Pavement Design and Construction Issues for Florida Green Book
Teleconference Meeting: Bridge No. 850-410-5666
November 16, 2010 (9:00am – 10:30am)
Tarpon Conference Room – District Seven Headquarters
Agenda

Attendees:

Quigley, Robert; 'agarganta@cte.cc'; 'clmpe@aol.com'; 'jim.burnside@tampagov.net'; 'dcerlanek@alachuacounty.us'; 'kbryant@baycountyfl.gov'; 'Ty Mullis'; Dietrich, Bruce; OHagan, David; Prasad, Ananth; Blanchard, Brian; D7-HQ, Tarpon

1. **Unpaved Roads (30 minutes)**

   Design Considerations (ADT, Design Speed, Land Use, Etc.):

2. **Safety Edge (30 minutes)**

   See handout for discussion:

3. **Additional Chapter 5 Enhancements (30 minutes)**

   RRR: Previous Green Book Meeting - all agreed this would be addressed under Chapter 10.

4. **Action Items:**

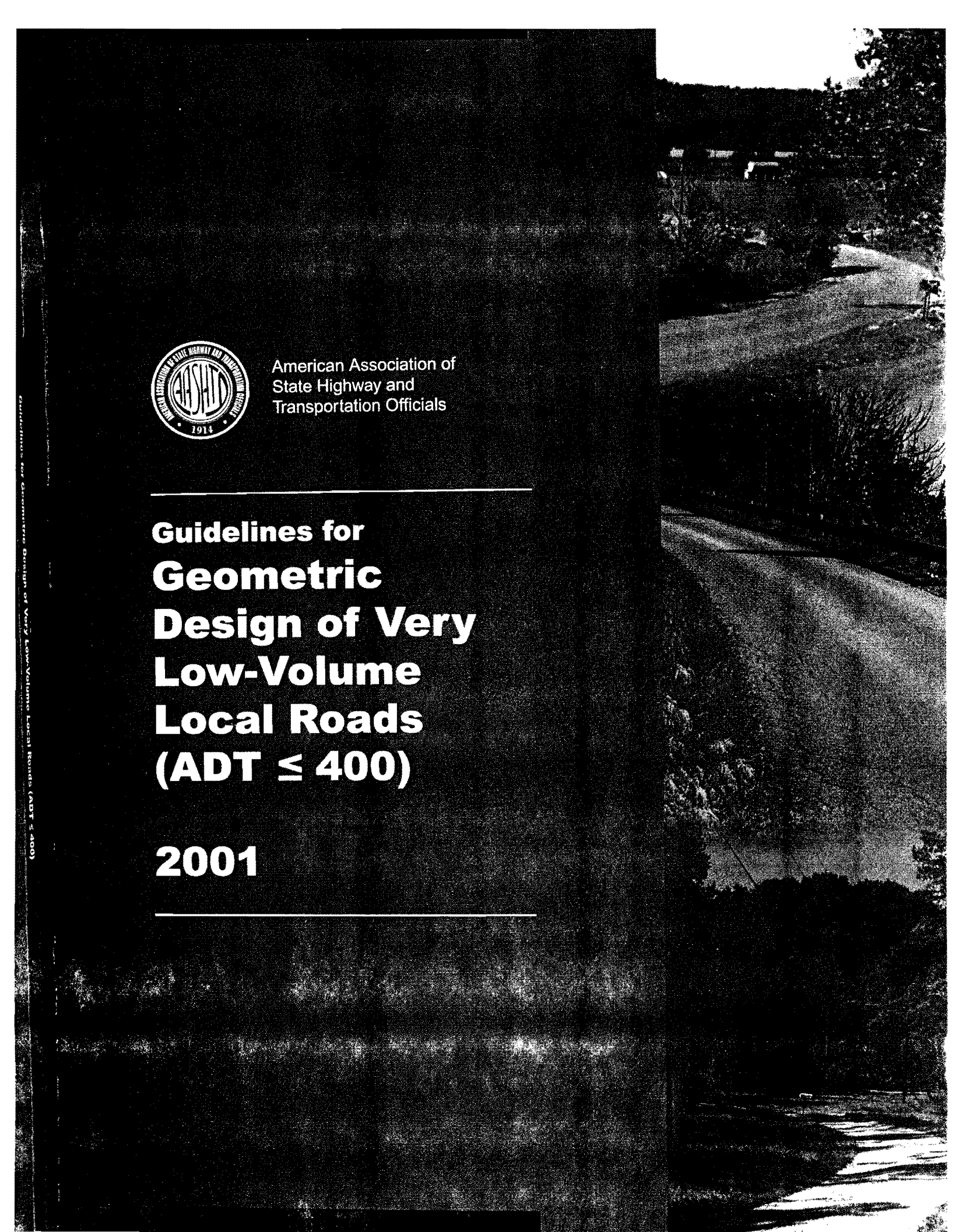
Member Responsibility:

