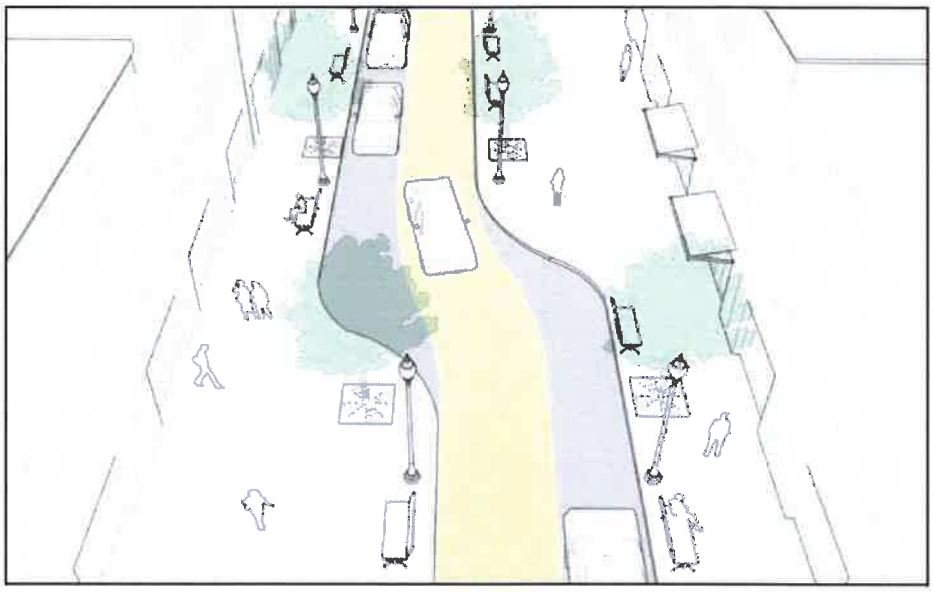
Horizontal deflection treatments are often more expensive than vertical deflection treatments. However, they have less of an impact on emergency responders and large vehicles with multiple axles. They generally do not create problems for bicyclists and motorcyclists. Because pavement area is usually reduced, additional landscaping may be possible, making horizontal deflection treatments useful as part of neighborhood beautification projects.

Information on striping and signing roundabouts can be found in the ***MUTCD.***

Table 15 – 2 Horizontal Treatments

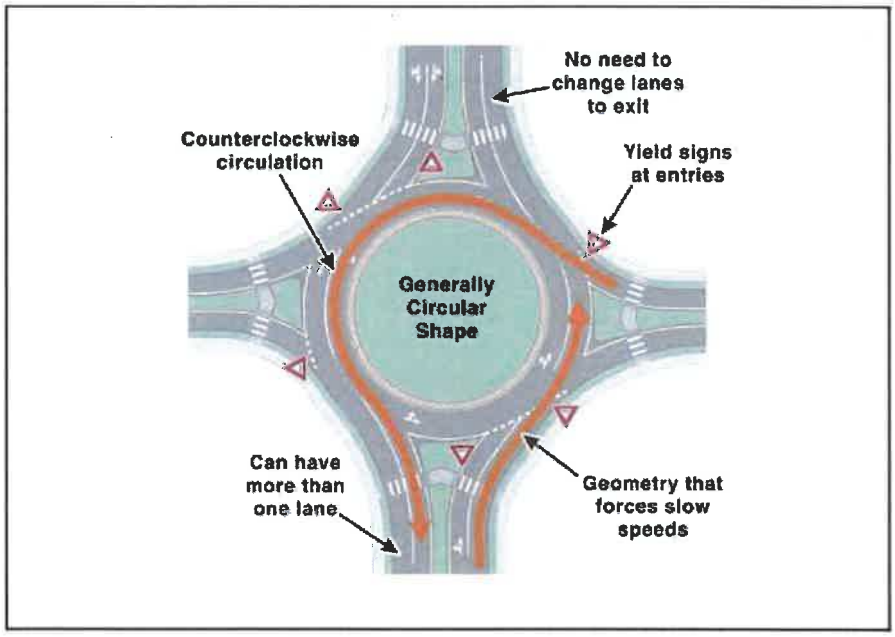
Treatment	Description	Effect	Concerns	Cost
Angled Slow Point	Angled deviation to deter the path of travel so that the street is not a straight line	Reduces speed and pedestrian crossing distance.	Landscaping must be controlled to maintain visibility. Conflicts may occur with opposing drivers.	Medium to High
Chicanes	Mainline deviation to deter the path of travel so that the street is not a straight line. See Figure 15 - 3.	Reduces speed and pedestrian crossing distance.	A chicane design may warrant additional signing and striping to ensure that drivers are aware of a slight bend in the roadway. Increases the area possible for landscaping.	Medium to High
Mini-Circles	A raised circular island in the center of an existing intersection, typically 15 to 20 feet in diameter. May have mountable truck apron to accommodate large vehicles.	Reduces speed and both the number and severity of crashes.	May restrict larger vehicles. May cause some confusion when not signed properly. Some communities have documented increased crashes when mini-circles replaced all-way stop intersections.	Low to Medium
Roundabouts	A circular intersection with specific design and traffic control features, including yield control of all entering traffic, channelized approaches, geometric curvature. May be appropriate at locations as an alternative to a traffic signal. See Figure 15 - 4.	Reduces vehicle speeds and reinforces a change in the driving environment in transition areas.	May require more space at the intersection itself than other intersection treatments. While Roundabouts have sometimes been considered traffic calming features, they are primarily traffic control measures.	High

