The California Department of Transportation (Caltrans) has developed new high speed rail guidance in the Sixth Edition, Highway Design Manual (HDM). The high speed rail guidance has been provided in Chapters 60, 80, and 300, as included in this manual change transmittal. The changes are described in the summary below with change-sheets available on the Caltrans Design website at: http://www.dot.ca.gov/hq/oppd/hdm/hdmtoc.htm. These revisions and changes are effective September 28, 2011, and shall be applied to on-going projects in accordance with HDM Index 82.5 – Effective Date for Implementing Revisions to Design Standards.

HDM Holders are encouraged to use the most recent version of the HDM available on-line at the above website. Should a HDM Holder choose to maintain a paper copy, the Holder is responsible for keeping their paper copy up to date and current. Using the latest version available on-line will ensure proper reference to the latest design standards and guidance. If you would like to be notified automatically of any significant changes or updates to the HDM, go to http://www.dot.ca.gov/hq/oppd/hdm/hdmlist.htm.

A summary of the most significant revisions are as follows:

<table>
<thead>
<tr>
<th>Index 62.10</th>
<th>Users, Page 60-11</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New index provided to include the definition for high speed rail.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 82.1B</th>
<th>Advisory Standards, Page 80-10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The new High Speed Rail Clearance advisory standard located in Index 309.1 was added to the list of advisory standards.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Index 309.1(1)</th>
<th>Horizontal Clearances, Page 300-20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Guidance was expanded to consider horizontal clearance objectives to the planned ultimate traveled way width of the highway facility. Also a reference was added to new subsection (4) for high speed rail clearance guidance.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Index 309.1(4)</th>
<th>High Speed Rail Clearances, Page 300-22</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New high speed rail clearance guidance has been provided. Included is the new advisory standard for horizontal clearance when a high speed rail corridor is to be constructed longitudinally to a freeway, expressway or a conventional highway with posted speeds over 40 mph.</td>
</tr>
</tbody>
</table>

CH 10 - DIVISION OF DESIGN

11 Organization and Functions
11.1 Organization 10-1

CH 20 - DESIGNATION OF HIGHWAY ROUTES

21 Highway Route Numbers
21.1 Legislative Route Numbers and Descriptions 20-1
21.2 Sign Route Numbers 20-1

CH 40 - FEDERAL-AID

41 Enabling Legislation
41.1 General 40-1

42 Federal-Aid System
42.1 National Highway System 40-1
42.2 Interstate 40-1

43 Federal-Aid Programs
43.1 Surface Transportation Program (STP) 40-1
43.2 Congestion Mitigation and Air Quality Improvement Program (CMAQ) 40-2
43.3 Bridge Replacement and Rehabilitation Program 40-2
43.4 Federal Lands Program 40-2
43.5 Special Programs 40-2

44 Funding Determination
44.1 Funding Eligibility 40-2
44.2 Federal Participation Ratio 40-2
44.3 Emergency Relief 40-2

CH 60 - NOMENCLATURE

61 Abbreviations
61.1 Official Names 60-1

62 Definitions
62.1 Geometric Cross Section 60-1
62.2 Highway Structures 60-2
62.3 Highway Types 60-2
## Table of Contents

<table>
<thead>
<tr>
<th>Topic Number</th>
<th>Subject</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>62.4</td>
<td>Interchanges and Intersections at Grade</td>
<td>60-4</td>
</tr>
<tr>
<td>62.5</td>
<td>Landscape Architecture</td>
<td>60-4</td>
</tr>
<tr>
<td>62.6</td>
<td>Right of Way</td>
<td>60-6</td>
</tr>
<tr>
<td>62.7</td>
<td>Pavement</td>
<td>60-6</td>
</tr>
<tr>
<td>62.8</td>
<td>Traffic</td>
<td>60-10</td>
</tr>
<tr>
<td>62.9</td>
<td>Drainage</td>
<td>60-11</td>
</tr>
<tr>
<td>62.10</td>
<td>Users</td>
<td>60-11</td>
</tr>
</tbody>
</table>

