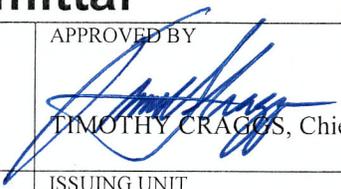


manual change transmittal

TITLE DIVISION OF DESIGN HIGHWAY DESIGN MANUAL SIXTH EDITION – CHANGE 09/22/14		APPROVED BY  TIMOTHY CRAGGS, Chief	NO. Date Issued: 09/22/14 Page 1 of 4
SUBJECT AREA Table of Contents; List of Figures; List of Tables; Chapters: 60, 80, 100, 300, 1000; and, Index		ISSUING UNIT DIVISION OF DESIGN	
SUPERCEDES SEE BELOW FOR SPECIFIC PAGE NUMBERS		DISTRIBUTION ALL HOLDERS OF THE 6TH EDITION, HIGHWAY DESIGN MANUAL	

The Table of Contents; List of Figures; List of Tables; Chapters: 60, 80, 100, 300, 1000; and the Index of the Sixth Edition, Highway Design Manual (HDM) have been revised. The changes to the HDM are summarized below with change sheets available on the Department Design website at: <http://www.dot.ca.gov/hq/oppd/hdm/hdmtoc.htm>. Changes include the use of publications and manuals other than FHWA and AASHTO, reorganized and expanded design speed guidance, as well as revised curb extension (bulbout) guidance. Also included are revisions that reflect current nomenclature and other errata. These changes are effective September 22, 2014, 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:

Index 62.1

Geometric Cross Section, Page 60-2

Deleted definition for “on-street parking” as the definition is included in the text where the use of the word is used. Renumbered definitions in sequential order.

Index 62.3

Highway Types, Page 60-3

Typographical corrections. Added definition for “collector-distributor road”. Added the word “Private” in front of “Driveway” for clarification. Added a definition for “throughway” for consistency with added guidance in Topic 101. Renumbered definitions in sequential order.

Index 62.4

Interchanges and Intersections at Grade, Page 60-5

Replaced “etc.” with “and other similar elements.” Minor grammatical corrections were made to other definitions in this Index.

Index 62.8

Highway Operations, Page 60-13

Corrected definitions for “high speed” and “low speed”, consistent with the AASHTO publications as well as the Caltrans Traffic Manual.

<u>Index 81.2</u>	Highway Context, Page 80-2 Minor corrections for consistency with added guidance in Topic 101. Replaced updated reference title with “Main Street, California”.
<u>Index 82.1</u>	Highway Design Manual Standards, Page 80-7 Minor Subindex (7) title change. Added Subindex (8) to clarify what published standards apply to transportation facilities under the jurisdiction of others.
<u>Index 82.2</u>	Approvals for Nonstandard Design, Page 80-8 Clarified the design decision responsibility related to local agencies.
<u>Index 82.3</u>	FHWA and AASHTO Standards and Policies, Page 80-8 Clarified the use of publications and manuals that are developed by organizations other than the FHWA and AASHTO.
<u>Index 82.6</u>	Design Information Bulletins and Other Caltrans Publications, Page 80-9 Minor Index title change.
<u>Table 82.1A</u>	Mandatory Standards, Page 80-11 Corrected missing superscript (1) for existing mandatory standards in Indexes 308.1 and 1003.1. Deleted mandatory standard “303.4 Shoulder at Bulbouts”, which was changed to an advisory standard for “Curb Face Setback at Bulbouts.”
<u>Table 82.1B</u>	Advisory Standards, Page 80-15 Added advisory standards for “303.4 Bulbouts at Mid-block locations” and “303.4 Curb Face Setback at Bulbouts” for consistency with changes made in Index 303.4.
<u>Topic 101</u>	Design Speed, Page 100-1 Rewritten and reorganized into general highway design speed discussion with clarification on how to select design speed with respect to highway context philosophy.
<u>Table 101.2</u>	Vehicular Design Speed, Page 100-3 Place types were added for conventional highways that are consistent with existing planning documents and terminology.
<u>Index 105.1</u>	General Policy, Page 100-6 Updated the current California Vehicle Code Section reference and guidance with respect to pedestrian facilities on conventional highways.
<u>Index 105.4</u>	Accessibility Requirements, Page 100-9 Updated California Government Code Section reference. Updated guidance and procedures.
<u>Index 106.1</u>	Stage Construction, Page 100-11 Minor typographical corrections.
<u>Index 108.2</u>	Transit Loading Facilities, Page 100-15 Minor typographical corrections.

- Index 110.10** **Proprietary Items, Page 100-30**
Updated text to reflect changes related to procedures and approvals for the use of proprietary items on various funded projects.
- Index 301.1** **Lane Width, Page 300-1**
Corrected mandatory standard by replacing the words “collector roads” with “collector-distributor roads” as defined in Chapter 60.
- Index 301.3** **Cross Slopes, Page 300-2**
Replaced the abbreviation “AC” with “HMA”.
- Index 302.2** **Cross Slopes, Page 300-3**
Minor punctuation and typographical corrections.
- Table 302.1** **Mandatory Standards for Paved Shoulder Widths on Highways, Page 300-4**
Correction made for consistency with revised definition for low speed in Chapter 60. Corrected the Index reference number for Note (3).
- Index 303.1** **General Policy, Page 300-7**
With respect to curbs, dikes, and side gutters, deleted bullet referring to curb extensions and bulbouts as the statement is no longer valid.
- Index 303.2** **Curb Types and Uses, Page 300-7**
Corrected dimension descriptions for vertical and sloped curb heights.
- Index 303.4** **Curb Extensions, Page 300-11**
General update of curb extension guidance. Replaced mandatory standard curb face setback distance of 3 feet with an advisory standard curb face setback distance of 2 feet for consistency with national practice.
- Figures 303.4A&B** **Typical Bulbout with and without Class II Bikeway (Bike Lane), Page 300-12**
Revised curb face setback distance and extended the figures to show bulbout on the local street/highway lane with the addition of Figure 303.4B on a separate page.
- Index 305.1** **Width, Page 300-17**
With respect to median standards, added reference to DIB 82. Reduced the advisory standard minimum median width for the specified place type on conventional highways from 18 to 12 feet.
- Index 307.2** **Two-lane Cross Sections for New Construction, Page 300-21**
Deleted reference to 2-foot shoulders, which is no longer the standard for new construction. Revised updated inlet grate design guidance.
- Index 309.1** **Horizontal Clearances for Highways, Page 300-26**
Minor space formatting correction of Index title, grammar correction, and Index reference correction. Replaced the term “collector” with “collector-distributor” where appropriate. Revised the mandatory standard for minimum horizontal clearance on conventional highways.

- Index 309.2** **Vertical Clearances, Page 300-28**
Minor space formatting correction of Index title. Revised guidance to reflect updated vertical clearance for non-electrified railroad facilities.
- Index 309.4** **Lateral Clearance for Elevated Structures, Page 300-33**
Minor punctuation correction.
- Index 309.5** **Structures Across or Adjacent to Railroads, Page 300-33**
Updated guidance to reflect PUC horizontal and vertical requirements.
- Table 309.5A** **Minimum Vertical Clearances Above Highest Rail, Page 300-34**
Revised minimum vertical clearances dimensions consistent with guidance update.
- Figure 309.5A** **Typical Horizontal Railroad Clearance from Grade Separated Structures, Page 300-36**
Revised figure number to Figure 309.5A to be consistent with new Figure 309.5B.
- Figure 309.5B** **Permanent Railroad Clearance Envelope, Page 300-37**
New figure represents the guidance update showing limits of vertical clearance requirement from future railroad track.
- Index 1003.1(6)** **Bike Paths Parallel and Adjacent to Streets and Highways, Page 1000-5**
With respect to Class I Bikeways, minor typographical corrections.
- Figure 1003.1A** **Two-Way Class I Bikeway (Bike Path), Page 1000-6**
Clarification labeling of edge of traveled way, edge of shoulder, hinge point, and side slope.
- Figure 1003.1B** **Typical Cross Section of Class I Bikeway (Bike Path) Parallel to Highway, Page 1000-7**
Clarification labeling of edge of traveled way, edge of shoulder, slope, and 2-foot minimum paved or all weather surface.
- Index 1003.1(7)** **Bike Paths in the Median of Highway or Roadway, Page 1000-8**
Clarified existing guidance to apply to local roads as well.
- Figure 1003.1C** **Minimum Length of Bicycle Path Crest Vertical Curve (L) Based on Stopping Sight Distance (S), Page 1000-11**
Corrected reference to Index 1003.1(10). Corrected $S < L$ on bottom right portion of figure.
- Figure 1003.1D** **Minimum Lateral Clearance (m) on Bicycle Path Horizontal Curves, Page 1000-12**
Corrected reference to Index 1003.1(10).

Table of Contents

Topic Number	Subject	Page Number
CHAPTER 10 - DIVISION OF DESIGN		
11	Organization and Functions	
11.1	Organization	10-1
CHAPTER 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
CHAPTER 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	California Stewardship & Oversight Agreement with FHWA	40-1
43.3	Congestion Mitigation and Air Quality Improvement Program (CMAQ)	40-2
43.4	Bridge Replacement and Rehabilitation Program	40-2
43.5	Federal Lands Program	40-2
43.6	Highway Safety Improvement Program	40-2
43.7	Special Programs	40-2
44	Funding Determination	
44.1	Funding Eligibility	40-2
44.2	Federal Participation Ratio	40-3
44.3	Emergency Relief	40-3
CHAPTER 60 - NOMENCLATURE		
61	Abbreviations	
61.1	Official Names	60-1
62	Definitions	
62.1	Geometric Cross Section	60-1

Table of Contents

Topic Number	Subject	Page Number
62.2	Highway Structures	60-2
62.3	Highway Types	60-2
62.4	Interchanges and Intersections at Grade	60-3
62.5	Landscape Architecture	60-6
62.6	Right of Way	60-7
62.7	Pavement	60-8
62.8	Highway Operations	60-12
62.9	Drainage	60-13
62.10	Users	60-13

CHAPTER 80 - APPLICATION OF DESIGN STANDARDS

81	Project Development Overview	
81.1	Philosophy	80-1
81.2	Highway Context	80-1
81.3	Place Types	80-2
81.4	Type of Highway	80-4
81.5	Access Control	80-5
81.6	Design Standards and Highway Context	80-5
82	Application of Standards	
82.1	Highway Design Manual Standards	80-5
82.2	Approvals for Nonstandard Design	80-7
82.3	Use of FHWA and AASHTO Standards and Policies	80-8
82.4	Mandatory Procedural Requirements	80-8
82.5	Effective Date for Implementing Revisions to Design Standards	80-8
82.6	Design Information Bulletins and Other Caltrans Publications	80-9
82-7	Traffic Engineering	80-9

CHAPTER 100 - BASIC DESIGN POLICIES

101	Design Speed	
101.1	Selection of Highway Design Speed	100-1
101.2	Highway Design Speed Standards	100-2
102	Highway Capacity & Level of Service	
102.1	Design Capacity (Automobiles)	100-3

Table of Contents

Topic Number	Subject	Page Number
	102.2 Design Capacity and Quality of Service (Pedestrians and Bicycles)	100-4
103	Design Designation	
	103.1 Relation to Design	100-4
	103.2 Design Period	100-4
104	Control of Access	
	104.1 General Policy	100-5
	104.2 Access Openings	100-5
	104.3 Frontage Roads	100-5
	104.4 Protection of Access Rights	100-6
	104.5 Relation of Access Opening to a Median Opening	100-6
	104.6 Maintaining Local Community Access	100-6
	104.7 Cross References	100-6
105	Pedestrian Facilities	
	105.1 General Policy	100-6
	105.2 Sidewalks and Walkways	100-6
	105.3 Pedestrian Grade Separations	100-8
	105.4 Accessibility Requirements	100-9
	105.5 Guidelines for the Location and Design of Curb Ramps	100-10
106	Stage Construction and Utilization of Local Roads	
	106.1 Stage Construction	100-11
	106.2 Utilization of Local Roads	100-11
107	Roadside Installations	
	107.1 Roadway Connections	100-12
	107.2 Maintenance and Police Facilities on Freeways	100-12
	107.3 Location of Border Inspection Stations	100-13
108	Coordination with Other Agencies	
	108.1 Divided Nonfreeway Facilities	100-13
	108.2 Transit Loading Facilities	100-14
	108.3 Commuter and Light Rail Facilities Within State Right of Way	100-16
	108.4 Bus Loading Facilities	100-16
	108.5 Bus Rapid Transit	100-17
	108.6 High-Occupancy Toll and Express Toll Lanes	100-17