Figure 15 – 3 Chicanes



NACTO Urban Street Design Guide, National Association of City Transportation Officials

Figure 15 – 4 Key Roundabout Characteristics



NCHRP Report 672: Roundabouts: An Informational Guide, Second Edition

D.3 Neighborhood Entry Control

Neighborhood entry control treatments include partial street closures and gateway type tools. They are used to reduce speeds and volume at neighborhood access points and may be used in conjunction with neighborhood beautification or enhancement projects and residential area identification.

Table 15 – 3 Neighborhood Entry Control

Treatment	Description	Effect	Concerns	Cost
Chokers	Midblock reduction of the street to a single travel lane for both directions.	Reduces speed and volume.	Costs increase if drainage needs to be rebuilt.	Mediu m to High
Gateway Treatment or Entrance Features	Treatment to a street that includes a sign, banner, landscaping, and roadway narrowing or other structure that helps to communicate a sense of neighborhood identity.	Reduces entry speed and pedestrian crossing distance. Discourages intrusion by cut through vehicles and identifies the area as residential.	Maintenance responsibility. May lose some on street parking.	Mediu m to High
Curb Extensions or Bulb-outs	Realignment of curb at intersection or mid-point of a block to decrease pavement width. See Figure 15 - 5.	Visually and physically narrows the roadway, shortens pedestrian crossing distance, increases space for plantings, street furniture.	May impact sight distance, parking, and drainage.	Mediu m to High
Midblock Median, Slow Point	An island or barrier in the center of a street that separate traffic.	Provides refuge for pedestrians and cyclists.	Landscaping may impede sight distance.	Varies
Lane Narrowing	Street physically narrowed to expand sidewalks and landscaping areas. Could include median, on street parking etc.	Improved pedestrian safety.	May create conflict with opposing drivers in narrow lanes.	Mediu m to High
One-Way In or One-Way Out Channelization	Intersection reduction of the street to single travel lane with channelization. Also called half road closure.	Reduces speed and traffic.	Costs increase if drainage must be rebuilt. Transfers additional vehicles to other ingress/egress points.	Mediu m to High
Textured Pavement	A change in pavement texture, and color (e.g., asphalt to brick), that helps make drivers aware of a change in driving environment.	Enhances pedestrian crossings, bike lanes, or on street parking.	Increase maintenance. May increase noise.	Low to Medium

Figure 15 – 5 Curb Extension or Bulb Out

First and Lee Streets, Ft. Myers, Florida

D.4 Diverters

A diverter consists of an island or curbed closure, which prevents certain movements at intersections, and reduces speeds and volumes. By diverting motorists within a neighborhood they can significantly reduce cut through traffic.

Diverters must be planned with care because they will impact the people who live in the neighborhood more than anyone else. Trip lengths increase, creating inconvenience to residents. Emergency responders must also be considered when diverting traffic.

Bicyclists and pedestrians should be provided access through traffic diverters.

Table 15 – 4 Diverters

Treatment	Description	Effect	Concerns	Cost
Diagonal Diverters	Barrier placed diagonally across an intersection, interrupting traffic flow forcing drivers to make turns.	Eliminates through traffic.	May inhibit access by emergency vehicles and residents and increase trip lengths.	Medium
Forced Turn Barrier/Diverters	Small traffic islands installed at inter-sections to restrict specific turning movements.	Reduces cut through traffic.	Could impact emergency vehicles response time.	Low to Medium
Road Closures, Cul-de-sac	One or more legs of the intersection closed to traffic.	Eliminates through traffic improving safety for all street users.	May increase volumes on other streets in the area. Access restriction may cause concerns for emergency responders. Additional right of way for proper turnaround at dead ends may be required.	Low to Medium
Median Closures	Small median islands installed at cross streets to prevent through movements and restrict left turns.	Reduces cut through traffic.	Could impact emergency vehicle responses, inhibit access, and increase trip lengths or transfer volumes to other streets.	Low to Medium

D.5 Other Treatments

These treatments are most effective when used in combination with other physical traffic calming features, and should be used as supplements.