Member Responsibility:

Member Responsibility:

Member Responsibility:

Notes:



American Association of
State Highway and
Transportation Officials

Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400)

2001

Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400)

UNPAVED ROADS

Many low-volume local roads have unpaved surfaces. Unpaved roads are generally appropriate for all functional subclasses of very low-volume local roads. Major access roads often have paved surfaces because they serve higher traffic volumes, but this is not considered mandatory. In particular, resource recovery (e.g., logging) roads and agricultural access roads in rural areas are frequently unpaved. Provision of an unpaved surface is an economic decision that is appropriate for many very low-volume local roads for which the cost of constructing and maintaining a paved surface would be prohibitive.

The safety of unpaved roads has been addressed in NCHRP Report 362 (**5**). This research established that crash rates are generally higher for unpaved roads than for paved roads for traffic volumes of 250 vehicles per day or more. The risk assessment by Neuman (**3**) found that roads in rural areas generally reach the threshold at which paving the road would be expected to result in one less severe crash every 10 to 15 years in the traffic volume range between 300 to 350 vehicles per day. However, there are no specific guidelines that indicate the maximum traffic volume level for which unpaved surfaces are appropriate.

NCHRP Report 362 (**5**) found crash rates for unpaved roads to be lower for narrower roadway widths. Therefore, existing unpaved roads should not generally be widened as a safety measure unless there is evidence of a site-specific safety problem that may be corrected by widening.

Unpaved roads are intended to operate at low to moderate speeds. Design speeds for unpaved roads should normally be 70 km/h [45 mph] or less, but may occasionally be as high as 80 km/h [50 mph] in situations the designer considers appropriate.

Provision of roadside clear zones, flatter slopes, or traffic barriers is generally inconsistent with the economic decision to build and maintain an unpaved surface and is not generally necessary for the low-speed environment of an unpaved road.

Design of horizontal alignment on unpaved roads differs from paved roads because paved and unpaved roads have different surface friction characteristics and because unpaved roads are typically designed for low-speed operation.

Exhibit 16 presents guidelines for the minimum radius of curvature for unpaved surfaces with no superelevation for application on very low-volume local roads. The exhibit is based on the design criteria of the United States Forest Service (**11**), which operates many unpaved roads. The minimum radius of curvature is a function of traction coefficient, which in turn is a function of the surface type (earth, gravel, crushed rock, packed snow, etc.) and the surface condition (dry, wet, ice, etc.) as shown in Exhibit 17. The recommended minimum curve radii in Exhibit 16 are based on use of a side friction factor, f, in Equation (2) that is 0.2 less than the traction coefficients shown in Exhibit 17. Use of high values of friction coefficient for design allows the designer to select smaller curve radii than would otherwise be used. Of course, the selection of a high traction coefficient is consistent with a higher surface type, and/or with an assumption that poor surface conditions such as snow, ice, or wet pavement are not sufficiently frequent for use as

a design control. The choice of the appropriate surface condition from Exhibit 17 should be based on the engineering judgment of the designer based on site-specific conditions.

Smaller curve radii than those shown in Exhibit 16 may be used where superelevation is provided. The minimum radius of curvature for such cases can be determined with Equation (2).

When an existing unpaved road is to be paved, a review of all geometric design elements of the road should be undertaken to assess their suitability for the higher speeds that are likely on a paved road.