Table of Contents

Topic Number	Subject	Page Number
	108.7 Coordination with the FHWA	100-17
109	Scenic Values in Planning and Design	
	109.1 Basic Precepts	100-18
	109.2 Design Speed	100-18
	109.3 Aesthetic Factors	100-18
110	Special Considerations	
	110.1 Design for Overloaded Material Hauling Equipment	100-19
	110.2 Control of Water Pollution	100-20
	110.3 Control of Air Pollution	100-24
	110.4 Wetlands Protection	100-26
	110.5 Control of Noxious Weeds – Exotic and Invasive Species	100-26
	110.6 Earthquake Consideration	100-26
	110.7 Traffic Control Plans	100-27
	110.8 Safety Reviews	100-29
	110.9 Value Analysis	100-30
	110.10 Proprietary Items	100-30
	110.11 Conservation of Materials and Energy	100-30
	110.12 Tunnel Safety Orders	100-32
111	Material Sites and Disposal Sites	
	111.1 General Policy	100-36
	111.2 Investigation of Local Materials Sources	100-36
	111.3 Materials Information Furnished to Prospective Bidders	100-37
	111.4 Materials Arrangements	100-38
	111.5 Procedures for Acquisition of Material Sites and Disposal Sites	100-38
	111.6 Mandatory Material Sites and Disposal Sites on Federal-aid Projects	100-40
112	Contractor's Yard and Plant Sites	
	112.1 Policy	100-40
	112.2 Locating a Site	100-40
113	Geotechnical Design Report	
	113.1 Policy	100-41
	113.2 Content	100-41
	113.3 Submittal and Review	100-41

Table of Contents

Topic Number	Subject	Page Number
114	Materials Report	
114.1	Policy	100-41
114.2	Requesting Material Report(s)	100-41
114.3	Content	100-42
114.4	Preliminary Materials Report	100-42
114.5	Review and Retention of Records	100-42
115	Designing for Bicycle Traffic	
115.1	General	100-42
116	Bicyclists and Pedestrians on Freeways	
116.1	General	100-43
CHAPTER 200 - GEOMETRIC DESIGN AND STRUCTURE STANDARDS		
201	Sight Distance	
201.1	General	200-1
201.2	Passing Sight Distance	200-1
201.3	Stopping Sight Distance	200-2
201.4	Stopping Sight Distance at Grade Crests	200-2
201.5	Stopping Sight Distance at Grade Sags	200-2
201.6	Stopping Sight Distance on Horizontal Curves	200-2
201.7	Decision Sight Distance	200-3
202	Superelevation	
202.1	Basic Criteria	200-3
202.2	Standards for Superelevation	200-4
202.3	Restrictive Conditions	200-4
202.4	Axis of Rotation	200-9
202.5	Superelevation Transition	200-9
202.6	Superelevation of Compound Curves	200-12
202.7	Superelevation on City Streets and County Roads	200-12
203	Horizontal Alignment	
203.1	General Controls	200-12
203.2	Standards for Curvature	200-16
203.3	Alignment Consistency	200-16

Table of Contents

Topic Number	Subject	Page Number
	203.4 Curve Length and Central Angle	200-16
	203.5 Compound Curves	200-16
	203.6 Reversing Curves	200-17
	203.7 Broken Back Curves	200-17
	203.8 Spiral Transition	200-17
	203.9 Alignment at Bridges	200-17
204	Grade	
	204.1 General Controls	200-17
	204.2 Position with Respect to Cross Section	200-18
	204.3 Standards for Grade	200-18
	204.4 Vertical Curves	200-18
	204.5 Sustained Grades	200-19
	204.6 Coordination of Horizontal and Vertical Alignment	200-22
	204.7 Separate Grade Lines	200-22
	204.8 Grade Line of Structures	200-22
205	Road Connections and Driveways	
	205.1 Access Openings on Expressways	200-25
	205.2 Private Road Connections	200-26
	205.3 Urban Driveways	200-26
	205.4 Driveways on Frontage Roads and in Rural Areas	200-27
	205.5 Financial Responsibility	200-28
206	Pavement Transitions	
	206.1 General Transition Standards	200-28
	206.2 Pavement Widening	200-28
	206.3 Pavement Reductions	200-28
	206.4 Temporary Freeway Transitions	200-30
207	Airway-Highway Clearances	
	207.1 Introduction	200-30
	207.2 Clearances	200-30
	207.3 Submittal of Airway-Highway Clearance Data	200-30
208	Bridges, Grade Separation Structures, and Structure Approach Embankment	
	208.1 Bridge Lane and Shoulder Width	200-35

Table of Contents

Topic Number	Subject	Page Number
208.2	Cross Slope	200-35
208.3	Median	200-35
208.4	Bridge Sidewalks	200-37
208.5	Open End Structures	200-37
208.6	Bicycle and Pedestrian Overcrossings and Undercrossings	200-37
208.7	Equestrian Undercrossings and Overcrossings	200-37
208.8	Cattle Passes, Equipment, and Deer Crossings	200-37
208.9	Railroad Underpasses and Overheads	200-38
208.10	Bridge Barriers and Railings	200-38
208.11	Structure Approach Embankment	200-40
209	Currently Not In Use	
210	Reinforced Earth Slopes and Earth Retaining Systems	
210.1	Introduction	200-46
210.2	Construction Methods and Types	200-46
210.3	Alternative Earth Retaining Systems (AERS)	200-52
210.4	Cost Reduction Incentive Proposals (CRIP)	200-53
210.5	Aesthetic Consideration	200-53
210.6	Safety Railing, Fences, and Concrete Barriers	200-54
210.7	Design Responsibility	200-54
210.8	Guidelines for Type Selection and Plan Preparation	200-55
CHAPTER 300 – GEOMETRIC CROSS SECTION		
301	Traveled Way Standards	
301.1	Lane Width	300-1
301.2	Class II Bikeway (Bike Lane) Lane Width	300-1
301.3	Cross Slopes	300-2
302	Highway Shoulder Standards	
302.1	Width	300-3
302.2	Cross Slopes	300-3
302.3	Safety Edge	300-6
303	Curbs, Dikes, and Side Gutters	
303.1	General Policy	300-6

Table of Contents

Topic Number	Subject	Page Number
	303.2 Curb Types and Uses	300-7
	303.3 Dike Types and Uses	300-9
	303.4 Curb Extensions	300-11
	303.5 Position of Curbs and Dikes	300-11
	303.6 Curbs and Dikes on Frontage Roads and Streets	300-14
304	Side Slopes	
	304.1 Side Slope Standards	300-14
	304.2 Clearance From Slope to Right of Way Line	300-15
	304.3 Slope Benches and Cut Widening	300-16
	304.4 Contour Grading and Slope Rounding	300-16
	304.5 Stepped Slopes	300-16
305	Median Standards	
	305.1 Width	300-17
	305.2 Median Cross Slopes	300-18
	305.3 Median Barriers	300-19
	305.4 Median Curbs	300-19
	305.5 Paved Medians	300-19
	305.6 Separate Roadways	300-19
306	Right of Way	
	306.1 General Standards	300-19
	306.2 Right of Way Through the Public Domain	300-19
307	Cross Sections for State Highways	
	307.1 Cross Section Selection	300-19
	307.2 Two-lane Cross Sections for New Construction	300-19
	307.3 Two-lane Cross Sections for 2R, 3R, and other Projects	300-21
	307.4 Multilane Divided Cross Sections	300-21
	307.5 Multilane All Paved Cross Sections with Special Median Widths	300-21
	307.6 Multilane Cross Sections for 2R and 3R Projects	300-25
	307.7 Reconstruction Projects	300-25
308	Cross Sections for Roads Under Other Jurisdictions	
	308.1 City Streets and County Roads	300-25

Table of Contents

Topic Number	Subject	Page Number
309	Clearances	
	309.1 Horizontal Clearances for Highways	300-26
	309.2 Vertical Clearances	300-28
	309.3 Tunnel Clearances	300-33
	309.4 Lateral Clearance for Elevated Structures	300-33
	309.5 Structures Across or Adjacent to Railroads	300-33
310	Frontage Roads	
	310.1 Cross Section	300-35
	310.2 Outer Separation	300-35
	310.3 Headlight Glare	300-35
CHAPTER 400 – INTERSECTIONS AT GRADE		
401	Factors Affecting Design	
	401.1 General	400-1
	401.2 Human Factors	400-1
	401.3 Traffic Considerations	400-2
	401.4 The Physical Environment	400-2
	401.5 Intersection Type	400-2
	401.6 Transit	400-3
402	Operational Features Affecting Design	
	402.1 Capacity	400-3
	402.2 Collisions	400-3
	402.3 On-Street Parking	400-4
	402.4 Consider All Users	400-4
	402.5 Speed-Change Areas	400-4
403	Principles of Channelization	
	403.1 Preference to Major Movements	400-4
	403.2 Areas of Conflict	400-4
	403.3 Angle of Intersection	400-5
	403.4 Points of Conflict	400-5
	403.5 Currently Not In Use	400-6
	403.6 Turning Traffic	400-6

Table of Contents

Topic Number	Subject	Page Number
	403.7 Refuge Areas	400-9
	403.8 Prohibited Turns	400-9
	403.9 Effective Signal Control	400-9
	403.10 Installation of Traffic Control Devices	400-9
	403.11 Summary	400-9
	403.12 Other Considerations	400-10
404	Design Vehicles	
	404.1 General	400-10
	404.2 Design Considerations	400-10
	404.3 Design Tools	400-11
	404.4 Design Vehicles and Related Definitions	400-12
	404.5 Turning Templates & Vehicle Diagrams	400-14
405	Intersection Design Standards	
	405.1 Sight Distance	400-14
	405.2 Left-turn Channelization	400-23
	405.3 Right-turn Channelization	400-25
	405.4 Traffic Islands	400-29
	405.5 Median Openings	400-30
	405.6 Access Control	400-32
	405.7 Public Road Intersections	400-34
	405.8 City Street Returns and Corner Radii	400-34
	405.9 Widening of 2-lane Roads at Signalized Intersections	400-34
	405.10 Roundabouts	400-34
406	Ramp Intersection Capacity Analysis	400-42
CHAPTER 500 – TRAFFIC INTERCHANGES		
501	General	
	501.1 Concepts	500-1
	501.2 Warrants	500-1
	501.3 Spacing	500-1
502	Interchange Types	
	502.1 General	500-1

Table of Contents

Topic Number	Subject	Page Number
904	Vista Point Standards and Guidelines	
	904.1 General	900-17
	904.2 Site Selection	900-18
	904.3 Design Features and Facilities	900-18
905	Park and Ride Standards and Guidelines	
	905.1 General	900-19
	905.2 Site Selection	900-19
	905.3 Design Features and Facilities	900-20
CHAPTER 1000 – BICYCLE TRANSPORTATION DESIGN		
1001	Introduction	
	1001.1 Bicycle Transportation	1000-1
	1001.2 Streets and Highways Code References	1000-1
	1001.3 Vehicle Code References	1000-1
	1001.4 Bikeways	1000-2
1002	Bikeway Facilities	
	1002.1 Selection of the Type of Facility	1000-2
1003	Bikeway Design Criteria	
	1003.1 Class I Bikeways (Bike Paths)	1000-3
	1003.2 Class II Bikeways (Bike Lanes)	1000-13
	1003.3 Class III Bikeways (Bike Routes)	1000-13
	1003.4 Trails	1000-14
	1003.5 Miscellaneous Criteria	1000-14
CHAPTER 1100 – HIGHWAY TRAFFIC NOISE ABATEMENT		
1101	General Requirements	
	1101.1 Introduction	1100-1
	1101.2 Objective	1100-1
	1101.3 Terminology	1100-2
	1101.4 Procedures for Assessing Noise Impacts	1100-2
	1101.5 Prioritizing Construction of Retrofit Noise Barriers	1100-2
1102	Design Criteria	
	1102.1 General	1100-2