Table 15 – 5 Other Treatments

Treatment	Description	Effect	Concerns	Cost
Pavement Markings	Highlighting various area of road to increase driver's awareness of certain conditions such as bike lanes or crosswalks. See Figure 15 - 6.	Inexpensive and may reduce speed.	May not be as effective as a structure such as curb.	Low
Traversable Barriers	A barrier placed across any portion of a street that is traversable by pedestrians, bicycles, and emergency vehicles but not motor vehicles.	Eliminates cut-through traffic.	Inconvenience to some residents.	Medium
Colored Bike Lanes or Shoulders	A bike lane or shoulder painted, covered with a surface treatment or constructed of a pigmented pavement designed to contrast with the adjacent pavement.	Visually narrows the roadway and may reduce speeds.	May not be effective on roadways with 12 foot lanes.	Low to medium

Figure 15 – 6 Bicycle Lane, Advance Yield Bar and Crosswalk

Franklin Blvd, Tallahassee, Florida

E REFERENCES FOR INFORMATIONAL PURPOSES

The publications listed below are additional sources, of information related to topics presented in this chapter. Search the Internet Web for up-to-date resources using "traffic+calming" as key words.

1. Manual on Uniform Traffic Control Devices, with Revisions 1 and 2, May 2012 (MUTCD). US Department of Transportation, Federal Highway Administration http://mutcd.fhwa.dot.gov/kno_2009r1r2.htm

2. Code of Practice for the Installation of Traffic Control Devices in South Australia, July 2013. Traffic and Operational Standards Section, Department Transportation, P.O. Box. 1, Walkerville, South Australia, 5081. (updated in 2013)

3. National Cooperative Highway Research Program (NCHRP) Report 672, Roundabouts: An Informational Guide, Second Edition, (2010) http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_672.pdf

4. The Florida Intersection Design Guide. Florida Department of Transportation, http://www.dot.state.fl.us/officeofdesign/publicationslist.shtm

5. Traffic Calming Measures - Speed Hump, Institute of Transportation Engineers, http://www.ite.org/traffic/

6. New York State Supplement (2001) to the Manual of Uniform Traffic Control Devices, 2009. Transportation Planning, Highway Safety, and Traffic Engineering Division, New York State Department of Transportation, 1220 Washington Avenue, Albany, NY 12232-0204. https://www.dot.ny.gov/divisions/operating/oom/transportation-systems/repository/B-2011Supplement-adopted.pdf

7. New York State Vehicle & Traffic Law, (latest edition). New York State Department of Motor Vehicles, Swan Street Building, Empire State Plaza, Albany, NY, 12228.

8. Roundabout Design Guidelines, Supplement to the NCHRP 672 (October 2012). Maryland Department of Transportation, State Highway Administration http://sha.md.gov/OHD2/MDSHA_Roundabout_Guidelines.pdf

9. Traffic Control Systems Handbook, Revised Edition, 2005, Federal Highway Administration, DC 20590. (Updated in 2013) http://ops.fhwa.dot.gov/publications/fhwahop06006/

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CHAPTER 16

RESIDENTIAL STREET DESIGN

TABLES

CHAPTER 16

RESIDENTIAL STREET DESIGN

A INTRODUCTION

The street is a public way designed for the purposes of serving motor vehicles, bicycles, pedestrians, and transit vehicles. The primary function of residential streets is to provide access to homes that front those streets. The primary consideration, therefore, of residential street design should be to foster a safe and pleasant environment for the residents that live along the street, and safe traveling conditions for motorists, bicyclists and pedestrians. The convenience of motorists is a secondary consideration.

The street design should create an environment that cautions drivers that they are in a residential area where they must safely share the traveling space with pedestrians and bicyclists, both child and adult. Visual cues such as meandering streets, sidewalks, landscaping, signage, narrowed streets, changes in pavement texture (such as brick, stamped, or textured surfaces), and raised crosswalks all serve to heighten drivers' awareness for the need to maintain lower speeds. Incorporating such features into residential street design at inception will reduce or eliminate the need for traffic calming retrofits.

Section B of this chapter discusses the primary objectives of Residential Street Design in more detail, to aid the designer in the selection of proper criteria. ***Section C*** sets forth specific design criteria for residential streets.

B OBJECTIVES

The basic principles of residential street design are based on four factors:

1. Safety
2. Efficiency of Service
3. Livability and Amenities
4. Economy of Land Use, Construction, and Maintenance

The following 17 principles incorporate these factors. These principles are not intended as absolute criteria, since instances may occur where certain principles conflict. The principles should therefore be used as concepts for layout of proper street systems.