Metric					
Design speed (km/h)	Minimum radius (m) for specified traction coefficient				
	0.7	0.6	0.5	0.4	0.3
20	15	15	15	20	35
30	15	20	25	40	75
40	30	35	45	65	130
50	40	50	70	100	200
60	60	75	95	145	285
70	80	100	130	195	385
US Customary					
Design speed (mph)	Minimum radius (ft) for specified traction coefficient				
	0.7	0.6	0.5	0.4	0.3
15	50	50	50	75	150
20	55	70	90	135	270
25	85	105	140	210	420
30	120	150	200	300	600
35	165	205	275	410	820
40	215	270	360	535	1070
45	270	340	450	675	1350

Source: Adapted from USFS Preconstruction Handbook (11)

Exhibit 16. Guidelines for Minimum Radius of Curvature for New Construction of Unpaved Surfaces with No Superelevation (11)

Material	Surface Condition		
	Dry	Wet	Other
Gravel, packed, oiled	0.50 - 0.85	0.40 - 0.80	–
Gravel, loose	0.40 - 0.70	0.36 - 0.75	–
Rock, crushed	0.55 - 0.75	0.55 - 0.75	–
Earth[a]	0.55 - 0.65	0.40 - 0.50	–
Dry, packed snow	–	–	0.20 - 0.55
Loose snow	–	–	0.10 - 0.60
Snow, lightly salted	–	–	0.29 - 0.31
Snow, lightly salted with chains	–	–	0.34
Ice, without chains	–	–	0.07 - 0.12

[a] reduce earth values by 50 percent for wet clays

Source: USFS Road Preconstruction Handbook (11)

Exhibit 17. Traction Coefficients Used in Design of Horizontal Alignment on Unpaved Roads (11)

TWO-WAY SINGLE-LANE ROADS

Two-way single-lane roads may be used in constrained locations, where traffic volumes are extremely low. Such cross sections are normally used on local roads where traffic volumes are less than 50 vehicles per day. On resource recovery roads used by professional drivers who are often in contact with one another by radio, two-way single-lane roads may be used for traffic volumes up to 100 vehicles per day. Two-way single-lane roads are designed to operate at low speeds, typically no more than 50 km/h [30 mph].

Two-way single-lane roads are often unpaved and normally have widths in the range from 3.5 to 4.0 m [11.5 to 13.0 ft]. Design values of stopping sight distance for two-way single-lane roads should be twice the stopping sight distance for a comparable two-lane road, as shown in Exhibit 8. USFS guidelines recommend that turnouts be provided at regular intervals on two-way single-lane roads to allow opposing vehicles to pass one another safely (**11**). The location of turnouts should consider topography and horizontal and vertical alignment. In some cases, particularly where increased sight distances are impractical, widening of the roadway at crests should be considered.

Firenbark

Section 336.045, Florida Statutes. Uniform minimum standards for design, construction, and maintenance; advisory committees.

(1) The department shall develop and adopt uniform minimum standards and criteria for the design, construction, and maintenance of all public streets, roads, highways, bridges, sidewalks, curbs and curb ramps, crosswalks, where feasible, bicycle ways, underpasses and overpasses used by the public for vehicular and pedestrian traffic. In developing such standards and criteria, the department shall consider design approaches which provide for the compatibility of such facilities with the surrounding natural or manmade environment; the safety and security of public spaces; and the appropriate aesthetics based upon scale, color, architectural style, materials used to construct the facilities, and the landscape design and landscape materials around the facilities....

(4) All design and construction plans for projects that are to become part of the county road system and are required to conform with the design and construction standards established pursuant to subsection (1) must be certified to be in substantial conformance with the standards established pursuant to subsection (1) that are then in effect by a professional engineer who is registered in this state.

These standards are intended to provide basic guidance for developing and maintaining a highway system with reasonable operating characteristics and a minimum number of hazards.

Standards established by this Manual are intended for use on all new construction projects off the state highway and federal aid systems. It is understood that the standards herein cannot be applied completely to all reconstruction and maintenance type projects. However, the standards shall be applied to the extent that economic and environmental considerations and existing development will allow.

When this Manual refers to guidelines and design standards given by current American Association of State Highway and Transportation Officials (AASHTO) publications, these guidelines and standards shall generally be considered as minimum criteria. The Department may have standards and criteria that differ from the minimum presented in this Manual or by AASHTO for streets and highways under its jurisdiction. A county or municipality may substitute standards and criteria adopted by the Department for some or all portions of design, construction, and maintenance of their facilities. Department standards, criteria, and manuals must be used when preparing projects on the state highway system or the national highway system.

Criteria and standards set forth in other manuals, which have been incorporated by reference, shall be considered as requirements within the authority of this Manual.