Table of Contents

Topic Number	Subject	Page Number
1102.2	Noise Barrier Location	1100-2
1102.3	Noise Barrier Heights	1100-3
1102.4	Noise Barrier Length	1100-4
1102.5	Alternative Noise Barrier Designs	1100-4
1102.6	Noise Barrier Aesthetics	1100-5
1102.7	Maintenance Consideration in Noise Barrier Design	1100-6
1102.8	Emergency Access Considerations in Noise Barrier Design	1100-6
1102.9	Drainage Openings in Noise Barrier	1100-7

List of Figures

Figure Number	Subject	Page Number
CHAPTER 10 – DIVISION OF DESIGN		
11.1	Division of Design Functional Organization Chart	10-2
CHAPTER 20 – DESIGNATION OF HIGHWAY ROUTES		
21.1	Interstate Highway System in California	20-2
CHAPTER 60 – NOMENCLATURE		
62.2	Types of Structures	60-4
CHAPTER 100 – BASIC DESIGN POLICIES		
110.12	California Mining and Tunneling Districts	100-35
CHAPTER 200 – GEOMETRIC DESIGN AND STRUCTURE STANDARDS		
201.4	Stopping Sight Distance on Crest Vertical Curves	200-5
201.5	Stopping Sight Distance on Sag Vertical Curves	200-6
201.6	Stopping Sight Distance on Horizontal Curves	200-7
201.7	Decision Sight Distance on Crest Vertical Curves	200-8
202.2	Maximum Comfortable Speed on Horizontal Curves	200-11
202.5A	Superelevation Transition	200-13
202.5B	Superelevation Transition Terms & Definitions	200-14
202.6	Superelevation of Compound Curves	200-15
204.4	Vertical Curves	200-20
204.5	Critical Lengths of Grade for Design	200-21
205.1	Access Openings on Expressways	200-26
206.2	Typical Two-lane to Four-lane Transitions	200-29
207.2A	Airway-Highway Clearance Requirements (Civil Airports)	200-31
207.2B	Airway-Highway Clearance Requirements (Heliport)	200-32
207.2C	Airway-Highway Clearance Requirements (Military Airports)	200-33
207.2D	Airway-Highway Clearance Requirements (Navy Carrier Landing Practice Field)	200-34
208.1	Offsets to Safety-Shape Barriers	200-36
208.10A	Vehicular Railings for Bridge Structures	200-41
208.10B	Combination Vehicular Barrier and Pedestrian Railings for Bridge Structures	200-42
208.10C	Pedestrian Railings for Bridge Structures	200-43

List of Figures

Figure Number	Subject	Page Number
208.11A	Limits of Structure Approach Embankment Material	200-44
208.11B	Abutment Drainage Details	200-45
210.8	Type Selection and PS&E Process for Reinforced Earth Slopes and Earth Retaining Systems	200-58

CHAPTER 300 – GEOMETRIC CROSS SECTION

301.2A	Typical Class II Bikeway (Bike Lane) Cross Section	300-5
303.3	Dike Type Selection and Placement	300-10
303.4A	Typical Bulbout with Class II Bikeway (Bike Lane)	300-12
303.4B	Typical Bulbout without Class II Bikeway (Bike Lane)	300-13
305.6	Optional Median Designs for Freeways with Separate Roadways	300-20
307.2	Geometric Cross Sections for Two-lane Highways (New Construction)	300-22
307.4	Geometric Cross Sections for Freeways and Expressways	300-23
307.5	Geometric Cross Sections for All Paved Multilane Highways	300-24
309.2	Department of Defense Rural and Single Interstate Routes	300-30
309.5A	Typical Horizontal Railroad Clearances from Grade Separated Structures	300-36
309.5B	Permanent Railroad Clearance Envelope	300-37

CHAPTER 400 - INTERSECTIONS AT GRADE

403.3A	Angle of Intersection (Minor Leg Skewed to the Right)	400-6
403.3B	Class II Bikeway Crossing Railroad	400-6
403.6A	Typical Bicycle and Motor Vehicle Movements at Intersections of Multilane Streets without Right-Turn-Only Lanes	400-7
403.6B	Bicycle Left-Turn-Only Lane	400-8
404.5A	STAA Design Vehicle – 56-Foot Radius	400-15
404.5B	STAA Design Vehicle – 67-Foot Radius	400-16
404.5C	California Legal Design Vehicle – 50-Foot Radius	400-17
404.5D	California Legal Design Vehicle – 60-Foot Radius	400-18
404.5E	40-Foot Bus Design Vehicle	400-19
404.5F	45-Foot Bus & Motorhome Design Vehicle	400-20
404.5G	60-Foot Articulated Bus Design Vehicle	400-21
405.2A	Standard Left-turn Channelization	400-26
405.2B	Minimum Median Left-turn Channelization (Widening on One Side of Highway)	400-27

List of Figures

Figure Number	Subject	Page Number
405.2C	Minimum Median Left-turn Channelization (Widening on Both Sides in Urban Areas with Short Blocks)	400-28
405.4	Pedestrian Refuge Island	400-32
405.5	Typical Design for Median Openings	400-33
405.7	Public Road Intersections	400-35
405.9	Widening of Two-lane Roads at Signalized Intersections	400-36
405.10	Roundabout Geometric Elements	400-40
406A	Spread Diamond	400-43
406B	Tight Diamond	400-44
406C	Two-quadrant Cloverleaf	400-45

CHAPTER 500 - TRAFFIC INTERCHANGES

502.2	Typical Local Street Interchanges	500-3
502.3	Typical Freeway-to-freeway Interchanges	500-9
504.2A	Single Lane Freeway Entrance	500-12
504.2B	Single Lane Freeway Exit	500-13
504.2C	Location of Freeway Ramps on a Curve	500-14
504.3A	Typical Freeway Entrance With 1-Lane Ramp Meter	500-23
504.3B	Typical Freeway Entrance Loop Ramp With 1-Lane Ramp Meter	500-24
504.3C	Typical Freeway Entrance Loop Ramp With 2-Lane Ramp Meter	500-25
504.3D	Typical Freeway Entrance for Ramp Volumes < 1500 VPH With 2-Lane Ramp Meter	500-26
504.3E	Typical Freeway Entrance for Ramp Volumes > 1500 VPH With 2-Lane Ramp Meter	500-27
504.3F	Typical Freeway Entrance for Ramp Volumes < 1500 VPH 3-Lane Ramp Meter (2 mixed-flow lanes + HOV preferential lane)	500-28
504.3G	Typical Freeway Entrance for Ramp Volumes > 1500 VPH 3-Lane Ramp Meter (2 mixed-flow lanes + HOV preferential ane)	500-29
504.3H	Typical Freeway Connector 2-Lane Meter (1 mixed-flow lane + HOV preferential lane)	500-30
504.3I	Typical Freeway Connector 3-Lane Meter (2 mixed-flow lanes + HOV preferential lane)	500-31
504.3J	Location of Ramp Intersections on the Crossroads	500-32
504.3K	Transition to Two-lane Exit Ramp	500-33

List of Figures

Figure Number	Subject	Page Number
504.3L	Two-Lane Entrance and Exit Ramps	500-34
504.4	Diverging Branch Connections	500-37
504.7A	Design Curve for Freeway and Collector Weaving	500-40
504.7B	Lane Configuration of Weaving Sections	500-41
504.7D	Percentage Distribution of On- and Off-ramp Traffic in Outer Through Lane and Auxiliary Lane (Level of Service D Procedure)	500-43
504.7E	Percentage of Ramp Traffic in the Outer Through Lane (No Auxiliary Lane) (Level of Service D Procedure)	500-44
504.8	Typical Examples of Access Control at Interchanges	500-45

CHAPTERS 600-670 - PAVEMENT ENGINEERING

CHAPTER 600 – GENERAL ASPECTS

602.1	Basic Pavement Layers of the Roadway	600-4
-------	--------------------------------------	-------

CHAPTER 610 – PAVEMENT ENGINEERING CONSIDERATIONS

613.5A	Shoulder Design for TI Equal to Adjacent Lane TI	600-11
613.5B	Shoulder Design for TI Less than Adjacent Lane TI	600-12
615.1	Pavement Climate Regions	600-22

CHAPTER 620 – RIGID PAVEMENT

621.1	Types of Rigid Pavement	620-2
623.1	Rigid Pavement Catalog Decision Tree	620-8
626.1	Rigid Pavement at Ramp or Connector Gore Area	620-25
626.2A	Rigid Pavement and Shoulder Details	620-28
626.2B	Rigid Shoulders Through Ramp and Gore Areas	620-29
626.4	Rigid Bus Pad	620-31

CHAPTER 650 – PAVEMENT DRAINAGE

651.2A	Typical Section with Treated Permeable Base Drainage Layer	650-2
651.2B	Cross Drain Interceptor Details for Use with Treated Permeable Base	650-3
651.2C	Cross Drain Interceptor Trenches	650-5

CHAPTER 660 – BASE AND SUBBASE

662.3	Typical Cross Section of ATPB Application	660-2
-------	---	-------

List of Figures

Figure Number	Subject	Page Number
CHAPTER 670 - STRUCTURE APPROACH SLABS		
671.1	Structure Approach Slab Layout	670-2
673.2	Structure Approach Drainage Details (Rehabilitation)	670-5
673.3	Structure Approach Pavement Transition Details (Rehabilitation)	670-6
CHAPTERS 800-890 - HIGHWAY DRAINAGE DESIGN		
CHAPTER 800 - GENERAL ASPECTS		
804.7A	Technical Information for Location Hydraulic Study	800-11
804.7B	Floodplain Evaluation Report Summary	800-13
CHAPTER 810 - HYDROLOGY		
816.5	Typical Flood Hydrograph	810-9
816.6	Velocities for Upland Method of Estimating Travel Time for Shallow Concentrated Flow	810-11
819.2A	Runoff Coefficients for Undeveloped Areas	810-16
819.2C	Regional Flood-Frequency Equations	810-19
819.7A	Desert Regions in California	810-25
819.7B	Example Depth-Area Reduction Curve	810-30
819.7C	San Bernardino County Hydrograph for Desert Areas	810-34
819.7D	USBR Example S-Graph	810-35
819.7E	Soil Slips vs. Slope Angle	810-39
819.7F	Alluvial Fan	810-42
819.7H	Recommended Bulking Factor Selection Process	810-47
CHAPTER 830 - TRANSPORTATION FACILITY DRAINAGE		
837.1	Storm Drain Inlet Types	830-12
CHAPTER 850 - PHYSICAL STANDARDS		
855.1	Minor Bedload Abrasion	850-20
855.2	Abrasion Test Panels	850-21
855.3A	Minimum Thickness of Metal Pipe for 50-Year Maintenance-Free Service Life	850-32
855.3B	Chart for Estimating Years to Perforation of Steel Culverts	850-33

List of Figures

Figure Number	Subject	Page Number
--------------------------	----------------	------------------------

CHAPTER 860 - OPEN CHANNELS

861.1	Small Roadside Channel	860-1
861.2	Roadside Channel Outlet to Storm Drain at Drop Inlet	860-1
861.3	Concrete Lined Channel with Excessive Weed Growth	860-3
862.1	Small-Rock Lined Channel Outside of Clear Recovery Zone	860-5
863.1	Small-Rock Lined Channel with Rounded Bottom	860-5
865.1	Steep-Sloped Channel with Composite Vegetative Lining	860-9
865.2	Concrete Lined Channel	860-9
865.3	Long-Term Flexible Lining	860-10
865.4	Grass-Lined Median Channel	860-12
864.3C	Specific Energy Diagram	860-19