### CHAPTER 80 - APPLICATION OF DESIGN STANDARDS

81 Project Development Overview

81.1 Philosophy

82 Application of Standards

82.1 Highway Design Manual Standards

82.2 Approvals for Nonstandard Design

82.3 Use of FHWA and AASHTO Standards and Policies

82.4 Mandatory Procedural Requirements

82.5 Effective Date for Implementing Revisions to Design Standards

82.6 Design Information Bulletins and Other Guidance

### CHAPTER 100 - BASIC DESIGN POLICIES

101 Design Speed

101.1 Selection of Design Speed

101.2 Design Speed Standards

102 Highway Capacity

102.1 Design Capacities

102.2 References

103 Design Designation

103.1 Relation to Design

103.2 Design Period

104 Control of Access

104.1 General Policy

104.2 Access Openings

104.3 Frontage Roads
# Table of Contents

<table>
<thead>
<tr>
<th>Topic Number</th>
<th>Subject</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>104.4</td>
<td>Protection of Access Rights</td>
<td>100-5</td>
</tr>
<tr>
<td>104.5</td>
<td>Relation of Access Opening to a Median Opening</td>
<td>100-5</td>
</tr>
<tr>
<td>104.6</td>
<td>Cross References</td>
<td>100-5</td>
</tr>
<tr>
<td>105</td>
<td><strong>Pedestrian Facilities</strong></td>
<td></td>
</tr>
<tr>
<td>105.1</td>
<td>Sidewalks</td>
<td>100-5</td>
</tr>
<tr>
<td>105.2</td>
<td>Pedestrian Grade Separations</td>
<td>100-6</td>
</tr>
<tr>
<td>105.3</td>
<td>Accessibility Requirements</td>
<td>100-7</td>
</tr>
<tr>
<td>105.4</td>
<td>Guidelines for the Location and Design of Curb Ramps</td>
<td>100-8</td>
</tr>
<tr>
<td>106</td>
<td><strong>Stage Construction and Utilization of Local Roads</strong></td>
<td></td>
</tr>
<tr>
<td>106.1</td>
<td>Stage Construction</td>
<td>100-9</td>
</tr>
<tr>
<td>106.2</td>
<td>Utilization of Local Roads</td>
<td>100-10</td>
</tr>
<tr>
<td>107</td>
<td><strong>Roadside Installations</strong></td>
<td></td>
</tr>
<tr>
<td>107.1</td>
<td>Roadway Connections</td>
<td>100-11</td>
</tr>
<tr>
<td>107.2</td>
<td>Maintenance and Police Facilities on Freeways</td>
<td>100-11</td>
</tr>
<tr>
<td>107.3</td>
<td>Location of Border Inspection Stations</td>
<td>100-11</td>
</tr>
<tr>
<td>108</td>
<td><strong>Coordination with Other Agencies</strong></td>
<td></td>
</tr>
<tr>
<td>108.1</td>
<td>Divided Nonfreeway Facilities</td>
<td>100-11</td>
</tr>
<tr>
<td>108.2</td>
<td>Bus Loading Facilities</td>
<td>100-12</td>
</tr>
<tr>
<td>108.3</td>
<td>Coordination with the FHWA</td>
<td>100-13</td>
</tr>
<tr>
<td>109</td>
<td><strong>Scenic Values in Planning and Design</strong></td>
<td></td>
</tr>
<tr>
<td>109.1</td>
<td>Basic Precepts</td>
<td>100-14</td>
</tr>
<tr>
<td>109.2</td>
<td>Design Speed</td>
<td>100-14</td>
</tr>
<tr>
<td>109.3</td>
<td>Aesthetic Factors</td>
<td>100-14</td>
</tr>
<tr>
<td>110</td>
<td><strong>Special Considerations</strong></td>
<td></td>
</tr>
<tr>
<td>110.1</td>
<td>Design for Overloaded Material Hauling Equipment</td>
<td>100-15</td>
</tr>
<tr>
<td>110.2</td>
<td>Control of Water Pollution</td>
<td>100-16</td>
</tr>
<tr>
<td>110.3</td>
<td>Control of Air Pollution</td>
<td>100-20</td>
</tr>
<tr>
<td>110.4</td>
<td>Wetlands Protection</td>
<td>100-22</td>
</tr>
<tr>
<td>110.5</td>
<td>Control of Noxious Weeds – Exotic and Invasive Species</td>
<td>100-22</td>
</tr>
<tr>
<td>110.6</td>
<td>Earthquake Consideration</td>
<td>100-22</td>
</tr>
<tr>
<td>Topic Number</td>
<td>Subject</td>
<td>Page Number</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>110.7</td>
<td>Traffic Control Plans</td>
<td>100-23</td>
</tr>
<tr>
<td>110.8</td>
<td>Safety Reviews</td>
<td>100-25</td>
</tr>
<tr>
<td>110.9</td>
<td>Value Analysis</td>
<td>100-26</td>
</tr>
<tr>
<td>110.10</td>
<td>Proprietary Items</td>
<td>100-26</td>
</tr>
<tr>
<td>110.11</td>
<td>Conservation of Materials and Energy</td>
<td>100-26</td>
</tr>
<tr>
<td>110.12</td>
<td>Tunnel Safety Orders</td>
<td>100-28</td>
</tr>
<tr>
<td>111</td>
<td>Material Sites and Disposal Sites</td>
<td></td>
</tr>
<tr>
<td>111.1</td>
<td>General Policy</td>
<td>100-32</td>
</tr>
<tr>
<td>111.2</td>
<td>Investigation of Local Materials Sources</td>
<td>100-33</td>
</tr>
<tr>
<td>111.3</td>
<td>Materials Information Furnished to Prospective Bidders</td>
<td>100-34</td>
</tr>
<tr>
<td>111.4</td>
<td>Materials Arrangements</td>
<td>100-34</td>
</tr>
<tr>
<td>111.5</td>
<td>Procedures for Acquisition of Material Sites and Disposal Sites</td>
<td>100-35</td>
</tr>
<tr>
<td>111.6</td>
<td>Mandatory Material Sites and Disposal Sites on Federal-aid Projects</td>
<td>100-36</td>
</tr>
<tr>
<td>112</td>
<td>Contractor's Yard and Plant Sites</td>
<td></td>
</tr>
<tr>
<td>112.1</td>
<td>Policy</td>
<td>100-36</td>
</tr>
<tr>
<td>112.2</td>
<td>Locating a Site</td>
<td>100-37</td>
</tr>
<tr>
<td>113</td>
<td>Geotechnical Design Report</td>
<td></td>
</tr>
<tr>
<td>113.1</td>
<td>Policy</td>
<td>100-37</td>
</tr>
<tr>
<td>113.2</td>
<td>Content</td>
<td>100-37</td>
</tr>
<tr>
<td>113.3</td>
<td>Submittal and Review</td>
<td>100-37</td>
</tr>
<tr>
<td>114</td>
<td>Materials Report</td>
<td></td>
</tr>
<tr>
<td>114.1</td>
<td>Policy</td>
<td>100-37</td>
</tr>
<tr>
<td>114.2</td>
<td>Requesting Material Report(s)</td>
<td>100-37</td>
</tr>
<tr>
<td>114.3</td>
<td>Content</td>
<td>100-38</td>
</tr>
<tr>
<td>114.4</td>
<td>Preliminary Materials Report</td>
<td>100-38</td>
</tr>
<tr>
<td>114.5</td>
<td>Review and Retention of Records</td>
<td>100-38</td>
</tr>
<tr>
<td><strong>CHAPTER 200 - GEOMETRIC DESIGN AND STRUCTURE STANDARDS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>201</td>
<td>Sight Distance</td>
<td></td>
</tr>
<tr>
<td>201.1</td>
<td>General</td>
<td>200-1</td>
</tr>
<tr>
<td>201.2</td>
<td>Passing Sight Distance</td>
<td>200-1</td>
</tr>
<tr>
<td>201.3</td>
<td>Stopping Sight Distance</td>
<td>200-2</td>
</tr>
</tbody>
</table>
(c) Traffic Signal--A power-operated control device by which traffic is warned or directed to take a specific action. These devices do not include signals at toll plazas, power-operated signs, illuminated permanent markers, warning lights, or steady burning electric lamps.

(14) Volume. The number of vehicles passing a given point during a specified period of time.

(15) Weaving. The crossing of traffic streams moving in the same general direction accomplished by merging and diverging.

(16) Ramp Metering. A traffic management strategy which utilizes a system of traffic signals on freeway entrance and connector ramps to regulate the volume of traffic entering a freeway corridor in order to maximize the efficiency of the freeway and thereby minimize the total delay in the transportation corridor.

62.9 Drainage

See Chapter 800 for definition of drainage terms.