This Manual is intended for use by qualified engineering practitioners for the communication of standards and criteria (including various numerical design values and use conditions). The design, construction, and maintenance references for the infrastructure features contained in this Manual recognize many variable and often complex process considerations. The engineering design process, and hence the associated use of this Manual, incorporates aspects of engineering judgment, design principles, science, and recognized standards towards matters involving roadway infrastructure.

Users of this Manual are cautioned that the strict application of exact numerical values, conditions or use information taken from portions of the text may not be appropriate for all circumstances. Individual references to design values or concepts should not be used out of context or without supporting engineering judgment.

The contents of this Manual are reviewed annually by the Florida "Greenbook" Advisory Committee. Membership of this committee is established by the above referenced Section 336.045(2), Florida Statutes. Notification of revisions or additions to the Manual will be distributed to all registered Manual holders and dated. Comments, suggestions, or questions may be directed to any committee member.

336.045 Uniform minimum standards for design, construction, and maintenance; advisory committees.
(1) The department shall develop and adopt uniform minimum standards and criteria for the design, construction, and maintenance of all public streets, roads, highways, bridges, sidewalks, curbs and curb ramps, crosswalks, where feasible, bicycle ways, underpasses, and overpasses used by the public for vehicular and pedestrian traffic. In developing such standards and criteria, the department shall consider design approaches which provide for the compatibility of such facilities with the surrounding natural or manmade environment; the safety and security of public spaces; and the appropriate aesthetics based upon scale, color, architectural style, materials used to construct the facilities, and the landscape design and landscape materials around the facilities. The department shall annually provide funds in its tentative work program to implement the provisions of this subsection relating to aesthetic design standards. The minimum standards adopted must include a requirement that permanent curb ramps be provided at crosswalks at all intersections where curbs and sidewalks are constructed in order to give handicapped persons and persons in wheelchairs safe access to crosswalks.

(2) An advisory committee of professional engineers employed by any city or any county in each transportation district to aid in the development of such standards shall be appointed by the head of the department. Such committee shall be composed of: one member representing an urban center within each district; one member representing a rural area within each district; one member within each district who is a professional engineer and who is not employed by any governmental agency; and one member employed by the department for each district.

(3) Notwithstanding the provisions of any general or special law to the contrary, all plans and specifications for the construction of public streets and roads by any municipality or county shall provide for permanent curb ramps at crosswalks at all intersections where curbs and sidewalks are constructed in order to give handicapped persons and persons in wheelchairs safe access to crosswalks.

(4) All design and construction plans for projects that are to become part of the county road system and are required to conform with the design and construction standards established pursuant to subsection (1) must be certified to be in substantial conformance with the standards established pursuant to subsection (1) that are then in effect by a professional engineer who is registered in this state.

(5) Curb ramps which are required by subsections (1) and (3) to be provided at all intersections of curbs and sidewalks on public streets and roads shall be constructed to be in substantial conformance with the Uniform Federal Accessibility Standards published by the General Services Administration, Department of Housing and Urban Development, Department of Defense, and United States Postal Service. The provisions of this subsection apply to curb ramps let to contract on or after July 1, 1986.

(6) If the governing body of a county or municipality has adopted a design element as part of its comprehensive plan pursuant to part II of chapter 163, the department shall consider such element during project development of transportation facilities. The design of transportation facilities constructed by the department within the boundaries of that county or municipality must be consistent with that element to the maximum extent feasible.