**CHAPTER 870 - CHANNEL AND SHORE PROTECTION -
EROSION CONTROL**

872.1	Slope Failure Due to Loss of Toe	870-4
872.2	Alternative Highway Locations Across Debris Cone	870-11
872.3	Alluvial Fan	870-11
872.4	Desert Wash Longitudinal Encroachment	870-12
873.2A	Nomenclature of Tidal Ranges	870-14
873.2B	Significant Wave Height Prediction Nomograph	870-17
873.2C	Design Breaker Wave	870-19
873.2D	Wave Run-up on Smooth Impermeable Slope	870-19
873.3A	Nomograph of Stream-Bank Rock Slope Protection	870-26
873.3C	Rock Slope Protection	870-27
873.3D	RSP Lined Ocean Shore	870-32
873.3E	Gabion Line Streambank	870-34
873.3F	Concreted-Rock Slope Protection	870-35
873.3G	Nomographs for Design of Rock Slope Shore Protection	870-37
873.3H	Toe Failure - Concreted RSP	870-36
873.4A	Thalweg Redirection Using Bendway Weirs	870-45
873.4B	Bridge Abutment Guide Banks	870-45
873.4C	Typical Groin Layout With Resultant Beach Configuration	870-47

List of Figures

Figure Number	Subject	Page Number
873.4D	Alignment of Groins to an Oblique Sea Warrants Shortening Proportional to Cosine of Obliquity	870-47
873.4E	Typical Stone Dike Groin Details	870-49
CHAPTER 890 - STORM WATER MANAGEMENT		
892.3	Example of a Cumulative Hydrograph with and without Detention	890-4
CHAPTER 1000 - BICYCLE TRANSPORTATION DESIGN		
1003.1A	Two-way Class I Bikeway (Bike Path)	1000-6
1003.1B	Typical Cross Section of Class I Bikeway (Bike Path) Parallel to Highway	1000-7
1003.1C	Minimum Lengths of Bicycle Path Crest Vertical Curve (L) Based on Stopping Sight Distance (S)	1000-11
1003.1D	Minimum Lateral Clearance (<i>m</i>) on Bicycle Path Horizontal Curves	1000-12
1003.5	Railroad Crossing Class I Bikeway	1000-15

List of Tables

Table Number	Subject	Page Number
-------------------------	----------------	------------------------

CHAPTER 80 - APPLICATION OF DESIGN STANDARDS

82.1A	Mandatory Standards	80-10
82.1B	Advisory Standards	80-14
82.1C	Decision Requiring Other Approvals	80-18

CHAPTER 100 - BASIC DESIGN POLICIES

101.2	Vehicular Design Speed	100-3
-------	------------------------	-------

CHAPTER 200 - GEOMETRIC DESIGN AND STRUCTURE STANDARDS

201.1	Sight Distance Standards	200-1
201.7	Decision Sight Distance	200-3
202.2	Standard Superelevation Rates (Superelevation in Feet per Foot for Curve Radius in Feet)	200-10
203.2	Standards for Curve Radius	200-16
204.3	Maximum Grades for Type of Highway and Terrain Conditions	200-18
204.8	Falsework Span and Depth Requirements	200-24
210.2	Types of Reinforced Earth Slopes and Earth Retaining Systems	200-49

CHAPTER 300 - GEOMETRIC CROSS SECTION

302.1	Mandatory Standards for Paved Shoulder Width on Highways	300-4
303.1	Selection of Curb Type	300-8
307.2	Shoulder Widths for Two-lane Roadbed New Construction Projects	300-21
309.2A	Vertical Clearances	300-29
309.2B	California Routes on the Rural and Single Interstate Routing System	300-31
309.5A	Minimum Vertical Clearances Above Highest Rail	300-34
309.5B	Minimum Horizontal Clearances to Centerline of Nearest Track	300-38

CHAPTER 400 - INTERSECTIONS AT GRADE

401.3	Vehicle Characteristics/Intersection Design Elements Affected	400-2
405.1A	Corner Sight Distance (7-1/2 Second Criteria)	400-22
405.1B	Application of Sight Distance Requirements	400-23
405.2A	Bay Taper for Median Speed-change Lanes	400-24
405.2B	Deceleration Lane Length	400-24
405.4	Parabolic Curb Flares Commonly Used	400-31

CHAPTER 60 NOMENCLATURE

Unless indicated otherwise in this manual, wherever the following abbreviations, terms, or phrases are used, their intent and meaning shall be as identified in this Chapter.

Topic 61 - Abbreviations

Index 61.1 - Official Names

AASHTO	American Association of State Highway and Transportation Officials
Caltrans or Department	California Department of Transportation
CFR	Code of Federal Regulations
CTC or Commission	California Transportation Commission
DES	Division of Engineering Services
District	Department of Transportation Districts
DOT	U.S. Department of Transportation
DOD	Division of Design
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
GS	Geotechnical Services
METS	Office of Materials Engineering and Testing Services
OAP	Office of Asphalt Pavement
OCPFF	Office of Concrete Pavement and Pavement Foundations
PP	Pavement Program
PS&E	Plans, Specifications, and Estimate
PUC	Public Utilities Commission
SD	Structure Design
SHOPP	State Highway Operation and Protection Plan
STIP	State Transportation Improvement Program

Topic 62 - Definitions

62.1 Geometric Cross Section

(1) Lane.

- (a) Auxiliary Lane--The portion of the roadway for weaving, truck climbing, speed change, or for other purposes supplementary to through movement.

(b) Lane Numbering--On a multilane roadway, the lanes available for through travel in the same direction are numbered from left to right when facing in the direction of travel.

(c) Multiple Lanes--Freeways and conventional highways are sometimes defined by the number of through lanes in both directions. Thus an 8-lane freeway has 4 through lanes in each direction. Likewise, a 4-lane conventional highway has 2 through lanes in each direction. Lanes that are not equally distributed to each direction would otherwise be described as appropriate.

(d) Median Lane--A speed change lane within the median to accommodate left turning vehicles.

(e) Speed Change Lane--An auxiliary lane, including tapered areas, primarily for the acceleration or deceleration of vehicles when entering or leaving the through lanes.

(f) Traffic Lane/Vehicle Lane--The portion of the traveled way for the movement of a single line of vehicles, both motor vehicle and bicycle.

(2) Bikeways.

(a) Class I Bikeway (Bike Path). Provides a completely separated facility for the exclusive use of bicycles and pedestrians with crossflow by vehicles minimized.

(b) Class II Bikeway (Bike Lane). Provides a striped lane for one-way bike travel on a street or highway.

(c) Class III Bikeway (Bike Route). Provides for shared use with pedestrian or motor vehicle traffic.

(3) *Maintenance Vehicle Pullout (MVP)*. Paved areas, or appropriate all weather surfaces, adjacent to the shoulder for field personnel to park off the traveled way and access the work site.

(4) *Median*. The portion of a divided highway separating the traveled ways in opposite directions.

- (5) *Outer Separation.* The portion of an arterial highway between the traveled ways of a roadway and a frontage street or road.
- (6) *Roadbed.* That portion of the roadway extending from curb line to curb line or shoulder line to shoulder line. Divided highways are considered to have two roadbeds.
- (7) *Roadside.* A general term denoting the area adjoining the outer edge of the roadbed to the right of way line. Extensive areas between the roadbeds of a divided highway may also be considered roadside.
- (8) *Roadway.* That portion of the highway included between the outside lines of the sidewalks, or curbs and gutters, or side ditches including also the appertaining structures, and all slopes, ditches, channels, waterways, and other features necessary for proper drainage and protection.
- (9) *Shoulder.* The portion of the roadway contiguous with the traveled way for the accommodation of stopped vehicles, for emergency use, for errant vehicle recovery, and for lateral support of base and surface courses. The shoulder may accommodate on-street parking as well as bicyclists and pedestrians, see the guidance in this manual as well as DIB 82.
- (10) *Sidewalk.* A surfaced pedestrian way contiguous to a roadbed used by the public where the need for which is created primarily by the local land use. See DIB 82 for further guidance.
- (11) *Traveled Way.* The portion of the roadway for the movement of vehicles and bicycles, exclusive of shoulders.

62.2 Highway Structures

- (1) *Illustration of Types of Structures.* Figure 62.2 illustrates the names given to common types of structures used in highway construction. This nomenclature must be used in all phases of planning.
- (2) *Bridges.* Structures that span more than 20 feet, measured along the centerline of the road between undercopings of abutments, and

multiple span structures, including culverts, where the total measurement of the individual spans are in excess of 20 feet, measured from center to center of supports along the centerline of the road and the distance between individual culvert barrels is less than one-half the culvert diameter. Culverts that fit the definition of a bridge will be designed and maintained by the Division of Engineering Services - Structures Design and assigned a bridge number.

- (3) *Culverts.* See Index 806.2.

62.3 Highway Types

- (1) *Freeway.* A freeway, as defined by statute, is a highway in respect to which the owners of abutting lands have no right or easement of access to or from their abutting lands or in respect to which such owners have only limited or restricted right or easement of access. This statutory definition also includes expressways.

The engineering definitions for use in this manual are:

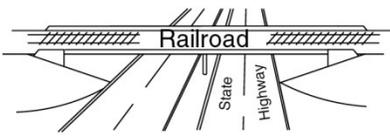
- (a) *Freeway*--A divided arterial highway with full control of access and with grade separations at intersections.
- (b) *Expressway*--An arterial highway with at least partial control of access, which may or may not be divided or have grade separations at intersections.
- (2) *Controlled Access Highway.* In situations where it has been determined advisable by the Director or the CTC, a facility may be designated a "controlled access highway" in lieu of the designation "freeway". All statutory provisions pertaining to freeways and expressways apply to controlled access highways.
- (3) *Conventional Highway.* A highway without control of access which may or may not be divided. Grade separations at intersections or access control may be used when justified at spot locations.
- (4) *Highway.* In general a public right of way for the purpose of travel or transportation.

- (a) Alley--A road passing through a continuous row of houses, buildings, etc. that permits access from the local street network to backyards, garages, etc.
 - (b) Arterial Highway--A general term denoting a highway primarily for through travel usually on a continuous route.
 - (c) Bypass--An arterial highway that permits users to avoid part or all of a city or town center, a suburban area, or an urban area.
 - (d) Collector-Distributor Road--A separated freeway system adjacent to a freeway, which connects two or more local road ramps or freeway connections to the freeway at a limited number of points.
 - (e) Collector Road--A route that serves travel of primarily intracounty rather than statewide importance in rural areas or a route that serves both land access and traffic circulation within a residential neighborhood, as well as commercial and industrial areas in urban and suburban areas.
 - (f) Divided Highway--A highway with separated roadbeds for traffic traveling in opposing directions.
 - (g) Major Street or Major Highway--An arterial highway with intersections at grade and direct access to abutting property on which geometric design and traffic control measures are used to expedite the safe movement of through traffic.
 - (h) Through Street or Through Highway--The highway or portion thereof at the entrance to which vehicular traffic from intersecting highways is regulated by "STOP" signs or traffic control signals or is controlled when entering on a separate right-turn roadway by a "YIELD" sign.
- (5) *Parkway.* An arterial highway for non-commercial vehicles, with full or partial control of access, which is typically located within a park or a ribbon of park-like development.
- (6) *Scenic Highway.* A State or county highway, in total or in part, that is recognized for its scenic value, protected by a locally adopted corridor protection program, and has been officially designated by the Department.
 - (7) *Street or Road.*
 - (a) Cul-de-Sac Street--A local street open at one end only, with special provisions for turning around.
 - (b) Dead End Street/No Outlet--A local street open at one end only, without special provisions for turning around.
 - (c) Frontage Street or Road--A local street or road auxiliary to and located on the side of an arterial highway for service to abutting property and adjacent areas and for control of access.
 - (d) Local Street or Local Road--A street or road primarily for access to residence, business or other abutting property.
 - (e) Private Road or Private Driveway--A way or place in private ownership and used for travel by the owner and those having express or implied permission from the owner but not by other members of the public.
 - (f) Street--A way or place that is publicly maintained and open for the use of the public to travel. Street includes highway.
 - (g) Toll Road, Bridge or Tunnel--A highway, bridge, or tunnel open to traffic only upon payment of a toll or fee.
 - (8) *Throughway.* A conventional highway or a suburban arterial in developed or developing areas, that is characterized by lower density (not built out) land uses, adjacent undeveloped land or parkland, direct access to abutting property, at-grade intersections, and that may have shoulders with or without curb and gutter.