62.10 Users

(1) High Speed Rail. A type of intercity and interregional passenger rail service that operates significantly faster than conventional rail. Top operating speeds are typically 150 to 220 miles per hour. These trains may be powered by overhead high voltage lines or technologies such as Maglev. The tracks are grade separated within a separate controlled access right of way and may or may not be shared with freight trains.
Table 82.1B
Advisory Standards

CHAPTER 100  BASIC DESIGN
POLICIES

Topic 101  Design Speed
Index 101.1 Selection of Design Speed - Local Facilities
101.1 Selection of Design Speed - Local Facilities - with Connections to State Facilities

Topic 104  Control of Access
Index 104.5 Relation of Access Opening to Median Opening

Topic 105  Pedestrian Facilities
Index 105.1 Minimum Sidewalk Width
105.4 New Construction, Two Ramp Design

Topic 107  Roadside Installations
Index 107.1 Standards for Roadway Connections
107.1 Number of Exits and Entrances Allowed at Roadway Connections

CHAPTER 200  GEOMETRIC DESIGN
AND STRUCTURE STANDARDS

Topic 201  Sight Distance
Index 201.3 Stopping Sight Distance on Grades
201.7 Decision Sight Distance

Topic 202  Superelevation
Index 202.2 Superelevation on Same Plane for Rural Two-lane Roads
202.5 Superelevation Transition
202.5 Superelevation Runoff
202.5 Superelevation in Restrictive Situations
202.6 Superelevation of Compound Curves
202.7 Superelevation on City Streets and County Roads

Topic 203  Horizontal Alignment
Index 203.1 Horizontal Alignment - Local Facilities
203.3 Alignment Consistency and Design Speed
203.5 Compound Curves
203.6 Reversing Curves

Topic 204  Grade
Index 204.1 Standards for Grade - Local Facilities
204.3 Standards for Grade
204.3 Ramp Grades
204.4 Vertical Curves
204.5 Decision Sight Distance at Climbing Lane Drops
204.6 Design Speeds for Horizontal and Vertical Curves
204.8 Falsework Span and Depth Requirements

Topic 205  Road Connections and Driveways
Index 205.1 Access Openings on Expressways

Topic 206  Pavement Transitions
Index 206.3 Lane Drop Transitions
206.3 Lane Width Reductions

Topic 208  Bridges, Grade Separation Structures, and Structure Approach Embankment
Index 208.3 Decking of Bridge Medians
208.6 Minimum Width of Pedestrian Overcrossings
208.10 Protective Screening on Overcrossings
208.10 Bicycle Railing Locations

Topic 210  Earth Retaining Systems
Index 210.5 Cable Railing
Table 82.1B
Advisory Standards (Cont.)

CHAPTER 300  GEOMETRIC CROSS SECTION

Topic 301  Pavement Standards
Index 301.2  Algebraic Differences of Cross Slopes

Topic 303  Curbs, Dikes, and Side Gutters
Index 303.1  Use of Curb with Operating Speeds of 45 mph and Greater
            303.1 Selection of Curb Type
            303.3 Selection of Dike Type

Topic 304  Side Slopes
Index 304.1  Side Slopes 4:1 or Flatter
            304.1 18 ft Minimum Catch Distance

Topic 305  Median Standards
Index 305.1  Median Width
            305.2 Median Cross Slopes

Topic 308  Cross Sections for Roads Under Other Jurisdictions
Index 308.1  Cross Section Standards for City Streets and County Roads without Connection to State Facilities
            308.1 Minimum Shoulder Width Requirements for Bicycles

Topic 309  Clearances
Index 309.1  Clear Recovery Zone
            309.1 Safety Shaped Barriers at Retaining, Pier, or Abutment Walls
            309.1 High Speed Rail Clearance
            309.5 Structures Across or Adjacent to Railroads - Vertical Clearance

Topic 310  Frontage Roads
Index 310.2  Outer Separation - Urban Areas
            310.2 Outer Separation - Rural Areas

CHAPTER 400  INTERSECTIONS AT GRADE

Topic 403  Principles of Channelization
Index 403.3 Angle of Intersection

Table 404  Design Vehicles
Index 404.3 STAA Design Vehicles on the National Network and on Terminal Access Routes
        404.3 California Legal Design Vehicle Accommodation
        404.3 45-Foot Bus & Motorhome Design Vehicle

Topic 405  Intersection Design Standards
Index 405.1 Corner Sight Distance at Public Road Intersections
        405.1 Decision Sight Distance at Intersections
        405.5 Emergency Openings and Sight Distance
        405.5 Median Opening Locations

CHAPTER 500  TRAFFIC INTERCHANGES

Topic 502  Interchange Types
Index 502.2 Isolated Ramps and Partial Interchanges

Topic 504  Interchange Design Standards
Index 504.2 Collector-distributor Deceleration Lane and “DL” Distance
        504.2 Paved Width at Gore
        504.2 Contrasting Surface Treatment
        504.2 Auxiliary Lanes
        504.2 Freeway Exit Design Speed
        504.2 Decision Sight Distance at Exits
        504.2 Design Speed and Alignment Consistency at Inlet Nose
        504.2 Freeway Ramp Grades
        504.2 Differences in Pavement Cross Slopes at Freeway Entrances and Exits
        504.2 Vertical Curves at Freeway Exits
        504.2 Crest Vertical Curves at Freeway Exit Terminal
Figure 307.5
Geometric Cross Sections for All Paved Multilane Highways

TANGENT SECTION

SUPERELEVATION SECTION

NOTES

1. CROSS SLOPES  See Index 302.2
2. SIDE SLOPES   See Index 304.1
3. SHOULDERS     See Index 307.5
4. DIKES         See Index 303.3
5. MEDIANS       See Index 305.1 (3)
6. SIDE GUTTERS  See Index 834.3 (3)
7. RIGHT OF WAY  See Index 306.1
It is important to note that AASHTO, A Policy on Geometric Design of Highways and Streets, standards are based on functional classification and not on a Federal-aid System.

Chapter 1 of AASHTO, A Policy on Geometric Design of Highways and Streets, list standards for the following six functional classes:

- Local rural roads
- Local urban streets
- Rural collectors
- Urban collectors
- Rural arterials
- Urban arterials

AASHTO, A Policy on Geometric Design of Highways and Streets, gives minimum lane and shoulder widths. When selecting a cross section, the effects on capacity of commercial vehicles and grades should be considered as discussed under Topic 102 and in the Transportation Research Board, Highway Capacity Manual.