Select Year: 2010 Go

The 2010 Florida Statutes

Title XXIX
PUBLIC HEALTH

Chapter 403
ENVIRONMENTAL CONTROL

View Entire Chapter

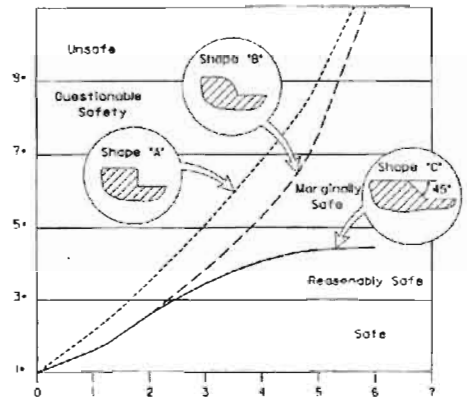
PART I
POLLUTION CONTROL

Air emissions trading.
403.0875 Citation of rule.
403.0876 Permits; processing.
403.0877 Certification by professionals regulated by the Department of Business and Professional Regulation.
403.088 Water pollution operation permits; conditions.
403.0881 Wastewater or reuse or disposal systems or water treatment works; construction permits.
403.0882 Discharge of demineralization concentrate.
403.0885 Establishment of federally approved state National Pollutant Discharge Elimination System (NPDES) Program.
403.08852 Clarification of requirements under rule 62-302.520(2), F.A.C.
403.0891 State, regional, and local stormwater management plans and programs.
403.0893 Stormwater funding; dedicated funds for stormwater management.
403.0896 Training and assistance for stormwater management system personnel.
403.091 Inspections.
403.092 Package sewage treatment facilities; inspection.
403.111 Confidential records.
403.121 Enforcement; procedure; remedies.
403.131 Injunctive relief, remedies.
403.135 Persons who accept wastewater for spray irrigation; civil liability.
403.141 Civil liability; joint and several liability.
403.151 Compliance with rules or orders of department.
403.161 Prohibitions, violation, penalty, intent.
403.1651 Ecosystem Management and Restoration Trust Fund.
403.1655 Environmental short-term emergency response program.
403.1815 Construction of water distribution mains and sewage collection and transmission systems; local regulation.
403.182 Local pollution control programs.
403.1832 Department to accept federal aid; Grants and Donations Trust Fund.
403.1834 State bonds to finance or refinance facilities; exemption from taxation.
403.1835 Water pollution control financial assistance.
403.1837 Florida Water Pollution Control Financing Corporation.
403.1838 Small Community Sewer Construction Assistance Act.
403.191 Construction in relation to other law.
403.201 Variances.
403.231 Department of Legal Affairs to represent the state.
403.251 Safety clause.
403.281 Definitions; weather modification law.
403.291 Purpose of weather modification law.
403.301 Artificial weather modification operation; license required.
403.311 Application for weather modification licensing; fee.
403.321 Proof of financial responsibility.
403.331 Issuance of license; suspension or revocation; renewal.
403.341 Filing and publication of notice of intention to operate; limitation on area and time.

403.351 Contents of notice of intention.
403.361 Publication of notice of intention.
403.371 Proof of publication.
403.381 Record and reports of operations.
403.391 Emergency licenses.
403.401 Suspension or revocation of license.
403.411 Penalty.
403.412 Environmental Protection Act.
403.413 Florida Litter Law.
403.4131 Litter control.
403.41315 Comprehensive illegal dumping, litter, and marine debris control and prevention.
403.4132 Litter pickup and removal.
403.4133 Adopt-a-Shore Program.
403.4135 Litter receptacles.
403.414 Environmental award program.
403.415 Motor vehicle noise.
403.4151 Exempt motor vehicles.
403.4153 Federal preemption.
403.4154 Phosphogypsum management program.
403.4155 Phosphogypsum management; rulemaking authority.
403.42 Florida Clean Fuel Act.
403.44 Florida Climate Protection Act.

Relative Safety of Various Edge Elevations and Shapes

The chart below shows how various edge shapes relate to safety.



Longitudinal EdgeElevation Change (inches)

* These numbers are subjective severity levels.

[Zimmer and Ivey, Texas Transportation Institute, 1982]

Asphalt pavement contractors can use a special edging device on resurfacing equipment to install the "Safety Edge" while resurfacing. The roadway shown above was placed by the Georgia DOT using the "Safety Edge."

Call FHWA for More Information about the "Safety Edge"

The Georgia Department of Transportation working with the FHWA has demonstrated the ability to construct the "Safety Edge" with no impact on production and at less than 1% additional material costs. Based on the successful performance after one year in service, GDOT intends to incorporate the "Safety Edge" design into all resurfacing projects beginning in 2005. Local city and county governments in Georgia, such as Gwinnet County, are also making the safety edge part of their routine overlay design. Other state SHA's, such as Indiana DOT and the NY DOT, are implementing the safety edge on several pilot projects in 2005.

Contact

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U.S.Department of Transportation
Federal Highway Administration

Pbu. No. FHWA-SA-05-003

You Can Prevent Crashes Caused by Unsafe Pavement Edge Drop-offs

THE SAFETY EDGE

Pavement Edge Treatment

- **Saves Lives**
- **Reduces Tort Liability**
- **Reduces Maintenance Expense**
- **Costs Less than 1% of Pavment Resurfacing Budget**

Unsafe Pavement Edges are a Serious Safety Problem

An estimated 11,000 Americans suffer injuries and 160 die each year in crashes related to unsafe pavement edges, at a cost of $1.2 billion. The true extent of the problem is difficult to assess because the role of the hazardous pavement edge in the sequence of events leading to a crash often is not documented.