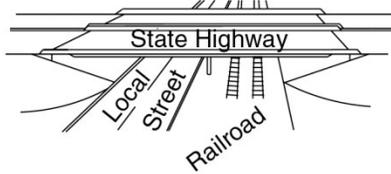
62.4 Interchanges and Intersections at Grade

- (1) *Central Island.* The raised area in the center of a roundabout around which traffic

Figure 62.2
Types of Structures



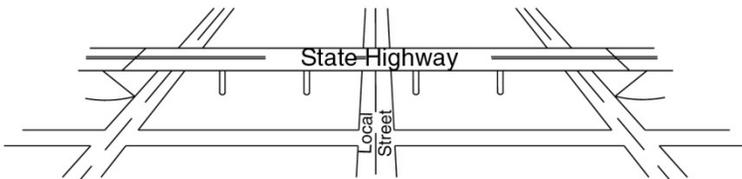
UNDERPASS



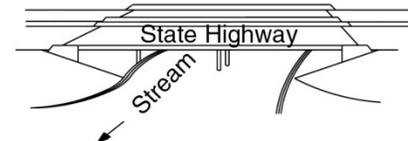
OVERHEAD



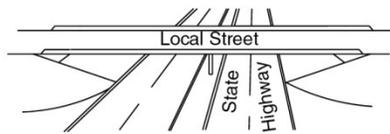
BRIDGE & OVERHEAD



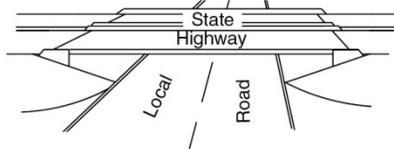
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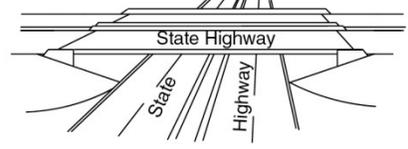
BRIDGE



OVERCROSSING



UNDERCROSSING



SEPARATION

- circulates. The central island does not necessarily need to be circular in shape.
- (2) *Circulatory Roadway.* The curved roadbed that users of a roundabout travel on in a counterclockwise direction around the central island.
 - (3) *Channelization.* The separation or regulation of conflicting movements into definite paths of travel by the use of pavement markings, raised islands, or other suitable means to facilitate the safe and orderly movement of vehicles, bicycles and pedestrians.
 - (4) *Crosswalk.* Crosswalk is either:
 - (a) That portion of a roadway included within the prolongation or connection of the boundary lines of sidewalks at intersections where the intersecting roadways meet at approximately right angles, except the prolongation of such lines from an alley across a street.
 - (b) Any portion of a roadway distinctly indicated for pedestrian crossing by lines or other markings on the surface.
 - (5) *Geometric Design.* The arrangement of the visible elements of a road, such as alignment, grades, sight distances, widths, slopes, and other similar elements.
 - (6) *Gore.* The area immediately beyond the divergence of two roadbeds bounded by the edges of those roadbeds.
 - (7) *Grade Separation.* A crossing of two highways, highway and local road, or a highway and a railroad at different levels.
 - (8) *Inscribed Circle Diameter.* The distance across the circle of a roundabout, inscribed by the outer curb (or edge) of the circulatory roadway. It is the sum of the central island diameter and twice the circulatory roadway width.
 - (9) *Interchange.* A system of interconnecting roadways in conjunction with one or more grade separations that provides for the movement of vehicles between two or more roadways on different levels.
 - (10) *Interchange Elements.*
 - (a) Branch Connection--A multilane connection between two freeways.
 - (b) Freeway-to-freeway Connection--A single or multilane connection between freeways or any two high speed facilities.
 - (c) Ramp--A connecting roadway between a freeway or expressway and another highway, road, or roadside area.
 - (11) *Intersection.* The general area where two or more roadways join or cross, including the roadway and roadside facilities for movements in that area.
 - (12) *Island.* A defined area between roadway lanes for control of vehicle movements or for pedestrian refuge. Within an intersection a median or an outer separation is considered an island.
 - (13) *Landscape Buffer/Strip.* A planted section adjacent to the legs of a roundabout that separates users of the roadway from users of the shared use/Class I Bikeway and assists with guiding pedestrians to the designated crossing locations. Also known as "way finding."
 - (14) *Minimum Turning Radius.* The radius of the path of the outer front wheel of a vehicle making its sharpest turn.
 - (15) *Offset Left-Turn Lanes.* Left-turn lanes are shifted as far to the left as practical rather than aligning the left-turn lane exactly parallel with and adjacent to the through lane.
 - (16) *Offtracking.* The difference between the paths of the front and rear wheels of a vehicle as it negotiates a turn.
 - (17) *Pedestrian Refuge.* A section of pavement or sidewalk, completely surrounded by asphalt or other road materials, where users can stop before completing the crossing of a road.
 - (18) *Roundabout.* A type of circular intersection with specific geometric and traffic control features that in combination lower speed operations and lower speed differentials among all users immediately prior to, through, and beyond the intersection. Vehicle speed is

controlled by deflection in the path of travel, and the “yield upon entry” rule for traffic approaching the roundabout’s circulatory roadway. Curves and deflections are introduced that limit operating speeds.

- (19) *Splitter Island.* A raised or painted traffic island that separates traffic in opposing directions of travel. They are typically used at roundabouts and on the minor road approaches to an intersection.
- (20) *Skew Angle.* The complement of the acute angle between two centerlines which cross.
- (21) *Swept width.* The total width needed by the vehicle body to traverse a curve. It is the distance measured along the curve radius from the outer front corner of the body to the inner rear corner of the body as the vehicle traverses around a curve. This width is used to determine lane width and clearance to objects, such as signs, poles, etc., as well as vehicles, bicycles, and pedestrians.
- (22) *Tracking width.* The total width needed by the tires to traverse a curve; it is the distance measured along the curve radius from the outer front tire track to the inner rear tire track as the vehicle traverses around a curve. This width is used to determine the minimum width required for the vehicle turning. Consideration for additional width may be needed for other vehicles, bicycles and pedestrians.
- (23) *Truck Apron.* The traversable portion of the roundabout central island adjacent to the circulatory roadway that may be needed to accommodate the wheel tracking of large vehicles. A truck apron is sometimes provided on the outside of the circulatory roadway, but cannot encroach upon the pedestrian crossing.
- (24) *Weaving Section.* A length of roadway, designed to accommodate two traffic streams merging and diverging within a short distance.
- (25) *Wheelbase.* For single-unit vehicles, the distance from the first axle to the single rear axle or, in the case of a tandem or triple set of rear axles, to the center of the group of rear axles. See Topic 404

62.5 Landscape Architecture

- (1) *“A” Soil Horizon.* Formed below the “O” soil horizon layer, defined in part (9) below, where mineral matter is mixed with decayed organic matter.
- (2) *Classified Landscaped Freeway.* A classified landscaped freeway is a planted section of freeway that meets the criteria established by the California Code of Regulations Outdoor Advertising Regulations, Title 4, Division 6. This designation is used in the control and regulation of outdoor advertising displays.
- (3) *Duff.* A vegetative material that has been collected and removed from the project during clearing and grubbing activities, or chipped or ground up and stockpiled for reapplication to the final slope surface.
- (4) *Highway Planting.* Highway planting addresses safety requirements, provides compliance with environmental commitments, and assists in the visual integration of the transportation facility within the existing natural and built environment. Highway planting provides planting to satisfy legal mandates, environmental mitigation requirements, Memoranda of Understanding or Agreement between the Department and local agencies for aesthetics or erosion control. Highway planting also includes roadside management strategies that improve traveler and worker safety by reducing the frequency and duration of maintenance worker exposure.

Highway planting required due to the impacts of a roadway construction project must be programmed and funded by the parent roadway project.

Highway planting, funded and maintained by the Department on conventional highways, is limited to planting that provides: safety improvements, erosion control/storm water pollution prevention, revegetation, and required mitigation planting. Highway planting on freeways, controlled access highways and expressways, funded and maintained by the Department, is limited to areas that meet specific criteria. See Chapter 29 “Landscape Architecture” of the Project Development Procedures Manual (PDPM) for

more detailed information regarding warranted planting.

- (5) *Highway Planting Restoration.* Highway planting restoration provides for replacement, restoration, and rehabilitation of existing vegetation damaged by weather, acts of nature or deterioration, to integrate the facility with the adjacent community and surrounding environment. Highway planting restoration also provides erosion control to comply with National Pollutant Discharge Elimination System (NPDES) permit requirements. These projects include strategies designed to protect the safety of motorists and maintenance workers by minimizing recurrent maintenance activities.
- (6) *Highway Planting Revegetation.* Highway planting revegetation provides planting as mitigation for native vegetation damaged or removed due to a roadway construction project. Highway planting revegetation may include irrigation systems as appropriate. Highway planting revegetation, required due to the impacts of a roadway construction project, must be programmed and funded by the parent roadway project.
- (7) *Imported Topsoil.* Soil that is delivered onto a project from a commercial source and is fertile, friable soil of loamy character that contains organic matter.
- (8) *Local Topsoil.* Existing soil obtained from the “A” and “O” soil horizons within the project limits, typically during excavation activities.
- (9) *“O” Soil Horizon.* The surface layer consisting of loose and partly decaying organic matter.
- (10) *Park and Ride.* A paved area for parking which provides a connection point for public access to a variety of modal options. See Topic 905.
- (11) *Replacement Highway Planting.* Replacement highway planting replaces vegetation installed by the Department or others, that has been damaged or removed due to transportation project construction. Replacement highway planting may also include irrigation modifications and/or replacement.

Replacement highway planting required due to the impacts of a roadway construction project must be programmed in conjunction with and funded from the parent roadway project.

- (12) *Required Mitigation Planting.* Required mitigation planting provides planting and other work necessary to mitigate environmental impacts due to roadway construction. The word “required” indicates that the work is necessary to meet legally required environmental mitigation or permit requirements. Required mitigation planting may be performed within the operational right of way, immediately adjacent to the highway or at an offsite location as determined by the permit. A planting project for required mitigation due to the impacts of a roadway construction project must be programmed and funded by the parent roadway project.
- (13) *Safety Roadside Rest Area System.* The safety roadside rest area system is a component of the highway system providing roadside areas where travelers can stop, rest and manage their travel needs. Planned with consideration of alternative stopping opportunities such as truck stops, commercial services, and vista points, the rest area system provides public stopping opportunities where they are most needed, usually between large towns and at entrances to major metropolitan areas. Within the safety roadside rest system, individual rest areas may include vehicle parking, picnic tables, sanitary facilities, telephones, water, tourist information panels, traveler service information facilities and vending machines. See Topic 903.
- (14) *Street Furniture.* Features such as newspaper boxes, bicycle racks, bus shelters, benches, art or drinking fountains that occupy space on or alongside pedestrian sidewalks.
- (15) *Vista Point.* Typically a paved dedicated area beyond the shoulder that permits travelers to stop and view a scenic area. In addition to parking areas, amenities such as trash receptacles, interpretive displays, and in some cases, rest rooms, drinking water and telephones may be provided. See Topic 904.

62.6 Right of Way

- (1) *Acquisition.* The process of obtaining rights of way.
- (2) *Air Rights.* The property rights for the control or specific use of a designated airspace involving a highway.
- (3) *Appraisal.* An expert opinion of the market value of property including damages and special benefits, if any, as of a specified date, resulting from an analysis of facts.
- (4) *Business District (or Central Business District).* The commercial and often the geographic heart of a city, which may be referred to as "downtown." Usually contains retail stores, theatres, entertainment and convention venues, government buildings, and little or no industry because of the high value of land. Historic sections may be referred to as "old town."
- (5) *Condemnation.* The process by which property is acquired for public purposes through legal proceedings under power of eminent domain.
- (6) *Control of Access.* The condition where the right of owners or occupants of abutting land or other persons to access in connection with a highway is fully or partially controlled by public authority.
- (7) *Easement.* A right to use or control the property of another for designated purposes.
- (8) *Eminent Domain.* The power to take private property for public use without the owner's consent upon payment of just compensation.
- (9) *Encroachment.* In terms of exceptions and permits, includes, but is not limited to, any structure, object, or activity of any kind or character which is within the State right of way, but it is not a part of the State facility or serving a transportation need.
- (10) *Inverse Condemnation.* The legal process which may be initiated by a property owner to compel the payment of just compensation, where the property has been taken for or damaged by a public purpose.