The minimum width of 2-lane overcrossing structures shall not be less than 28 feet curb to curb. Also see Index 208.1(2) and Index 307.3.

If the local agency has definite plans to widen the local street either concurrently or within 5 years following freeway construction, the reconstruction to be accomplished by the State should generally conform to the widening planned by the local agency. Stage construction should be considered where the planned widening will occur beyond the 5-year period following freeway construction or where the local agency has a master plan indicating an ultimate width greater than the existing facility. Where an undercrossing is involved, the initial structure construction should provide for ultimate requirements.

Where a local facility crosses over or under a freeway or expressway and connects to the State facility (such as ramp terminal intersections), the minimum design standards for the cross section of the local facility shall be at least equal to those for a conventional highway with the exception that the outside shoulder width shall match the approach roadway, but not less than 4 feet (shoulder width should not be less than 5 feet where curbs with 2-foot gutter pans are proposed and bicycle use is expected). The minimum width for two-lane overcrossings at interchanges shall be 40 feet curb-to-curb.

**Topic 309 - Clearances**

**309.1 Horizontal Clearances**

*(1) General.* The horizontal clearance to all roadside objects should be based on engineering judgment with the objective of maximizing the distance between roadside objects and the edge of traveled way. Engineering judgment should be exercised in order to balance the achievement of horizontal clearance objectives with the prudent expenditure of available funds.

Certain yielding objects, such as sand filled barrels, metal beam guardrail, breakaway wood posts, etc. may encroach within the clear recovery zone (see Index 309.1(2)). While these objects are designed to reduce the severity of accidents, efforts should be made to maximize the distance between any object and the edge of traveled way.

Clearances are measured from the edge of the traveled way to the nearest point on the obstruction (usually the bottom). Consideration should be given to the planned ultimate traveled way width of the highway facility. Horizontal clearances greater than those cited below under subsection (3) - "Minimum Clearances" shall be provided where necessary to meet horizontal stopping sight distance requirements. See subsection (4) for high speed rail clearance guidance. See discussion on "... technical reductions in design speed..." under Topic 101.

*(2) Clear Recovery Zone (CRZ).* The roadside environment can and should be made as safe as practical. A clear recovery zone is an unobstructed, relatively flat (4:1 or flatter) or gently sloping area beyond the edge of the traveled way which affords the drivers of errant vehicles the opportunity to regain control. The AASHTO Roadside Design Guide provides detailed design guidance for...
creating a forgiving roadside environment. See also Index 304.1 regarding side slopes.

The following clear recovery zone widths are the minimum desirable for the type of facility indicated. Consideration should be given to increasing these widths based on traffic volumes, operating speeds, terrain, and costs associated with a particular highway facility:

- Freeways and Expressways – 30 feet
- Conventional Highways – 20 feet*

* On conventional highways with posted speeds less than or equal to 40 mph and curbs, clear recovery zone widths do not apply. See minimum horizontal clearance, Index 309.1(3)(c).

Fixed objects including bridge piers, abutments, retaining walls, and noise barriers closer to the edge of traveled way than the distances listed above should be eliminated, moved, redesigned to be made yielding, or shielded in accordance with the following guidelines:

(a) Fixed objects should be eliminated or moved outside the clear recovery zone to a location where they are unlikely to be hit.

(b) If sign posts six inches or more in any dimension or light standards cannot be eliminated or moved outside the clear recovery zone, they should be made yielding with a breakaway feature.

(c) If a fixed object cannot be eliminated, moved outside the clear recovery zone, or modified to be made yielding, it should be shielded by guardrail or a crash cushion.

Shielding must be in conformance with the guidance found in Chapter 7 of the Traffic Manual. For input on the need for shielding at a specific location, consult District Traffic Operations.

When the planting of trees is being considered, see the additional discussion and standards in Chapter 900.

Where compliance with the above stated clear recovery zone guidelines are impractical, the minimum horizontal clearance cited below shall apply to the unshielded fixed object. These minimum horizontal clearances apply to yielding objects as well.

(3) Minimum Clearances. The following minimum horizontal clearances shall apply to all objects that are closer to the edge of traveled way than the clear recovery zone distances listed above:

(a) The minimum horizontal clearance to all objects, such as bridge rails and safety-shaped concrete barriers, as well as sand-filled barrels, metal beam guardrail, etc., on all freeway and expressway facilities, including auxiliary lanes, ramps, and collector roads, shall be equal to the standard shoulder width of the highway facility as stated in Table 302.1. A minimum clearance of 4 feet shall be provided where the standard shoulder width is less than 4 feet. Approach rail connections to bridge rail may require special treatment to maintain the standard shoulder width.

(b) The minimum horizontal clearance to walls, such as abutment walls, retaining walls in cut locations, and noise barriers on all facilities, including auxiliary lanes, ramps and collector roads, shall not be less than 10 feet.

(c) On conventional highways, frontage roads, city streets and county roads (all without curbs), the minimum horizontal clearance shall be the standard shoulder width as listed in Tables 302.1 and 307.2, except that a minimum clearance of 4 feet shall be provided where the standard shoulder width is less than 4 feet. For RRR projects, widths are provided in DIB 79.

On conventional highways with curbs, typically in urban conditions, a minimum horizontal clearance of 1 feet 6 inches should
be provided beyond the face of curbs to any obstruction. On curbed highway sections, a minimum clearance of 3 feet should be provided along the curb returns of intersections and near the edges of driveways to allow for design vehicle offtracking (see Topic 404). Where sidewalks are located immediately adjacent to curbs, fixed objects should be located beyond the back of sidewalk to provide an unobstructed area for pedestrians.

In areas without curbs, the face of Type 60 concrete barrier should be constructed integrally at the base of any retaining, pier, or abutment wall which faces traffic and is 15 feet or less from the edge of traveled way (right or left of traffic and measured from the face of wall). See Index 1102.2 for the treatment of noise barriers.

The minimum width of roadway openings between Temporary Railing (Type K) on bridge deck widening projects should be obtained from the District Permit Engineer.

The Regional Permit Manager should be consulted on the use of the route by overwidth loads.

See Chapter 7 of the Traffic Manual for other requirements pertaining to clear recovery zone, guardrail at fixed objects and embankments, and crash cushions.