What is the Definition of an Unsafe Pavement Edge?

Unsafe edge drop-offs cause crashes.

An edge dropoff of four or more inches is considered unsafe if the roadway edge is at a 90° angle to the shoulder surface. Near vertical edge dropoffs of less than four inches are still considered a safety hazard to the driving public and may cause difficulty upon reentry to the paved surface.

How do Unsafe Edges Cause Crashes?

Drivers who slip off a resurfaced road onto an unimproved shoulder are likely to lose control as they attempt to climb onto the roadway. The pavement edge creates a "scrubbing" condition that must be overcome through over-steering. As drivers over-steer to reenter the roadway, they are prone to lose control of the vehicle. Compounding the danger, the rear wheel may catch the edge of the shoulder, swinging the car around. These actions may cause the car to veer into the adjacent lane, where it may collide or sideswipe oncoming cars, overturn, or run off the road and crash.

PAVEMENT EDGE HAZARDS AND TORT LIABILITY

Tort liability claims resulting from pavement edge drop-offs cost highway agenciesmillions each year. In one case, the court awarded $6 million for injuries caused by a low, defective shoulder drop-off.

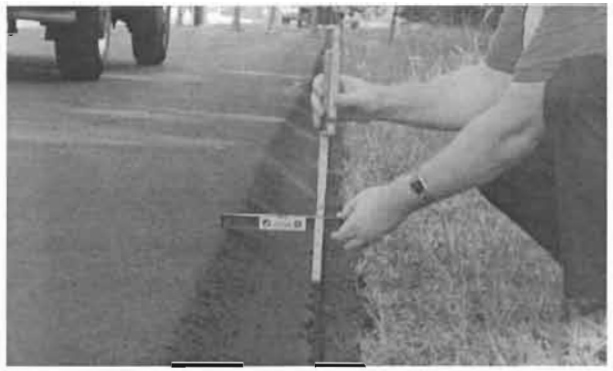
Be Part of the Solution by Specifying the "Safety Edge"

Adopting a standard contract specification requiring a 30-35° angle asphalt fillet along each side of the roadway in all resurfacing projects is a simple and cost-effective way to assure pavement edge safety.

Solutions to the pavement edge drop-off hazard are to:

- Require a ***30-35° angle asphalt fillet*** "Safety Edge" as a contract specification in all pavement resurfacing projects; and
- ***Routinely resurface shoulders*** when roadways are resurfaced.

The asphalt fillet provides a safer roadway edge, and a stronger interface between the roadway and the shoulder. The cost of an asphalt fillet is minimal in comparison to the total amount of the resurfacing contract, and pays back in countless dollars saved from reduction of fatalities, injuries, property damage and lawsuits.



An inexpensive way to assure pavement edge safety is to specify a 30°- 35° angle asphalt fillet "Safety Edge."

The fillet ties the existing shoulder into the resurfaced roadway and allows a vehicle to reenter the roadway safely. Highway agencies are able to restore the shoulder after the resurfacing project is completed.

CHAPTER 5

PAVEMENT DESIGN AND CONSTRUCTION

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CHAPTER 5

PAVEMENT DESIGN AND CONSTRUCTION

A INTRODUCTION

{General comments:

1. *Address Safety Edge?*
2. *Address resurfacing (RRR)?*
3. *Address standards for unpaved roads?}*

The function of the pavement or roadway surface is to provide a safe and efficient travel path for vehicles using the street or highway. The pavement should provide a good riding surface with a minimum amount of distraction to the driver. The pavement friction characteristics should be such that adequate longitudinal and lateral forces between the vehicle tires and the pavement can be developed to allow a margin of safety for required vehicle maneuvers. These characteristics should be provided at the highest reasonable level for the expected pavement surface, weather conditions, and the anticipated operational characteristics of the facility.

In order for the pavement to perform its function properly, the following objectives shall be used to guide the design and construction of the pavement:

- Provide sufficient pavement structure and the proper pavement material strength to prevent pavement distress prior to the end of the design period.
- Develop and maintain adequate skid resistance qualities to allow for safe execution of braking, cornering, accelerating, and other vehicle maneuvers.
- Provide drainage to promote quick drying and to reduce the likelihood of hydroplaning and splashing.