1. Adequate vehicular and pedestrian access should be provided to all parcels.
2. Local street systems should be designed to minimize through traffic movements unless it is specifically desired by the County or municipality to connect residential developments.
3. Street patterns should minimize excessive vehicular travel through connectivity between adjacent residential developments, and to larger street networks.
4. Local street systems should be logical and comprehensible, and systems of street names and house numbers should be simple, consistent, and understandable.
5. Local circulation systems and land-development patterns should not detract from the efficiency of adjacent major streets due to lack of connectivity.
6. Elements in the local circulation system should not have to rely on extensive traffic regulations and enforcement in order to function efficiently and safety.
7. Traffic generators within residential areas should be considered in the local circulation pattern.
8. The planning and construction of residential streets should clearly indicate their local function. The street's residential nature should be obvious to those driving on them.
9. The street system should be designed for a relatively uniform low volume of traffic.
10. Local streets should be designed to discourage excessive speeds.

11. Pedestrian-vehicular conflict points should be minimized.
12. The amount of space in the land development devoted to motor vehicle uses should be minimized.
13. Smaller block sizes may be used to encourage walking or bicycling. See ***Chapter 19 – Traditional Neighborhood Development*** for more information.
14. The arrangement of local streets should permit economical and practical patterns, shapes, and sizes of development parcels and provide interconnectivity without using arterials or collectors.
15. Local streets should consider and utilize topography from the standpoint of both economics and amenities.
16. Appropriate provisions for transit service within residential areas should be included.
17. Street design should consider horizontal and vertical compatibility and connectivity with sidewalks, bicycle lanes, and pedestrian walkways.

C DESIGN ELEMENTS

C.1 Design Speed

For local residential streets, design speeds of 15 to 30 mph are appropriate, depending on the adjacent development, terrain, available right of way, and other area controls. Alleys and narrow roadways intended to function as shared spaces (that is, could be used to access driveways, for garbage pickup, and travel by walking or bicycling) may have design speeds as low as 10 mph. Design speeds greater than 30 mph in residential areas require increased sight distances and radii which are contrary to the function of a local residential street.

C.2 Sight Distance

C.2.a Stopping Sight Distance

The minimum stopping sight distance is shown in Table 16 – 1 Minimum Stopping Sight Distance for Residential Streets.

Table 16 – 1 Minimum Stopping Sight Distance for Residential Streets

Design Speed (mph)	Stopping Sight Distance (feet)
10	45
15	75
20	125
25	150
30	200

C.2.b Passing Sight Distance

Passing should not be encouraged on local residential streets, and design for passing sight distance is seldom applicable on these streets. If longer straight sections and higher design and posted speeds support passing, the street shall be designed under the design criteria established in ***Chapter 3 - Geometric Design***.

C.2.c Intersection Sight Distance

Intersections shall be designed with adequate corner sight distance as set forth in Table 16 – 2 Minimum Corner Intersection Sight Distance for Residential Streets. Intersection design should take into consideration growth of landscaping and other amenities. Where a local residential street intersects a higher-order street, the design criteria of the higher-order street shall control within the right of way of the higher-order street.

Table 16 – 2 Minimum Corner Intersection Sight Distance for Residential Streets

Design Speed (mph)	Corner Intersection Sight Distance * (feet)
10	110
15	160
20	210
25	260
30	310

* Corner sight distance measured from a point on the minor road at least 14.5 feet from the edge of the major road pavement and measured from a height of eye at 3.5 feet on the minor road to a height of object at 3.5 feet on the major road.

Where stop or yield control is not used, the corner sight distance should be a minimum of 300 feet. If restrictions are unavoidable, a minimum of 200 feet is allowed with proper warning signage found in the ***Manual on Uniform Traffic Control Devices (MUTCD)*** such as an intersection warning sign (W2 series) or cross traffic does not stop here plaque (W4-4P). To maintain the minimum sight distance, restrictions on height of

embankments, locations of buildings, and screening fences may be necessary. Any landscaping in the sight distance triangle should be low growing, and should not be higher than 3 feet above the level of the intersecting street pavements. Tree overhangs should be trimmed to at least 8 feet above the level of the intersections.

Intersecting streets should meet at approximately right angles. Angles of less than 60 degrees should be avoided.

C.3 Horizontal Alignment

C.3.a Minimum Centerline Radius

The minimum radii for horizontal curves are given in Table 16 – 3 Minimum Centerline Radii for Residential Streets. Typically, superelevation should not be utilized on local residential streets. Where superelevation is appropriate or required, the street shall be designed under the design criteria established in ***Chapter 3 – Geometric Design***.

Table 16 – 3 Minimum Centerline Radii for Residential Streets

Design Speed (mph)	Min. Centerline Radius (feet)
10	25
15	50
20	89
25	166
30	275

C.3.b Minimum Curb Return Radius

Where there are substantial pedestrian movements, the minimum radius of curb return where curbs are used, or the outside edge of pavement where curbs are not used shall be 15 feet. A minimum radius of 25 feet is desirable to accommodate turning movements of service vehicles.