(4) **High Speed Rail Clearances.** When a high speed rail corridor is to be constructed longitudinally to a freeway, expressway or a conventional highway with posted speeds over 40 mph, the nearest fixed object or feature associated with the operation of the rail facility should be located a minimum of 52 feet horizontally from the planned ultimate edge of the traveled way. See Index 62.10 for the definition of high speed rail. The terrain and the required highway features between the edge of traveled way and the rail facility to be constructed must be evaluated to determine on a case-by-case basis whether or not shielding behind guardrail, barrier or other safety device in conformance with the guidance found in Chapter 7 of the Traffic Manual is needed. For input on the need for shielding at a specific location, consult District Traffic Operations.

### 309.2 Vertical Clearances

**Major Structures.**

(a) Freeways and Expressways, All construction except overlay projects – **16 feet 6 inches shall be the minimum vertical clearance over the roadbed of the State facility** (e.g., main lanes, shoulders, ramps, collector-distributor roads, speed change lanes, etc.).

(b) Freeways and Expressways, Overlay Projects – **16 feet shall be the minimum vertical clearance over the roadbed of the State facility.**

(c) Conventional Highways, Parkways, and Local Facilities, All Projects – **15 feet shall be the minimum vertical clearance over the traveled way and 14 feet 6 inches shall be the minimum vertical clearance over the shoulders of all portions of the roadbed.**

**Minor Structures.** Pedestrian over-crossings shall have a minimum vertical clearance 2 feet greater than the standard for major structures for the State facility in question.

Sign structures shall have a vertical clearance of 18 feet over the roadbed of the State facility.

(3) **Rural Interstates and Single Routing in Urban Areas:** This subset of the Interstate System is composed of all rural Interstates and a single routing in urban areas. Those routes described in Table 309.2B and Figure 309.2 are given special attention in regards to minimum vertical clearance as a result of agreements between the FHWA and the Department of Defense. **Vertical clearance for structures on this system shall meet the standards listed above for freeways and expressways.**

In addition to the standards listed above, vertical clearances of less than 16 feet over any portion of this system will be subjected to extensive review by FHWA and must be approved by the Military Traffic Management Command Traffic Engineering Agency.
(MTMCTEA) in Washington D. C. Documentation in the form of a Design Exception Fact Sheet must be submitted to FHWA to obtain approval for less than 16 feet of vertical clearance. Vertical clearances of less than 16 feet over any Interstate will require FHWA/MTMCTE notification. See Robert L. Buckley’s memo dated March 30, 2000 to District Directors for more information on this subset of the Interstate system.

(4) General Information. The standards listed above and summarized in Table 309.2A are the minimum allowable on the State Highway system for the facility and project type listed. For the purposes of these vertical clearance standards, all projects on the freeway and expressway system other than overlay projects shall be considered to be covered by the “new construction” standard.

When approved by a design exception (see HDM Index 82.2) clearances less than the values given above may be allowed on a case by case basis given adequate justification based upon engineering judgment, economic, environmental or right of way considerations. Typical instances where lesser values may be approved are where the structure is protected by existing lower structures on either side or where a project includes an existing structure that would not be feasible to modify to the current standard. In no case should vertical clearance be reduced below 15 feet over the traveled way or 14 feet 6 inches over the shoulders over any portion of a State highway facility.

Efforts should be made to avoid decreasing the existing vertical clearance whenever possible and consideration should be given to the feasibility of increasing vertical clearance on projects involving structural section removal and replacement. Any project that would reduce vertical clearances below 16 feet 6 inches or lead to an increase in the vertical clearance should be brought to the attention of the Design Coordinator, the District Permit Engineer and the Regional Permit Manager at the earliest possible date.

The Regional Permit Manager should be informed of any changes (temporary or permanent) in vertical clearance.

(5) Federal Aid Participation. Federal-aid participation is normally limited to the following maximum vertical clearances unless there are external controls such as the need to provide for falsework clearance or the vertical clearance is controlled by an adjacent structure in a multi-structure interchange:

(a) Highway Facilities.

- 17 feet over freeways and expressways.
- 15 feet 6 inches over other highways (15 feet over shoulders).
- For pedestrian structures, 2 feet greater than the above values.

(b) Railroad Facilities.

- 23 feet over the top of rails for non-electrified rail systems.
- 24 feet 3 inches over the top of rails for existing or proposed 25 kv electrification.
- 26 feet over the top of rails for existing or proposed 50 kv electrification.

These clearances include an allowance for future ballasting of the rail facility. The cost of reconstructing or modifying any existing railroad-highway grade separation structure solely to accommodate electrification will not be eligible for Federal-aid highway fund participation. Where a rail system is not currently electrified, the railroad must have a plan adopted which specifies the intent to electrify the subject rail segment within a reasonable time frame in order to provide clearances in excess of 23 feet.

Any exceptions to the clearances listed above should be reviewed with the FHWA early in the design phase to ensure that they will participate in the structure costs. All excess clearances should be documented in the project files as to reasons and appropriate concurrences.
Table 309.2A
Vertical Clearances

<table>
<thead>
<tr>
<th></th>
<th>Traveled Way</th>
<th>Shoulder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeways and Expressways, New Construction, Lane Additions, Reconstruction and Modification</td>
<td>16½ ft</td>
<td>16½ ft</td>
</tr>
<tr>
<td>Freeways and Expressways, Overlay Projects</td>
<td>16 ft</td>
<td>16 ft</td>
</tr>
<tr>
<td>All Projects on Conventional Highways and Local Facilities</td>
<td>15 ft</td>
<td>14½ ft</td>
</tr>
<tr>
<td>Sign Structures</td>
<td>18 ft</td>
<td>18 ft</td>
</tr>
<tr>
<td>Pedestrian and Minor Structures</td>
<td>Standard + 2 ft</td>
<td>See 309.2(2)</td>
</tr>
<tr>
<td>Structures on the Rural and Single Interstate Routing System</td>
<td>See 309.2(3)</td>
<td></td>
</tr>
</tbody>
</table>
309.3 Tunnel Clearances

(1) Horizontal Clearances. Tunnel construction is so infrequent and costly that the width should be considered on an individual basis. For the minimum width standards for freeway tunnels see Index 309.1.

Normally, the minimum horizontal clearance on freeways should include the full roadbed width of the approaches.

In one-way tunnels on conventional highways the minimum side clearance from the edge of the traveled way shall be 4 feet 6 inches on the left and 6 feet on the right. For two-way tunnels, this clearance shall be 6 feet on each side.