- (11) *Negotiation.* The process by which property is sought to be acquired for project purposes through mutual agreement upon the terms for transfer of such property.
- (12) *Partial Acquisition.* The acquisition of a portion of a parcel of property.
- (13) *Relinquishment.* A transfer of the State's right, title, and interest in and to a highway, or portion thereof, to a city or county.
- (14) *Right of Access.* The right of an abutting land owner for entrance to or exit from a public road.
- (15) *Severance Damages.* Loss in value of the remainder of a parcel which may result from a partial taking of real property and/or from the project.
- (16) *Vacation.* The reversion of title to the owner of the underlying fee where an easement for highway purposes is no longer needed.

62.7 Pavement

The following list of definitions includes terminologies that are commonly used in California as well as selected terms from the "AASHTO Guide for the Design of Pavement Structures" which may be used by FHWA, local agencies, consultants, etc. in pavement engineering reports and research publications.

- (1) *Asphalt Concrete.* See Hot Mix Asphalt (HMA).
- (2) *Asphalt Rubber.* A blend of asphalt binder, reclaimed tire rubber, and certain additives in which the rubber component is at least 15 percent by weight of the total blend and has reacted in the hot asphalt binder sufficiently to cause swelling of the rubber particles.
- (3) *Asphalt Treated Permeable Base (ATPB).* A highly permeable open-graded mixture of crushed coarse aggregate and asphalt binder placed as the base layer to assure adequate drainage of the structural section, as well as structural support.
- (4) *Base.* A layer of selected, processed, and/or treated aggregate material that is placed immediately below the surface course. It

- provides additional load distribution and contributes to drainage and frost resistance.
- (5) *Basement Soil/Material*. See Subgrade.
- (6) *Borrow*. Natural soil obtained from sources outside the roadway prism to make up a deficiency in excavation quantities.
- (7) *California R-Value*. A measure of resistance to deformation of the soils under saturated conditions and traffic loading as determined by the stabilometer test (CT301). The California R-value, also referred to as R-value, measures the supporting strength of the subgrade and subsequent layers used in the pavement structure. For additional information, see Topic 614.
- (8) *Capital Preventive Maintenance*. Typically, Capital Preventive Maintenance (CAPM) consists of work performed to preserve the existing pavement structure utilizing strategies that preserve or extend pavement service life. The CAPM program is divided into pavement preservation and pavement rehabilitation. For further discussion see Topic 603.
- (9) *Cement Treated Permeable Base (CTPB)*. A highly permeable open-graded mixture of coarse aggregate, portland cement, and water placed as the base layer to provide adequate drainage of the structural section, as well as structural support.
- (10) *Composite Pavement*. These are pavements comprised of both rigid and flexible layers. Currently, for purposes of the procedures in this manual, only flexible over rigid composite pavements are considered composite pavements.
- (11) *Crack*. Separation of the pavement material due to thermal and moisture variations, consolidation, vehicular loading, or reflections from an underlying pavement joint or separation.
- (12) *Crack, Seat, and Overlay (CSO)*. A rehabilitation strategy for rigid pavements. CSO practice requires the contractor to crack and seat the rigid pavement slabs, and place a flexible overlay with a pavement reinforcing fabric (PRF) interlayer.
- (13) *Crumb Rubber Modifier (CRM)*. Scrap rubber produced from scrap tire rubber and other components, if required, and processed for use in wet or dry process modification of asphalt paving.
- (14) *Deflection*. The downward vertical movement of a pavement surface due to the application of a load to the surface.
- (15) *Dense Graded Asphalt Concrete (DGAC)*. See Hot Mix Asphalt (HMA).
- (16) *Depression*. Localized low areas of limited size that may or may not be accompanied by cracking.
- (17) *Dowel Bar*. A load transfer device in a rigid slab usually consisting of a plain round steel bar.
- (18) *Edge Drain System*. A drainage system, consisting of a slotted plastic collector pipe encapsulated in treated permeable material and a filter fabric barrier, with unslotted plastic pipe vents, outlets, and cleanouts, designed to drain both rigid and flexible pavement structures.
- (19) *Embankment*. A prism of earth that is constructed from excavated or borrowed natural soil and/or rock, extending from original ground to the grading plane, and designed to provide a stable support for the pavement structure.
- (20) *Equivalent Single Axle Loads (ESAL's)*. The number of 18-kip standard single axle load repetitions that would have the same damage effect to the pavement as an axle of a specified magnitude and configuration. See Index 613.3 for additional information.
- (21) *Flexible Pavement*. Pavements engineered to transmit and distribute vehicle loads to the underlying layers. The highest quality layer is the surface course (generally asphalt binder mixes) which may or may not incorporate underlying layers of base and subbase. These types of pavements are called "flexible" because the total pavement structure bends or flexes to accommodate deflection bending under vehicle loads. For further discussion, see Chapter 630.

- (22) *Grading Plane*. The surface of the basement material upon which the lowest layer of subbase, base, pavement surfacing, or other specified layer, is placed.
- (23) *Gravel Factor (G_f)*. Refers to the relative strength of a given material compared to a standard gravel subbase material. The cohesiometer values were used to establish the G_f currently used by Caltrans.
- (24) *Hot Mix Asphalt (HMA)*. Formerly known as asphalt concrete (AC), HMA is a graded asphalt concrete mixture (aggregate and asphalt binder) containing a small percentage of voids which is used primarily as a surface course to provide the structural strength needed to distribute loads to underlying layers of the pavement structure.
- (25) *Hot Recycled Asphalt (HRA)*. The use of reclaimed flexible pavement which is combined with virgin aggregates, asphalt, and sometimes rejuvenating agents at a central hot-mix plant and placed in the pavement structure in lieu of using all new materials.
- (26) *Joint Seals*. Pourable, extrudable or premolded materials that are placed primarily in transverse and longitudinal joints in concrete pavement to deter the entry of water and incompressible materials (such as sand that is broadcast in freeze-thaw areas to improve skid resistance).
- (27) *Lean Concrete Base*. Mixture of aggregate, portland cement, water, and optional admixtures, primarily used as a base for portland cement concrete pavement.
- (28) *Longitudinal Joint*. A joint normally placed between roadway lanes in rigid pavements to control longitudinal cracking; and the joint between the traveled way and the shoulder.
- (29) *Maintenance*. The preservation of the entire roadway, including pavement structure, shoulders, roadsides, structures, and such traffic control devices as are necessary for its safe and efficient utilization.
- (30) *Open Graded Asphalt Concrete (OGAC)*. See Open Graded Friction Course (OGFC).
- (31) *Open Graded Friction Course (OGFC)*. Formerly known as open graded asphalt concrete (OGAC), OGFC is a wearing course mix consisting of asphalt binder and aggregate with relatively uniform grading and little or no fine aggregate and mineral filler. OGFC is designed to have a large number of void spaces in the compacted mix as compared to hot mix asphalt. For further discussion, see Topic 631.
- (32) *Overlay*. An overlay is a layer, usually hot mix asphalt, placed on existing flexible or rigid pavement to restore ride quality, to increase structural strength (load carrying capacity), and to extend the service life.
- (33) *Pavement*. The planned, engineered system of layers of specified materials (typically consisting of surface course, base, and subbase) placed over the subgrade soil to support the cumulative vehicle loading anticipated during the design life of the pavement. The pavement is also referred to as the pavement structure and has been referred to as pavement structural section.
- (34) *Pavement Design Life*. Also referred to as performance period, pavement design life is the period of time that a newly constructed or rehabilitated pavement is engineered to perform before reaching a condition that requires CAPM, (see Index 603.4). The selected pavement design life varies depending on the characteristics of the highway facility, the objective of the project, and projected vehicle volume and loading.
- (35) *Pavement Drainage System*. A drainage system used for both asphalt and rigid pavements consisting of a treated permeable base layer and a collector system which includes a slotted plastic pipe encapsulated in treated permeable material and a filter fabric barrier with unslotted plastic pipe as vents, outlets and cleanouts to rapidly drain the pavement structure. For further discussion, see Chapter 650.
- (36) *Pavement Preservation*. Work done, either by contract or by State forces to preserve the ride quality, safety characteristics, functional serviceability and structural integrity of

- roadway facilities on the State highway system. For further discussion, see Topic 603.
- (37) *Pavement Service Life.* Is the actual period of time that a newly constructed or rehabilitated pavement structure performs satisfactorily before reaching its terminal serviceability or a condition that requires major rehabilitation or reconstruction. Because of the many independent variables involved, pavement service life may be considerably longer or shorter than the design life of the pavement. For further discussion, see Topic 612.
- (38) *Pavement Structure.* See Pavement.
- (39) *Pumping.* The ejection of base material, either wet or dry, through joints or cracks, or along edges of rigid slabs resulting from vertical movements of the slab under vehicular traffic loading. This phenomena is especially pronounced with saturated structural sections.
- (40) *Raveling.* Progressive disintegration of the surface course on asphalt concrete pavement by the dislodgement of aggregate particles and binder.
- (41) *Rehabilitation.* Work undertaken to extend the service life of an existing facility. This includes placement of additional surfacing and/or other work necessary to return an existing roadway, including shoulders, to a condition of structural or functional adequacy, for the specified service life. This might include the partial or complete removal and replacement of portions of the pavement structure. Rehabilitation is divided into pavement rehabilitation activities and roadway rehabilitation activities (see Indexes 603.3 and 603.4).
- (42) *Resurfacing.* A supplemental surface layer or replacement layer placed on an existing pavement to restore its riding qualities and/or to increase its structural (load carrying) strength.
- (43) *Rigid Pavement.* Pavement engineered with a rigid surface course (typically Portland cement concrete or a variety of specialty cement mixes for rapid strength concretes) which may incorporate underlying layers of stabilized or unstabilized base or subbase materials. These types of pavements rely on the substantially higher stiffness of the rigid slab to distribute the vehicle loads over a relatively wide area of underlying layers and the subgrade. Some rigid slabs have reinforcing steel to help resist cracking due to temperature changes and repetitive loading.
- (44) *Roadbed.* The roadbed is that area between the intersection of the upper surface of the roadway and the side slopes or curb lines. The roadbed rises in elevation as each increment or layer of subbase, base or surface course is placed. Where the medians are so wide as to include areas of undisturbed land, a divided highway is considered as including two separate roadbeds.
- (45) *Asphalt Rubber Binder.* A blend of asphalt binder modified with crumb rubber modifier (CRM) that may include less than 15 percent CRM by mass.
- (46) *Rubberized Hot Mix Asphalt (RHMA).* Formerly known as rubberized asphalt concrete (RAC). RHMA is a material produced for hot mix applications by mixing either asphalt rubber or asphalt rubber binder with graded aggregate. RHMA may be gap- (RHMA-G) or open- (RHMA-O) graded.
- (47) *R-value.* See California R-Value.
- (48) *Serviceability.* The ability at time of observation of a pavement to serve vehicular traffic (automobiles and trucks) which use the facility. The primary measure of serviceability is the Present Serviceability Index (PSI), which ranges from 0 (impossible road) to 5 (perfect road).
- (49) *Settlement.* Localized vertical displacement of the pavement structure due to slippage or consolidation of the underlying foundation, often resulting in pavement deterioration, cracking and poor ride quality.
- (50) *Structural Section.* See Pavement Structure.
- (51) *Structural Section Drainage System.* See Pavement Drainage System.

- (52) *Subbase*. Unbound aggregate or granular material that is placed on the subgrade as a foundation or working platform for the base. It functions primarily as structural support, but it can also minimize the intrusion of fines from the subgrade into the pavement structure, improve drainage, and minimize frost action damage.
- (53) *Subgrade*. Also referred to as basement soil, is that portion of the roadbed consisting of native or treated soil on which pavement surface course, base, subbase, or a layer of any other material is placed.
- (54) *Surface Course*. One or more uppermost layers of the pavement structure engineered to carry and distribute vehicle loads. The surface course typically consists of a weather-resistant flexible or rigid layer, which provides characteristics such as friction, smoothness, resistance to vehicle loads, and drainage. In addition, the surface course minimizes infiltration of surface water into the underlying base, subbase and subgrade. A surface course may be composed of a single layer with one or multiple lifts, or multiple layers of differing materials.
- (55) *Tie Bars*. Deformed reinforcing bars placed at intervals that hold rigid pavement slabs in adjoining lanes and exterior lane-to-shoulder joints together and prevent differential vertical and lateral movement.