C.4 Vertical Alignment

C.4.a Vertical Curves

Vertical curves shall be designed for a minimum stopping sight distance using the design criteria of 30 mph established in ***Chapter 3 – Geometric Design.***

C.5 Cross Section Elements

C.5.a Width of Roadway

The minimum width of a two-way residential roadway should be 20 feet from edge-of-pavement to edge-of-pavement (excluding curbs and gutters). Travel lanes should be a minimum of 10 feet wide, and wider where practicable. Under constrained conditions or in some very rural areas, lanes 9 feet or narrower may be used. Refer to ***Chapter 4*** of the ***AASHTO Guidelines for Geometric Design of Very Low-Volume Local Roads*** (ADT ≤ 400). Lanes narrower than 9 feet are prohibited in the absence of a Design Exception as provided for in ***Chapter 14 – Design Exceptions***.

When parking lanes are provided on one or both sides of the roadway, they shall be at least 7 feet wide including the gutter section where applicable.

Where curb and gutter sections are used, the roadway may be narrowed to the travel lane width (plus bike lane if present) at intersections. This will prevent parking close to the intersection, reduce crossing distances for pedestrians, provide space for curb ramps, and reduce turning speeds. By providing intersection curb extensions, the visual width of the roadway can be reduced.

C.5.b Medians

When used in residential areas, medians or traffic separators should conform to ***Chapter 3*** or ***Chapter 19***.

C.6 Cul-de-sacs and Turnarounds

C.6.a Turning Area

A residential street more than 100 feet long and open at one end only shall have a special turning area at the closed end. This turning area should be circular and have a radius appropriate to the types of vehicle expected. The minimum outside radius of a cul-de-sac shall be 30 feet. In constrained circumstances, other turning configurations such as a "hammerhead" may be considered. Cul-de-sacs can detract from connectivity if used excessively or inappropriately.

C.7 Pedestrian Considerations

C.7.a Sidewalks

In residential areas, sidewalks should be provided on both sides of the street. The sidewalks should be located as far as practicable from the travel lanes and usually close to the right of way line. In certain circumstances, such as where lots are very large or there are environmental limitations, sidewalk on only one side may be considered. Along collector roadways shared use paths may be provided in lieu of sidewalks. Connectivity to and between existing public sidewalk or shared use path facilities is desired.

Pedestrian access should be provided to schools, day care facilities, parks, churches, shopping areas, and transit stops within or adjacent to the residential development. Pedestrian access to these destinations and throughout the neighborhood shall be designed for safe and convenient pedestrian circulation. Sidewalks or shared use paths between houses or to connect cul-de-sacs may be used where necessary to provide direct access.

Sidewalks, crosswalks and mid-block crossings shall be constructed under the criteria set forth in ***Section C.7.d*** of ***Chapter 3 – Geometric Design***, and ***Chapter 8 – Pedestrian Facilities***.

C.8 Bicyclist Considerations

C.8.a Bicycle Facilities

Residential roadways are generally sufficient to accommodate bicycle traffic. When specific bicycle facilities are desired they should connect to existing facilities and be designed in accordance with ***Chapter 3 – Geometric Design*** and ***Chapter 9 – Bicycle Facilities***. For bike lane transitions, see ***Chapter 9***.

C.9 Shared Use Paths

Shared use paths may be provided in lieu of sidewalks along collector roads in accordance with ***Section C.7.a***. When shared use paths are desired, they should connect to other pedestrian and bicycle facilities within or adjacent to the residential area, and connect to schools, day care facilities, parks, churches, shopping areas, and transit stops. Shared use paths shall be designed in accordance with ***Section C*** of ***Chapter 9 – Bicycle Facilities***. Shared use paths may be used by golf carts in certain areas, under certain circumstances in accordance with ***Sections 316.212, 316.2125 and 316.2126, F.S.***

C.10 Clear Zone

Clear zone requirements for residential streets shall be based on ***Chapter 3 – Geometric Design***, Table 3 – 15 Minimum Width of Clear Zone.

D REFERENCES FOR INFORMATIONAL PURPOSES

The following is a list of publications that may be referenced for further guidance:

- AASHTO Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400):
  https://bookstore.transportation.org/

- Manual on Uniform Traffic Control Devices (MUTCD)
  http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm

CHAPTER 17

BRIDGES AND OTHER STRUCTURES

EXHIBITS

CHAPTER 17

BRIDGES AND OTHER STRUCTURES

A INTRODUCTION

Bridges provide safe passage for multimodal traffic over various obstacles along a road or path. This chapter presents guidelines and standards for designing, constructing, inspecting, and maintaining bridges as well as other structures such as walls and supports for signs, lights, and traffic signals. These standards and criteria are necessary due to the critical function these structures serve to communities throughout their lifespan. This chapter establishes uniform minimum standards and criteria for all bridges used by the public for vehicular and/or pedestrian traffic as well as other structures such as walls and supports for signs, lights, and traffic signals. The geometry of structures shall follow the standards and criteria set forth in ***Chapters 3, 8, 9***, and ***13***. Exceptions to these standards and criteria must be processed in accordance with the procedures described in ***Chapter 14***.