B PAVEMENT DESIGN

B.1 Pavement Type Selection

For new construction and major reconstruction projects, the designer should determine the type of pavement to be constructed utilizing formal analysis of existing and anticipated conditions. The Department has a documented procedure patterned after the ~~1986~~ 1993 AASHTO Guide for Design of Pavement Structures, Appendix B. This procedure may be found in Department's ~~Flexible~~ Pavement Type Selection ~~Design~~ Manual.

B.2 Structural Design

The pavement shall be designed and constructed so the required surface texture is maintained and its structure retains an adequate level of serviceability for the design period. The strength of the pavement materials shall be sufficient to maintain the desired roadway cross section without the formation of ruts or other depressions which would impede drainage. Subgrade strength and subgrade drainage are major factors to be considered in pavement design.

The Department's pavement design manuals are recommended as a guide for both flexible and rigid pavement design. Other design procedures are available including the AASHTO Guide for Design of Pavement Structures, ~~1986~~1993; ~~the AASHTO Interim Guide for Design of Pavement Structures, 1972;~~ and procedures which have been developed by the Portland Cement Association, the American Concrete Pavement Association, and the Asphalt Institute. The selection of the design procedure and the development of the design data must be managed by professional personnel competent to make these evaluations.

B.3 Skid Resistance

Pavements shall be designed and constructed so as to maintain adequate skid resistance for as long a period as the available materials, technology, and economic restraints will permit, thus eliminating cost and hazardous maintenance operations.

The results of relevant experience and testing (i.e., tests conducted by the Department's Materials Office) should be used in the selection of aggregate and other materials, the pavement mix design, the method of placement, and the techniques used for finishing the pavement surface. The design mixes should be

monitored by continuous field testing during construction. Changes to the design mix or construction procedures must be made by qualified pavement designers and laboratory personnel ONLY.

B.4 Drainage

Adequate drainage of the roadway and shoulder surfaces should be provided. Factors involved in the general pavement drainage pattern include: pavement longitudinal and cross slopes, shoulder slopes and surface texture, curb placement, and the location and design of collection structures. The selection of pavement cross slopes should receive particular attention to achieve the proper balance between drainage requirements and vehicle operating requirements. The use of curbs or other drainage controls adjacent to the roadway surface should be avoided, particularly on high speed facilities. Specific requirements for cross slopes and curb placement are given in CHAPTER 3 - GEOMETRIC DESIGN.

~~The use of grooving (across the roadway) in concrete pavements frequently improves the wet weather skid resistance and decreases the likelihood of hydroplaning. This technique should be considered for locations requiring frequent vehicle maneuvers (curves, intersections, etc.) or where heavy traffic volumes or high speeds will be encountered. The depth, width, and spacing of the grooves should be such that vehicle operations are not hindered.~~

B.5 Shoulder Treatment

The primary function of the shoulder is to provide an alternate travel path for vehicles in an emergency situation and preferred path for bicyclists. Shoulders should be capable of providing a safe path for vehicles traveling at roadway speed, and should be designed and constructed to provide a firm and uniform surface capable of supporting vehicles in distress. Particular attention ~~should~~ shall be given to providing a smooth transition from pavement to shoulder and avoiding hazardous "drop-offs." *{Safety Edge?}*

Paved shoulders may be provided to improve drainage of the roadway, to serve bicycles and transit users, and to minimize shoulder maintenance.

C PAVEMENT CONSTRUCTION

A regular program of inspection and evaluation should be conducted to ensure the pavement criteria are satisfied during the construction process. Any regular inspection program should include the following:

- The use of standard test procedures, such as AASHTO and the American Society for Testing and Materials (ASTM).
- The use of qualified personnel to perform testing and inspection.
- The use of an independent assurance procedure to validate the program.

After construction, the pavement surface shall be inspected to determine the required surface texture and smoothness was achieved and the surface has the specified slopes. Spot checking of skid resistance by approved methods should be considered. ~~Inspection of the roadway during wet weather conditions should be carried out as soon as possible to quickly locate drainage problems such as depressions in the pavement surface.~~ Periodic reinspection should be undertaken in conformance with the guidelines described in CHAPTER 10 – MAINTENANCE, Section F.4 Pavement Maintenance.

{We have received several comments in the past regarding criteria for unpaved roads. Is this something the subcommittee feels needs to be addressed in more detail?}