(2) Vertical Clearances. The minimum vertical clearance shall be 15 feet measured at any point over the traveled way and 14 feet 6 inches above the gutter at the curb line. On freeways and expressways, the vertical clearance listed in Index 309.2(1)(a) shall be used. Cost weighed against the probability of over-height vehicles will be the determining factors.

309.4 Lateral Clearance for Elevated Structures

Adequate clearance must be provided for maintenance, repair, construction, or reconstruction of adjacent buildings and of the structure; to avoid damage to the structure from a building fire or to buildings from a vehicle fire; to permit operation of equipment for fire fighting and other emergency teams. The minimum horizontal clearance between elevated highway structures, such as freeway viaducts and ramps, and adjoining buildings or other structures, shall be 15 feet for single-deck structures and 20 feet for double-deck structures. Spot encroachments on this clearance shall be approved in accordance with Index 82.2.

309.5 Structures Across or Adjacent to Railroads

Regulations governing clearances on railroads and street railroads with reference to side and overhead structures, parallel tracks, crossings of public roads, highways, and streets are established by the PUC.

(1) Normal Horizontal and Vertical Clearances. Although General Order No. 26-D specifies a minimum vertical clearance of 22 feet 6 inches above tracks on which freight cars not exceeding a height of 15 feet 6 inches are transported, a minimum of 23 feet should be used in design to allow for reballasting and normal maintenance of track. Railroads on which freight cars are not operated, should have a minimum vertical clearance of 19 feet. In establishing the grade line, the District should consult the DES to obtain the depth of structures and false work requirements, if any (see Index 204.6(4)).

At underpasses, General Order No. 26-D establishes a minimum vertical clearance of 14 feet above any public road, highway or street. However, the greater clearances specified under Index 309.2 shall be used.

All curbs, including median curbs, should be designed with 10 feet of clearance from the track centerline measured normal thereto.

The principal clearances which affect the design of highway structures and curbs are summarized in Tables 309.5A and B. It should be noted that collision walls may be required for the clearances given in Columns (3) and (4) of Table 309.5B. Usually, no collision walls are required if the clearance 10 feet or more on tangent track and 11 feet or more on curved track.

<table>
<thead>
<tr>
<th>Table 309.5A</th>
<th>Minimum Vertical Clearances Above Highest Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Structure</td>
<td>Normal Freight</td>
</tr>
<tr>
<td>Highway overhead and other structures including through railroad bridges.</td>
<td>23’ – 0”</td>
</tr>
</tbody>
</table>
(2) **Off-track Maintenance Clearance.** The 18-foot horizontal clearance is intended for sections of railroad where the railroad company is using or definitely plans to use off-track maintenance equipment. This clearance is provided on one side of the railroad right of way.

On Federal-aid projects, where site conditions are such that off-track maintenance clearance at an overpass is obtained at additional cost, Federal-aid funds may participate in the costs of such overhead designs that provide up to 18 feet horizontal clearance on one side of the track. In such cases, the railroad is required to present a statement that off-track maintenance equipment is being used, or is definitely planned to be used, along that section of the railroad right of way crossed by the overhead structure.

(3) **Walkway Clearances Adjacent to Railroads.** All plans involving construction adjacent to railroads should be such that there is no encroachment on the walkway adjoining the track. Walkway requirements are set forth in General Order No. 118 of the PUC. Where excavations encroach into walkway areas, the contractor is required to construct a temporary walkway with handrail as set forth in the contract special provisions.

(4) **Approval.** All plans involving clearances from a railroad track must be submitted to the railroad for approval as to railroad interests. Such clearances are also subject to approval by the PUC.

To avoid delays, early consideration must be given to railroad problems when design is started on a project.

**Topic 310 - Frontage Roads**

### 310.1 Cross Section

Frontage roads are normally relinquished to local agencies. When Caltrans and a county or city enter into an agreement (cooperative agreement, freeway agreement, or other type of binding agreement), the CTC may relinquish to the county or city any frontage or service road or outer highway within that city or county. The relinquished right of way (called a collateral facility) should be at least 40 feet wide and have been constructed as part of a State highway project, but not as a part of the main State highway. Index 308.1 gives width criteria for city streets and county roads. These widths are also applicable to frontage roads. **However, the minimum paved cross section for urban frontage roads shall be two 12-foot lanes with 4-foot outside shoulders.** See Chapter 1000 for shoulder requirements when bicycles are present. **The minimum paved cross section for rural frontage roads shall be 24 feet.**

### 310.2 Outer Separation

In urban areas and in mountainous terrain, the width of the outer separation should be a minimum of 26 feet from edge of traveled way to edge of traveled way. A greater width may be used where it is obtainable at reasonable additional cost, for example, on an urban highway centered on a city block and paralleling the street grid.

In rural areas, other than mountainous terrain, the outer separation should be a minimum of 40 feet wide from edge of traveled way to edge of traveled way.

See Figure 307.4 for cross sections of outer separation and frontage road.

### 310.3 Headlight Glare

Care should be taken in design of new frontage roads to avoid the potential for headlight glare interfering with the vision of motorists traveling in opposite directions on the frontage roads and in the outer freeway lanes. The preferred measures to prevent headlight glare interference on new construction are wider outer separations, revised alignment and raised or lowered profiles.
### GRADING PLANE
- Definition ........................................ 62.7

### GRATED LINE DRAIN
- .................................................. 837.2

### GRAVEL EQUIVALENT
- .................................................. 604.3

### GRAVITY WALL
- .................................................. 210.2

### GROIN
- .................................................. 873.4

### GROUND WATER
- Definition ........................................ 806.2
- .................................................. 841.2

### GUARDRAIL
- Bridge Approach Railings .................... 208.10
- References ..................................... 702

### GUIDE BANK
- .................................................. 873.4

### GUTTER PAN
- Cross Slope ...................................... 303.2
- General Policy .................................. 303.1
- Uses, Curb Types ............................... 303.2

### GUTTERS, SIDE
- .................................................. 834.3
- Capacity ........................................ 836.2
- Grade .......................................... 836.2
- Intersection, at ................................ 836.2
- Types ........................................... 836.1
- Valley .......................................... 836.2

### HAULING
- Overloaded Material/Equipment, Design for 110.1

### HEAD
- Available ....................................... 821.4

### HEADLIGHT SIGHT DISTANCE
- Grade Sags ...................................... 201.5

### HEADWAY
- .................................................. 62.8

### HIGH SPEED RAIL
- Definition ...................................... 62.10
- Clearances ..................................... 309.1