In addition to the design criteria provided in this chapter, the *2006 Americans with Disabilities Act Standards for Transportation Facilities* as required by *49 C.F.R 37.41* or *37.43* and the *2017 Florida Building Code – Accessibility, 6th Edition* as required by 61G20-4.002 impose additional requirements for the design and construction of pedestrian facilities on bridges or other structures. Examples of facilities include sidewalks and shared use paths, and drainage grates and inlets in or near the accessible route. Significant ADA design considerations exist for all facilities with grades that exceed 5%.

Note: This chapter applies to all bridges under local control, except for bridges constructed on or over the Department's system. For bridges constructed on and over the Department's system, as well as all bridges that will be maintained by the Department, the Department's policies, procedures, standards and specifications will apply.

B OBJECTIVES

The objectives of this chapter are as follows:

- To prescribe uniform criteria with respect to bridge and miscellaneous structures design and geometric layout.
- To alert owners to the various federal and state requirements to be included in the design, construction, maintenance, and inspection of their bridges and other structures.
- To provide practical suggestions specific to Florida on prudent structural engineering based on past experience with statutes, standards, and criteria.

C DESIGN

The design of bridges and other structures shall be led by a licensed professional engineer who shall assume responsible charge of the work. The standards and criteria included here are directed only toward specific considerations that shall be followed. Other considerations are necessary to create a comprehensive bridge design allowing owners and their *engineer's* flexibility in design. All bridges and other structures shall be designed in accordance with specifications (including guide specifications) published by the American Association of State Highway and Transportation Officials (AASHTO).

C.1 Bridges - General

All bridges and other structures shall be designed in accordance with specifications (including guide specifications) published by the American Association of State Highway and Transportation Officials (AASHTO). At a minimum, the ***AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, 8th Edition (2017)*** shall be used. Any bridge reconstruction (i.e., lengthening, widening, and/or major component replacement) shall be designed as specified in this section. Record of such reconstruction shall be maintained as specified in Section D of this chapter. The remaining design life should be considered in the design.

C.2 Bridge Live Loads

In addition to the notional (HL - 93) design load specified in ***LRFD***, bridges shall also require a FL 120 permit load rating greater than 1 as defined in the *Department's* ***Structures Manual, Volume 1 – Structures Design Guidelines, 2018 (SDG)***. This vehicle allows for a more consistent load rating comparison considering the current bridge inventory.

C.3 Bridge Superstructure

The superstructure of a bridge is that portion of the structure that spans between its supports or piers. Considerations that shall be incorporated into the design of all superstructures will include the following:

C.3.a Girder Transportation

The Engineer of Record (EOR) is responsible for investigating the feasibility of transportation for heavy, long and/or deep girder field sections. In general, the EOR should consider the following during the design phase:

- Whether or not multiple routes exist between the bridge site and a major transportation facility.
- The transportation of field sections longer than 130 ft or weighing more than 160,000 pounds requires coordination through the Department's Permit Office during the design phase of the project. Shorter and/or lighter field sections may be required if access to the bridge site is limited by roadway(s) with sharp horizontal curvature or weight restrictions.
- On steel superstructures, where field splice locations required by design result in lengths greater than 130 feet, design and detail "Optional Field Splices" in the plans.
- For curved steel box girders, prefabricated trusses, and integral pier cap elements, size field pieces such that the total hauling width does not exceed 16 feet.

C.3.b Vertical Clearance

All new bridges over roadways and shared use paths shall be designed to meet the vertical clearance standards specified in ***Chapter 3, Section C.7.j.4.(b)***, and ***Chapter 9, Section C.6***.

All new bridges over water shall be designed to meet the following vertical clearance standards:

- To allow debris to pass without causing damage, the clearance between the design flood stage and the low member of bridges shall be a minimum of two feet. This standard does not apply to culverts and bridge-culverts.

- For crossings subject to boat traffic, the minimum vertical navigation clearance should be:

Tidewater bays and streams	6 feet above Mean High Water *
Freshwater rivers, streams, non-regulated/controlled canals, and lakes	6 feet above Normal High Water
Regulated/controlled lakes and canals	6 feet above control elevation

* For locations subject to tidal salt / brackish water splashing, a 12-foot vertical clearance above Mean High Water should be considered for bridge durability reasons.

Higher clearances apply for crossings over legislated channels under the control of the U.S. Coast Guard (USCG). Designers should also consider future navigation demands and future shared use path demands in setting the vertical clearance of a bridge.