62.8 Highway Operations

- (1) *Annual Average Daily Traffic*. The average 24-hour volume, being the total number during a stated period divided by the number of days in that period. Unless otherwise stated, the period is a year. The term is commonly abbreviated as ADT or AADT.
- (2) *Delay*. The time lost while road users are impeded by some element over which the user has no control.
- (3) *Density*. The number of vehicles per mile on the traveled way at a given instant.
- (4) *Design Vehicles*. See Topic 404.
- (5) *Design Volume*. A volume determined for use in design, representing traffic expected to use the highway. Unless otherwise stated, it is an hourly volume.
- (6) *Diverging*. The dividing of a single stream of traffic into separate streams.
- (7) *Headway*. The time in seconds between consecutive vehicles moving past a point in a given lane, measured front to front.
- (8) *Level of Service*. A rating using qualitative measures that characterize operational conditions within a traffic stream and their perception by users.
- (9) *Managed Lanes*. Lanes that are proactively managed in response to changing operating conditions in efforts to achieve improved efficiency and performance. Typically employed on highways with increasing recurrent traffic congestion and limited resources.
- (a) High-Occupancy Vehicle (HOV) Lanes--An exclusive lane for vehicles carrying the posted number of minimum occupants or carpools, either part time or full time.
- (b) High Occupancy Toll (HOT) Lanes--An HOV lane that allows vehicles qualified as carpools to use the facility without a fee, while vehicles containing less than the required number of occupants to pay a toll. Tolls may change based on real time conditions (dynamic) or according to a schedule (static).
- (c) Express Toll Lanes--Facilities in which all users are required to pay a toll, although HOVs may be offered a discount. Tolls may be dynamic or static.
- (10) *Merging*. The converging of separate streams of traffic into a single stream.
- (11) *Running Time*. The time the vehicle is in motion.
- (12) *Spacing*. The distance between consecutive vehicles in a given lane, measured front to front.
- (13) *Speed*.
- (a) Design Speed--A speed selected to establish specific minimum geometric

design elements for a particular section of highway or bike path.

- (b) **Operating Speed**--The speed at which drivers are observed operating their vehicles during free-flow conditions. The 85th percentile of the distribution of a representative sample of observed speeds is used most frequently to measure the operating speed associated with a particular location or geometric feature.
 - (c) **Posted Speed**--The speed limit determined by law and shown on the speed limit sign.
 - (d) **High Speed** – A speed greater than 45 mph.
 - (e) **Low Speed** – A speed less than or equal to 45 mph.
 - (f) **Running Speed**--The speed over a specified section of highway, being the distance divided by running time. The average for all traffic, or component thereof, is the summation of distances divided by the summation of running times.
- (14) **Traffic.** A general term used throughout this manual referring to the passage of people, vehicles and/or bicycles along a transportation route.
- (15) **Traffic Control Devices.**
- (a) **Markings**--All pavement and curb markings, object markers, delineators, colored pavements, barricades, channelizing devices, and islands used to convey regulations, guidance, or warning to users.
 - (b) **Sign**--Any traffic control device that is intended to communicate specific information to users through a word, symbol and/or arrow legend. Signs do not include highway traffic signals or pavement markings, delineators, or channelizing devices.
 - (c) **Highway 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 pavement markers,

warning lights, or steady burning electrical lamps.

- (d) **Changeable Message Sign**--An electronic traffic sign used on roadways to give travelers information about traffic congestion, accidents, roadwork zones, speed limits or any dynamic information about current driving conditions.
- (16) **Volume.** The number of vehicles passing a given point during a specified period of time.
- (17) **Weaving.** The crossing of traffic streams moving in the same general direction accomplished by merging and diverging.
- (18) **Ramp Metering.** A vehicular traffic management strategy which utilizes a system of traffic signals on freeway entrance and connector ramps to regulate the volume of vehicles entering a freeway corridor in order to maximize the efficiency of the freeway and thereby minimizing the total delay in the transportation corridor.

62.9 Drainage

See Chapter 800 for definition of drainage terms.

62.10 Users

- (1) **Bicycle.** A device propelled via chain, belt or gears, exclusively by human power.
- (2) **Bus.** Any vehicle owned or operated by a publicly owned or operated transit system, or operated under contract with a publicly owned or operated transit system, and used to provide to the general public, regularly scheduled transportation for which a fare is charged. A general public paratransit vehicle is not a transit bus.
- (3) **Bus Rapid Transit (BRT).** A flexible rubber-tired rapid-transit mode that combines stations, vehicles, services, exclusive running ways, and Intelligent Transportation System elements into an integrated system with a strong positive identity that evokes a unique image.
- (4) **Commuter Rail.** Traditional rapid and heavy rail passenger service intended to provide travel options in suburban and urban areas. Corridor lengths are typically shorter than

intercity passenger rail services. Top operating speeds are in the range of 90 to 110 miles per hour. The tracks may or may not be shared with freight trains and typically are in a separate right of way.

- (5) *Conventional Rail.* Traditional intercity passenger rail and interregional freight rail. Top operating speeds are in the range of 60 to 110 miles per hour. The tracks may or may not be shared by passenger and freight trains and typically run within their own right of way corridor.
- (6) *Design Vehicle.* The largest vehicle commonly expected on a particular roadway. Descriptions of these vehicles are found in Index 404.4.
- (7) *Equestrian.* A rider on horseback.
- (8) *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.
- (9) *Light Rail.* A form of urban transit that uses rail cars on fixed rails in a right of way that may or may not be grade separated. Motorized vehicles and bicycles may share the same transportation corridor. These railcars are typically electrically driven with power supplied from an overhead line rather than an electrified third rail. Top operating speeds are typically 60 miles per hour.
- (10) *Pedestrian.* A person who is afoot or who is using any of the following: (a) a means of conveyance propelled by human power other than a bicycle, or (b) an electric personal assistive mobility device. Includes a person who is operating a self-propelled wheelchair, motorized tricycle, or motorized quadricycle and, by reason of physical disability, is otherwise unable to move about as a pedestrian as specified in part (a) above.

(11) *Street Car, Trams or Trolley.* A passenger rail vehicle which runs on tracks along public urban streets and also sometimes on separate rights of way. It may also run between cities and/or towns, and/or partially grade separated structures.

(12) *Transit.* Includes light rail; commuter rail; motorbus; street car, tram, trolley bus; BRT; automated guideway; and demand responsive vehicles. The most common application is for motorbus transit. See Index 404.4 for a description of the design vehicle as related to buses.

(13) *Vehicle.* A device to move, propel or draw a person upon a highway, except a device on rails or propelled exclusively by human power. This definition, abstracted from the CVC, is intended to refer to motor vehicles, excluding those devices necessary to provide mobility to persons with disabilities.

CHAPTER 80 APPLICATION OF DESIGN STANDARDS

Topic 81 - Project Development Overview

Index 81.1 - Philosophy

The Project Development process seeks to provide a degree of mobility to users of the transportation system that is in balance with other values. In the development of transportation projects, social, economic, and environmental effects must be considered fully along with technical issues so that final decisions are made in the best overall public interest. Attention should be given to such considerations as:

- (a) Need to provide transportation for all users (motorists, bicyclists, transit riders, and pedestrians) of the facility and transportation modes.
- (b) Attainment of community goals and objectives.
- (c) Needs of low mobility and disadvantaged groups.
- (d) Costs and benefits of eliminating or minimizing adverse effects on natural resources, environmental values, public services, aesthetic values, and community and individual integrity.
- (e) Planning based on realistic financial estimates.
- (f) The cost, ease, and safety of maintaining whatever is built.

Proper consideration of these items requires that a facility be viewed from the perspectives of the user, the nearby community, and larger statewide interests. For the user, efficient travel, mode selection, and safety are paramount concerns. At the same time, the community often is more concerned about local aesthetic, social, and economic impacts. The general population, however, tends to be interested in how successfully a project functions as part of the overall transportation system and how large a share of available capital resources it consumes. Therefore, individual projects must be selected for

construction on the basis of overall system benefits as well as community goals, plans, and values.

Decisions must also emphasize the connectivity between the different transportation modes so that they work together effectively.

The goal is to increase person and goods throughput, highway mobility and safety in a manner that is compatible with, or which enhances, adjacent community values and plans.

81.2 Highway Context

The context of a highway is a critical factor when developing the purpose and need statement for a project in addition to making fundamental design decisions such as its typical cross section and when selecting the design elements and aesthetic features such as street furniture and construction materials. Designing a highway that is sensitive to, and respectful of, the surrounding context is critical for project success in the minds of the Department and our stakeholders.

A “one-size-fits-all” design philosophy is not Departmental policy. Designers need to be aware of and sensitive to land use, community context and the associated user needs of the facility. In some instances, the design criteria and standards in this manual are based on the land use contexts in which the State highway is located, for instance: large population areas and downtowns in urban areas, small rural towns and communities, suburban commercial/residential areas, and rural corridors. This approach ensures the standards are flexible, and the approach allows and encourages methods to minimize impacts on scenic, historic, archaeological, environmental, and other important resources.

Beyond their intended transportation benefits, State highways can significantly impact the civic, social and economic conditions of local communities. Designing transportation facilities that integrate the local transportation and land uses while making the design responsive to the other needs of the community support the livability of the community and are usually a complementary goal to meeting the transportation needs of the users of the State highway system.

To do this successfully, the designer needs to have an understanding of the area surrounding the

highway and the users of the highway, its function within the regional and State transportation systems, (which includes all transportation modes), and the level of access control needed. To gain this understanding, the designer must consult the Transportation Concept Reports and work with the planning division and the local agencies.

In this manual, the following concepts are used to discuss the context of a highway:

- Place Type - the surrounding built and natural environment;
- Type of Highway - the role the highway plays in terms of providing regional or interregional connectivity and local access; and,
- Access Control - the degree of connection or separation between the highway and the surrounding land use.

A “Main Street” design is not specific to a certain place type, but is a design philosophy to be applied on State highways that also function as community streets. A “Main Street” design serves pedestrians, bicyclists, businesses and public transit with motorized traffic operating at speeds of 20 to 40 miles per hour. See the Department’s “Main Street, California” document for more information.

81.3 Place Types

A place type describes the area’s physical environment and the land uses surrounding the State highway. The place types described below are intentionally broad. Place types should be agreed upon in partnership with all of the project stakeholders; however, there likely may be more than one place type within the limits of a project. Ultimately, the place types selected can be used to determine the appropriate application of the guidance provided in this manual. These place type definitions are independent of the Federal government definitions of urban and rural areas. See Title 23 United States Code, Section 13 for further information.

Identifying the appropriate place type(s) involves discussions with the project sponsors, ideally through the Project Development Team (PDT) process, and requires coordination with the land use planning activities associated with the on-going local and regional planning activities. Extensive community engagement throughout both the

project planning and project development processes helps to formulate context sensitive project alternatives and transportation facilities that coordinate with the local land uses.

The following place types are used in this manual:

(1) *Rural Areas*. Rural areas are typically sparsely settled and developed. They can consist of protected federal and State lands, agricultural lands, and may include tourist and recreational destinations. However, as rural lands transition into rural communities, they can become more developed and suburban and urban-like by providing for a mixture of housing, commercial, industrial and public institutions. For the use of this manual, rural areas have been subcategorized as Natural Corridors, Developing Corridors and City/Town Centers (Rural Main Streets).

(a) Natural Corridors. Typically, the desire in these corridors is to preserve the natural and scenic countryside while at the same time provide transportation services to support the travel and tourism that occurs when visiting these locations. Examples of this place type are: National/State Forests and Parklands; agricultural lands with scattered farm buildings and residences; and, low density development. See Topic 109 for additional information.

(b) Developing Corridors. State highways traveling through these lands tend to be increasingly clustered with industrial, commercial, and residential areas as they lead into a rural city or town center. These corridors can be a transition zone among the aforementioned areas. Highways associated with these locations help to deliver tourists, but they also need to support the local communities and their local economies. In addition, these highways also serve a role and should be efficient at moving people and goods between regions.