### HIGHWAY
- .................................................. 62.3

### Capacity ........................................ 102
- Controlled Access ............................. 62.3
- Conventional ................................... 62.3
- Federal Lands Program ...................... 43.4
- Landscape Architect Definitions .......... 62.5
- Major ........................................... 62.3
- National Highway System ................... 42
- Parkway ........................................ 62.3
- Pedestrian Facilities ......................... 105
- Planting ........................................ 62.5
- Radial .......................................... 62.3
- Route Numbers ................................ 21.2
- Scenic .......................................... 62.3
- Structures, Definitions ...................... 62.2
- Structures, Grade Line ...................... 204.8
- Through ................................ ........ 62.3
- Types, Definitions ............................ 62.3

### HIGHPWAY DESIGN MANUAL STANDARDS
- .................................................. 82.1

### HORIZONTAL ALIGNMENT
- Aesthetic Factors ............................. 109.3
- Alignment Consistency ....................... 203.3
- Bridges ........................................ 203.9
- Broken Back Curves ........................... 203.7
- Compound Curves .............................. 203.5
- Curve Length and Central Angle .......... 203.4
- General Controls ............................. 203.1
- Grade, Coordination with .................. 204.6
- Radius ......................................... 203.2
- Reversing Curves ............................. 203.6
- Standards for Curvature .................... 203.2
- Spiral Transition ............................. 203.8

### HORIZONTAL CLEARANCE
- Bridges ........................................ 309.1
- Between Elevated Structures ............... 309.4
- Clear Distance ................................ 201.6
- Noise Barriers ................................ 1102.2
- Off-track Maintenance ....................... 309.5
- Railroad Walkway ............................. 309.5
- Railroads, Adjacent to ...................... 309.5
- Retaining Walls .............................. 309.1
- Structure ..................................... 309.1
- Tunnels ....................................... 309.3

### HORIZONTAL DRAINS
- .................................................. 841.5

### HOT MIX ASPHALT CONCRETE BASE
- also see BASE Engineering Criteria ........ 663

### HOT MIXED ASPHALT
- .................................................. 631.1
- also see FLEXIBLE PAVEMENT

### HYDRAULIC
- Gradient, Definition ........................ 806.2
- Jump, Definition .............................. 806.2
- Mean Depth, Definition ...................... 806.2
Index 14

September 28, 2011

HIGHWAY DESIGN MANUAL

Mean Depth ------------------------------------------ 864.3
Radius, Definition ---------------------------------- 806.2

HYDRAULIC DESIGN DISCHARGE
Empirical Methods ------------------------------------ 819.2
Field Investigation ------------------------------------ 815.3
Hydrograph Methods ----------------------------------- 816.5
Rational Methods ------------------------------------- 819.2
Regional Analysis ------------------------------------- 819.2
Statistical Methods ----------------------------------- 819.3
Summary of Methods ---------------------------------- 819.1

HYDROGRAPH
Definition ----------------------------------------------- 806.2
SCS Triangular Hydrograph ------------------------------ 819.4
Synthetic --------------------------------------------- 819.4
Unit ----------------------------------------------------- 819.4

HYDROGRAPHY
Definition ----------------------------------------------- 806.2

HYDROLOGIC DATA
Basin Characteristics ........................................ 812
Federal Agencies -------------------------------------- 815.3
Field Investigations ----------------------------------- 815.3
Precipitation ----------------------------------------- 815.2
Rainfall --------------------------------------------- 815.5
Sources ---------------------------------------------- 815.3
Stream Flow ------------------------------------------ 815.4
Surface Runoff --------------------------------------- 815.2
Transfer of Data -------------------------------------- 819.5

HYDROLOGICAL ANALYSIS
Gumbel Extreme Value Distribution ....................... 819.3
Log Normal Distribution ----------------------------- 819.3
Log Pearson Type III Distribution ....................... 819.3
Objectives ------------------------------------------ 811.2
Rational Methods ------------------------------------- 819.2
Regional Analysis Methods --------------------------- 819.2
SCS Triangular Hydrograph ----------------------------- 819.4
Synthetic Hydrograph -------------------------------- 819.4
Unit Hydrograph ------------------------------------- 819.4

HYDROLOGY
Definition ----------------------------------------------- 806.2

HYDROPLANING
Definition ----------------------------------------------- 831.4

I

INfiltration
Definition ----------------------------------------------- 806.2

INITIAL CONSTRUCTION

INLETS
Combination ------------------------------------------ 837.2
Curb Opening --------------------------------------- 837.2
Grate ----------------------------------------------- 837.2
Hydraulic Design ------------------------------------ 837.4
Location and Spacing ------------------------------- 837.3
Pipe Drop ------------------------------------------- 837.2
Time, Definition ------------------------------------- 806.2
Transition ------------------------------------------- 826.4
Types ----------------------------------------------- 837.2
Use of ----------------------------------------------- 837.1

INSPECTION STATIONS, BORDER

INTERCHANGES
Access Control ---------------------------------------- 504.8
Aesthetic Factors ------------------------------------- 109.3
Approval of Design ----------------------------------- 503.2
Auxiliary Lanes -------------------------------------- 504.5
Cloverleaf ------------------------------------------- 502.2
Concepts -------------------------------------------- 501.1
Data Required for Design ---------------------------- 503.1
Design, Procedure ----------------------------------- 503
Design, Standards ------------------------------------ 504
Diamond --------------------------------------------- 502.2
Elements -------------------------------------------- 62.4
Freeway Entrances and Exits, Design .................... 504.2
Freeway-to-freeway ---------------------------------- 502.3
Freeway-to-freeway Connections, Standards .......... 504.4
Freeway-to-freeway, Minimum Design Speed ............ 504.4
Freeway-to-freeway Omission of Movements ............ 502.3
Grade Separations ----------------------------------- 62.4
Grades Exits/Entrances ------------------------------- 504.2
Lane Reduction --------------------------------------- 504.6
Local Streets ---------------------------------------- 502.2
Parallel Street Systems ------------------------------ 502.2
Ramps ---------------------------------------------- 504.3
Sight Distance for Planting -------------------------- 902.2
Single Point Interchange ----------------------------- 502.2
Spacing --------------------------------------------- 501.3
Traffic ---------------------------------------------- 500
Trumpet -------------------------------------------- 502.2
Two-quadrant Cloverleaf ----------------------------- 502.2
Types ---------------------------------------------- 502
Warrants -------------------------------------------- 501.2
Weaving Sections ------------------------------------ 504.7
also see RAMPS