C.3.c Railings

All traffic, pedestrian, and bicycle railings shall comply with the requirements in ***Section 13*** of ***LRFD***. Traffic railings shall meet the crash requirements of at least Test Level 3 (TL-3) for bridges with design speeds greater than 45 mph and at least TL-2 for design speeds less than or equal to 45 mph.

For pedestrian/bicycle railings, two-pipe guiderails and details similar to the *Department's* ***Standard Plans, Indexes 515-070 and 515-080*** may be mounted on walls or other structures where drop-off hazards are 5 feet or less. Concrete, aluminum or steel railing and details similar in strength and geometry to *the Department's* ***Standard Plans, Indexes 515-021 thru 515-080 and 521-820 thru 521-825*** shall be used (or modified to suit environmental runoff concerns) where drop-off hazards are greater than 5 feet. See ***Standard Plans Instructions*** for more information.

C.3.d Expansion Joints

The number of joints should be minimized to reduce the inspection and maintenance needs of the bridge.

C.3.e Drainage

All bridge designs shall include a drainage design that is specific to its site. Conveyance of drainage off the bridge roadway should be designed to meet spread standards contained in the most recent version of the Department's *Drainage Manual, Chapter 3 (2018)* and may include open systems (i.e., scuppers) or closed systems (i.e., inlets and pipes) based on environmental permitting restrictions. Drainage from the bridge should not drop onto traffic below. Longitudinal conveyance piping attached to bridges is expensive and maintenance-intensive, and should be avoided whenever possible.

Conveyance of drainage off pedestrian facilities shall be designed to provide an accessible route for pedestrians. Further guidance on the design of bridge deck drainage may be found in the current version of *FHWA Publication HEC-21, "Design of Bridge Deck Drainage."*

C.3.f End Treatments

Requirements for end treatments of structures are given in ***Chapter 4 – Roadside Design***. Bridge barriers shall be designed to accommodate connection of a guardrail transition or energy absorbing system.

C.4 Bridge Substructure

The substructure of a bridge consists of all elements below the superstructure including its bearings, piers, and foundations. For guidance on bridges vulnerable to coastal storms, see *SDG, Section 2.5.* Considerations that shall be incorporated into the design of all substructures include the following:

C.4.a Scour

A hydrologic/hydraulic analysis shall be performed to quantify expected stages and flows at the bridge site. Anticipated substructure scour shall be developed for the following conditions:

Hydraulic Design Flood Frequency	Scour Design Flood Frequency	Scour Design Check Flood Frequency
Q_{10}	Q_{25}	Q_{50}
Q_{25}	Q_{50}	Q_{100}
Q_{50}	Q_{100}	Q_{500}
Notes: "Q" is the common term used for flow rate, an expression of volume of fluid which passes per unit of time. "x" is the return period in years (10, 25, 50, 100, 500).		

Any exceptions to the standards above hydrologic/hydraulic and scour analysis requirements shall be approved in writing by the Department's local District Drainage Engineer. Methodology for computing bridge hydrology/hydraulics and bridge scour should follow the guidelines set forth in the Department's ***Drainage Manual (2018).*** Further guidance and training may be obtained through ***FHWA Hydraulic Engineering Circulars (HEC) "HEC-18"*** and ***"HEC-20"*** and the Department's training courses on these topics. Additionally, for larger bridges (>120,000 sq. ft.), hydraulic designers may wish to consult with the local Department District Drainage Engineer for case-specific guidance. The ***SDG, Section 2.11*** and ***2.12*** and the Department's ***Drainage Manual, Chapter 4 (2018)*** provide guidance on scour load combinations with other loads.

C.4.b Navigation Aids and Vessel Collision

All bridges over USCG designated navigable waterways shall include bridge fender systems and consideration for potential vessel collision.

For guidance on navigation aids and bridge fender system design, see SDG Section 314. For guidance on vessel collision design see ***SDG, Section 2.11*** and ***LRFD, Section 3.14.***

C.4.c Pier Locations

All bridges over roadways shall have substructures supports set back from vehicular traffic lanes in accordance with ***Chapter 3, Section C.7.j.4.(a)***.

All bridges over water shall have substructure supports located with horizontal clearance requirements as listed below. In this case, horizontal clearance is defined as the clear distance between piers, fender systems, culvert walls, etc., projected by the bridge normal to the flow.

- For crossings subject to boat traffic a minimum horizontal clearance of 10 feet shall be provided.
- Where no boat traffic is anticipated, horizontal clearance shall be provided consistent with debris conveyance needs and structure economy.

C.5 Retaining and Noise Walls

The design of conventional, anchored, mechanically stabilized, and prefabricated modular retaining wall structures shall meet the requirements of ***LRFD Section 11.*** Local agencies should consider using only wall types approved by the Department. These are described in ***Section 3.12*** of the ***SDG.*** Local agencies should also follow the design criteria for retaining walls found in ***Section 3.13*** of the ***SDG.***

The design of noise walls should meet the requirements of the ***SDG, Section 3.16.*** For noise walls within the clear zone, their design and/or protection should comply with the following:

- For noise walls attached to the top of traffic railings only use crash tested systems consistent with the design speed of the facility. The Department has standards for TL-4 systems that meet the requirements of ***NCHRP Report 350 or the Manual for Assessing Safety Hardware (MASH).***
- Non-crash tested noise walls may be attached to structures if located behind an approved traffic railing and mounted at least five feet from the face of the traffic railing at deck level.

Potential existing off-site stormwater inflows through the proposed wall location should be verified in the field and considered in the wall design. For railings on top of walls, see ***Section C.3.c. Railings.***

C.6 Sign, Lighting, and Traffic Signal Supports

The design of sign, lighting, and traffic signal support structures shall meet the requirements of ***AASHTO's LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 1st Edition, 2018 Interim Revisions,*** and the Department's ***Structures Manual Volume 3 - FDOT***

Modifications to LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (LRFDLTS-1).

C.7 Pedestrian Bridges

For guidance on pedestrian bridges, see *SDG Chapter 10.*

D CONSTRUCTION

During the construction of a bridge or any structure at, over, or near a public facility, safety awareness is necessary and precautions shall be taken to protect the public. Provisions for protecting the public during construction shall be in accordance with the *MUTCD (2009 Edition with Revision Number 1 and 2, May 2012)* work zone traffic control procedures and the standards and criteria described in ***Chapter 11 – Work Zone Safety***. Worker safety is the responsibility of the contractor. Temporary barriers shall be installed on all bridges being widened or whose new construction is phased. Spread of stormwater on the bridge deck should be considered in planning temporary traffic routing.

During the construction of a bridge or any structure, records to be kept and maintained throughout its life shall include foundation construction records (pile driving records, shaft tip elevations, borings) and as-built plans. These records provide critical information necessary for future inspection, maintenance, emergency management, enhancement, reconstruction, and/or demolition of these structures. These records shall be delivered to the Department's local District Structures Maintenance Engineers.

Any proposed changes to the construction details or specifications shall be signed, sealed, and dated by a professional engineer licensed in the State of Florida.

E ROUTINE INSPECTION AND MAINTENANCE

Title 23, Code of Federal Regulations, Part 650, Subpart C, sets forth the ***National Bridge Inspection Standards (NBIS)*** for bridges on all public roads. ***Section 650.3*** defines bridges, specifies inspection procedures and frequencies, and indicates minimum qualifications for personnel. Each state is permitted to modify its bridge inspection standards to deviate from the NBIS standards but only following approval from the FHWA.

Section 335.074, F.S., mandates safety inspection of bridges.

Bridge inspectors shall be certified in accordance with *Chapter 14-48, F.A.C.* Safety inspection of bridges shall be conducted in accordance with *Chapter 14-48, F.A.C.*

The Department inspects all bridges in Florida, both on-system and off-system. The Department provides each local government with copies of its inspection reports. Each local government should maintain these reports to be responsive to Metropolitan Planning Organization requests for bridge rehabilitation, replacement, or enhancement designations. Please see the following for further information: *Bridge and Other Structures Reporting Manual 850-010-030*

All on-system and off-system bridges are assigned a Bridge Number by the Department. For new bridges, local agencies shall contact the Department's local District Structures Maintenance Engineers to have a number assigned.

F BRIDGE LOAD RATING AND POSTING

Section 335.074, F.S. Safety Inspection of Bridges requires that bridges on a public transportation facility be inspected for structural soundness and safety at regular intervals. The inspection shall consider age, traffic characteristics, state of maintenance, and known deficiencies of the bridge. The governmental entity having maintenance responsibility for any such bridge shall be responsible for having inspections performed and reports prepared.

As required by ***Section 335.074, F.S.***, each inspection shall be reported to the Department, using the Bridge Load Rating Summary Table form shown in Exhibit A. Further information for preparing a bridge load rating summary and fillable form may be found on the *Department's* ***Office of Maintenance, Bridge Load Rating*** web site.

Upon receipt of an inspection report that recommends reducing the weight limit on a bridge, the governmental entity having maintenance responsibility for the bridge shall load post the bridge within 30 days in accordance FS 335.074(5). Further requirements for reporting and posting of weight, size or speed limits on bridges are found in this statute, ***Section 316.555 F.S. Weight, load, speed limits may be lowered.*** The appropriate signage shall be promptly installed in accordance with the ***MUTCD.***

For new construction or reconstruction projects, the bridge owner is responsible for providing the Department with a load rating and completed Bridge Load Rating Summary Table (see Exhibit A – Bridge Load Rating Summary Table) within 90 days of opening for on-system bridges or 180 days for off-system bridges. The bridge owner should consider requiring the engineer of record to perform the load rating.