INTERMODAL SURFACE TRANSPORTATION
EFFICIENCY ACT (ISTEA)

INTERSECTION
Access Control ---------------------------------------- 405.6
Accidents ------------------------------------------- 402.2
Angle of Intersection ------------------------------- 403.3
Areas of Conflict ------------------------------------ 403.2
Bicycle, Affecting Design of ------------------------- 401.6
Capacity ........................................ 402.1
Capacity, Ramps ................................ 406
Channelization .................................. 403
Definition ....................................... 62.4
Design, Factors Affecting .................. 401
Design, Operational Features Affecting ... 402
Design, Standards ............................. 405
Design Vehicle .................................. 404
Driver, Affecting Design of .......... 401.2
Environment, Affecting Design of ....... 401.4
General, Factors Affecting Design ....... 401.1
at Grade ........................................ 400
Grade Separations ............................ 62.4
Left-turn Channelization .................... 405.2
Major Movement, Preference to ......... 403.1
Median Openings ............................. 405.5
Operational Features ......................... 402
Pedestrian, Affecting Design of ........... 401.5
Points of Conflict ............................ 403.4
Precautions .................................... 403.12
Prohibited Turns .............................. 403.8
Public Road .................................... 405.7
Ramp ............................................ 406
Refuge Area .................................... 403.7
Returns and Corner Radii, City Street ... 405.8
Right-turn Channelization ................. 405.3
Sight Distance ................................ 405.1
Signal Control ................................. 403.9
Speed-change Areas ......................... 403.5
Traffic Control Devices ..................... 403.10
Traffic Islands ................................ 405.4
Turning Traffic ................................ 403.6
Undesirable Geometric Features .......... 402.2
Vehicle, Affecting Design of ............. 401.3
Widening at Signalized Intersections .... 405.9

INTERSTATE
Funding ......................................... 42.2
Numbering ..................................... 21.2

INUNDATE
Definition ....................................... 806.2

INVERSE CONDEMNATION
............................................... 62.6

INVERT
Definition ....................................... 806.2
Paving, Definition ............................ 806.2
Paving ......................................... 852.1
............................................. 852.4
............................................. 853.6
Protection ...................................... 852.4
............................................. 852.5

INVERTED SIPHON
Definition ....................................... 806.2
............................................. 829.7

IRRIGATION SYSTEM
Crossover Conduits ............................ 706.4

ISLAND
............................................... 62.4
Traffic ......................................... 405.4

ISOHYETAL
Line, Definition ................................ 806.2
Map, Definition ................................ 806.2

ISOVEL
Definition ....................................... 806.2
............................................. 874

ISTEA
............................................... 41.1
............................................. 42.2

J

JACK
Definition ....................................... 806.2
............................................. 874

JACKING OPERATIONS
Definition ....................................... 806.2

JETTY
Definition ....................................... 806.2
Types .......................................... 873.4

JOINT
Longitudinal ................................... 62.7
Pavement ....................................... 622.3
Seals ......................................... 62.7

JOINT BANK PROTECTION COMMITTEE
............................................... 802.3

JOINT PLAIN CONCRETE PAVEMENT
............................................... 621.1
also see RIGID PAVEMENT

JOINTS
Culverts ....................................... 829.4
............................................. 854.1

JUNCTION STRUCTURES
.......................................... 838.5

K

KINEMATIC WAVE EQUATION
.......................................... 816.6

KIRPICH EQUATION
.......................................... 816.6
K-RAIL ................................................................. 204.8

L

L-TYPE WALL ............................................................. 210.2

LAG
Definition ......................................................... 806.2

LAMINAR FLOW
Definition ......................................................... 806.2

LANDSCAPE
Aesthetic Factors ................................................. 109.3
Architecture ....................................................... 62.5
Highway ............................................................. 900
Highway ............................................................. 62.5

LANE
Addition ............................................................ 206.2
Addition on Ramps .............................................. 504.3
Auxiliary .......................................................... 62.1
Climbing .......................................................... 204.5
Deceleration ...................................................... 405.2
Definitions ......................................................... 62.1
Distribution Factors ............................................. 602.3
Drops ............................................................... 206.3
Drops on Freeway-to-freeway Connectors ........... 504.4
Drops on Ramps .................................................. 504.3
Left Turn .......................................................... 405.2
Numbering ......................................................... 62.1
Passing ............................................................ 204.5
Reductions ......................................................... 206.3
Reduction at Interchanges ................................... 504.6
Right Turn ........................................................ 405.3
Separate Turning ............................................... 403.6
Speed Change ..................................................... 403.5
Two-way Left-turn Lanes ....................................... 405.2
Width ............................................................... 301.1
Width on Curves ............................................... 504.3
Width of Opening for Falsework .......................... 204.8

LATERAL
Definition ......................................................... 806.2
................................................................. 838.4
................................................................. 838.5

LEAN CONCRETE BASE
See BASE
Definition ......................................................... 62.7
Engineering Criteria .......................................... 663
Design, Flexible (Asphalt) Pavement .................. 633.1
Design, Rigid (Concrete) Pavement .................... 623.1

LEFT-TURN CHANNELIZATION .................................. 405.2

LEFT-TURN REFUGE .................................................. 403.7

LEGISLATION .......................................................... 41
ISTEA ............................................................... 41.1

LEVEE
Definition ......................................................... 806.2

LEVEL OF SERVICE ................................................... 62.8

LIFE-CYCLE COST ANALYSIS (LCCA) ....................... 619

LIME
Treatment Definition .......................................... 614.4
Use of ............................................................ 633.1

LIME TREATED SUBBASE
see SUBBASE

LININGS
Channel ........................................................... 873.3

LOAD TRANSFER DEVICE
See DOWEL BAR

LOADING FACILITIES
Bus ................................................................. 108.2

LOCAL STREETS/ROADS
Cross Section .................................................... 308.1
Definition ......................................................... 62.3
Design Speed ..................................................... 101.1
Driveways ......................................................... 205.3
Grade .............................................................. 204.1
Horizontal Alignment ......................................... 203.1
Interchanges ...................................................... 502.2
Returns and Corner Radii .................................. 405.8
Superelevation ................................................... 202.7

LOCKED GATES ........................................................ 701.2

LOG OF TEST BORINGS ............................................ 210.8

M

MAINTAINABILITY
Pavement .......................................................... 618.1

MAINTENANCE
Definitions ....................................................... 62.7