Industrial, commercial and retail buildings tend to be located separately from housing and are typically set back from the highway with parking areas placed in front. Truck traffic on these highways

tends to serve the needs of these industrial, commercial and retail buildings; however, there will be a component of the truck traffic that is transporting their loads inter-regionally. Therefore, corridors in areas that are in transition may need to accommodate design vehicles.

- (c) **City or Town Centers (Rural Main Streets).** State highways in this scenario are usually a conventional main street through the rural city or town, or they may be the only main street. The use of the State highway in this environment varies depending upon the individual community, as does the mix of buildings, services, businesses, and public spaces. Transit is often present and should be incorporated into the transportation system as appropriate. Transportation improvement projects on these main street highways can be more complicated and costly than similar projects in more rural settings. A balance usually needs to be maintained between the needs of the through traffic and those of the local main street environment. Thus, analyzing the pedestrian and bicyclist needs early in the development of the project and then following through on the agreements during the design of highway projects in these locations can be especially important. Accommodating the pedestrian and bicyclist needs concurrently in projects leads to greater efficiency in the use of funding.
- (2) **Suburban Areas.** Suburban areas lead into and can completely surround urban areas. A mixture of land uses is typical in suburban areas. This land use mixture can consist of housing, retail businesses and services, and may include regional centers such as shopping malls and other similar regional destinations; which are usually associated with suburban communities (cities and towns) that can be connected with larger urban centers and cities. Assessing the needs of pedestrians, bicyclists, and transit users in concert with the vehicular needs of motorists and truck drivers is necessary during the project planning, development and design of highway projects in these locations. Accommodating all of these needs concurrently into a project leads to greater efficiency in the use of funding. For the use of this manual, suburban areas have been categorized as either Lower Density/Residential Neighborhoods or Higher Density/Regional Community Centers (Suburban Main Streets).
- (a) **Lower Density / Residential Neighborhoods.** State highways typically do not cross through this place type. This place type usually feeds users onto the State highway system and is typically under the jurisdiction of a local entity. State highways, if they do interact with this place type, usually just connect at the edges of them where the pedestrians, bicyclists, and motor vehicle operators integrate into the highway system that includes transit facilities.
- (b) **Higher Density / Regional Community Centers (Suburban Main Streets).** As suburban areas grow they tend to merge together into each other's boundaries. Growth in some locations can create "Megacommunities." While these megacommunities seem to function as individual cities, they typically have multiple distinct community centers that require highways with the capacity to serve not only each center, but the center-to-center traveler needs. These areas typically require the State highway to serve not only the originally urbanized area, but also the newer suburban areas that have been created where the housing, shopping and employment opportunities are all centered. Anticipating and accommodating growth in this place type can be a challenge. State and local governments, the business community and citizens groups, and metropolitan planning organizations all need to agree on how to meet the community needs, and at times the interregional needs of the highway.
- (3) **Urban and Urbanized Areas.** Urban areas generally are the major population centers in the State. Large numbers of people live in

these urbanized areas where growth is expected to continue. Bicycling, transit, and walking are important transportation modes in these areas and as the facilities for pedestrians, transit and bicyclists expand in these areas, the percentage and number of travelers walking, using transit and bicycling is also likely to increase. State agencies and the local governmental entities, the business community and citizens groups, congestion Management Agencies and the local/regional metropolitan planning organization (MPO) need to all agree upon the concept of the transportation facilities being provided so that the community needs can be met.

Urban areas are typically high-density locations such as central business districts, downtown communities, and major activity centers. They have a full range of land uses and are associated with a large diversity of activities. For the use of place types in this manual, urban areas have been categorized as Lower Density Parklands and Residential Neighborhoods and Higher Density Urban Main Streets. Higher Density Urban Main Streets have been further characterized as Community Centers and Downtown Cores.

- (a) Lower Density Parklands and Residential Neighborhoods. Large numbers of people live in these urbanized areas and bicycling, transit and walking are important transportation modes in these areas. Parklands can enhance these neighborhoods and parkland preservation is a concern, as well as, access to support travel and tourism to the parklands.
- (b) High Density Urban Main Streets.
 - Community Centers or Corridor. Strategically improving the design and function of the existing State highways that cross these centers is typically a concern. Providing transportation options to enhancing these urban neighborhoods that combine highway, transit, passenger rail, walking, and biking options are desirable, while they also help promote tourism and shopping.

- Downtown Cores. Similar to community centers, much of the transportation system has already been built and its footprint in the community needs to be preserved while its use may need to be reallocated. Successfully meeting the mobility needs of a major metropolitan downtown core area requires a balanced approach. Such an approach is typically used to enhance the existing transportation network's performance by adding capacity to the highways, sidewalks, and transit stations for all of the users of the system, and/or adding such enhancement features as HOV lanes, BRT, walkable corridors, etc. Right of way is limited and costly to purchase in these locations. Delivery truck traffic that supports the downtown core businesses can also create problems.

The HEPGIS tool on the FHWA website is available to determine if the project is in an urban area. Urban areas are found on the Highway Information tab of the tool.

81.4 Type of Highway

Much of the following terminology is either already discussed in Chapter 20 or defined in Topic 62. The additional information in this portion of the manual is being provided to connect these terms with the guidance that is being provided.

- (1) *Functional Classification.* One of the first steps in the highway design process is to define the function that the facility is to serve. The two major considerations in functionally classifying a highway are access and throughput. Access and mobility are inversely related; as access is increased, mobility decreases. In the AASHTO "A Policy on Geometric Design of Highways and Streets", highways are functionally classified first as either urban or rural. The hierarchy of the functional highway system within either an urban or rural area consists of the following:

- Principal arterial - main movement (high mobility, limited access) Typically 4 lanes or more;
 - Minor arterial - interconnects principal arterials (moderate mobility, limited access) Typically 2 or 3 lanes with turn lanes to benefit through traffic;
 - Collectors - connects local roads to arterials (moderate mobility, moderate access) with few businesses; and,
 - Local roads and streets - permits access to abutting land (high access, limited mobility).
- Designers have the ability to design for all modes of travel (vehicular, bicycle, pedestrian, truck and transit); and,
 - Designers have the flexibility to tailor a project to the unique circumstances that relate to it and its location, while meeting driver expectation.

Designers should balance the interregional transportation needs with the needs of the communities they pass through. The design of projects should, when possible, expand the options for biking, walking, and transit use. In planning and designing projects, the project development team should work with locals that have any livable policies as revitalizing urban centers, building local economies, and preserving historic sites and scenic country roads. The “Main Streets: Flexibility in Planning, Design and Operations” published by the Department should be consulted for additional guidance as should the FHWA publication “Flexibility in Highway Design”.

Early consultation and discussion with the Design Coordinator and the Design Reviewer during the project initiation document (PID) phase is also necessary to avoid issues that may arise later in the project development process. Design Information Bulletin 78 “Design Checklist for the Development of Geometric Plans” is a tool that can be used to identify and discuss design features that may deviate from standard.

The California Road System (CRS) maps are the official functional classification maps approved by Federal highway Administration. These maps show functional classification of roads.

- (2) *Interstate Highways.* The interstate highway system was originally designed to be high-speed interregional connectors and it is a portion of the National Highway System (NHS). In urban and suburban areas, a large percentage of vehicular traffic is carried on the interstate highway system, rather than on the local arterials and streets.
- (3) *State Routes.* The State highway system is described in the California Streets and Highway Code, Division 1, Chapter 2 and they are further defined in this manual in Topic 62.3, Highway Types which provides definitions for freeways, expressways, and highways.

81.5 Access Control

Index 62.3 defines a controlled access highway and a conventional highway. The level of access control plays a part in determining the design standards that are to be utilized when designing a highway. See Index 405.6 for additional access control guidance.

81.6 Design Standards and Highway Context

The design guidance and standards in this manual have been developed with the intent of ensuring that:

Topic 82 - Application of Standards

82.1 Highway Design Manual Standards

- (1) *General.* The highway design criteria and policies in this manual provide a guide for the engineer to exercise sound judgment in applying standards, consistent with the above Project Development philosophy, in the design of projects. This guidance allows for flexibility in applying design standards and approving design exceptions that take the context of the project location into consideration; which enables the designer to tailor the design, as appropriate, for the specific circumstances while maintaining safety.

The design standards used for any project should equal or exceed the minimum given in the Manual to the maximum extent feasible, taking into account costs (initial and life-cycle), traffic volumes, traffic and safety benefits, right of way, socio-economic and environmental impacts, maintenance, etc. Because design standards have evolved over many years, many existing highways do not conform fully to current standards. It is not intended that current manual standards be applied retroactively to all existing State highways; such is neither warranted nor economically feasible. However, when warranted, upgrading of existing roadway features such as guardrail, lighting, superelevation, roadbed width, etc., should be considered, either as independent projects or as part of larger projects. A record of the decision not to upgrade the existing non-standard mandatory or advisory features shall be provided through the exception process (See Index 82.2).

This manual does not address temporary construction features. It is recognized that the construction conditions encountered are so diverse and variable that it is not practical to set geometric criteria. Guidance for use of traffic control devices for temporary construction zones can be found in Part 6 – Temporary Traffic Control of the California Manual on Uniform Traffic Control Devices (California MUTCD). Guidance for the engineering of pavements in temporary construction zones is available in Index 612.6. In this manual, design standards and guidance are categorized in order of importance in development of a State highway system. See Index 82.4 for other mandatory procedural requirements.

(2) *Controlling Criteria.* The FHWA has designated thirteen controlling criteria for selection of design standards of primary importance for highway safety, listed as follows: design speed, lane width, shoulder width, bridge width, horizontal alignment, vertical alignment, grade, stopping sight distance, cross slope, superelevation, horizontal clearance, vertical clearance and bridge structural

capacity. All but the last of these criteria are also designated as geometric criteria.

The design standards related to the 12 geometric criteria are designated as mandatory standards in this manual (see Index 82.1(2) and Table 82.1A).

- (3) *Mandatory Standards.* Mandatory design standards are those considered most essential to achievement of overall design objectives. Many pertain to requirements of law or regulations such as those embodied in the FHWA's 13 controlling criteria (see above). Mandatory standards use the word "shall" and are printed in **Boldface** type (see Table 82.1A).
- (4) *Advisory Standards.* Advisory design standards are important also, but allow greater flexibility in application to accommodate design constraints or be compatible with local conditions on resurfacing or rehabilitation projects. Advisory standards use the word "should" and are indicated by Underlining (see Table 82.1B).
- (5) *Decision Requiring Other Approvals.* There are design criteria decisions that are not bold or underlined text which require specific approvals from individuals to whom such decisions have been delegated. These individuals include, but are not limited to, District Directors, Traffic Liaisons, Design Coordinators or their combination as specified in this manual. These decisions should be documented as the individual approving desires.
- (6) *Permissive Standards.* All standards other than mandatory, advisory, or decisions requiring other approvals, whether indicated by the use of "should", "may", or "can" are permissive.
- (7) *Other Caltrans Publications.* In addition to the design standards in this manual, see Index 82.7 for general information on the Department's traffic engineering policy, standards, practices and study warrants.

Caution must be exercised when using other Caltrans publications which provide guidelines for the design of highway facilities,

such as HOV lanes. These publications do not contain design standards; moreover, the designs suggested in these publications do not always meet Highway Design Manual Standards. Therefore, all other Caltrans publications must be used in conjunction with this manual.

- (8) *Transportation Facilities Under the Jurisdiction of Others.* Generally, if the local road or street is a Federal-aid route it should conform to AASHTO standards; see Topic 308 – Cross Sections for Roads Under Other Jurisdictions. Occasionally though, projects on the State highway system involve work on adjacent transportation facilities that are under the jurisdiction of cities and counties. Some of these local jurisdictions may have published standards for facilities that they own and operate. The guidance in this manual may be applicable, but it was prepared for use on the State highway system. Thus, when project work impacts adjacent transportation facilities that are under the jurisdiction of cities and counties, local standards and AASHTO guidance must be used in conjunction with this manual to encourage designs that are sensitive to the local context and community values. Agreeing on which standards will be used needs to be decided early in the project delivery process and on a project by project basis.

82.2 Approvals for Nonstandard Design

- (1) *Mandatory Standards.* Design features or elements which deviate from mandatory standards indicated herein require the approval of the Chief, Division of Design. This approval authority has been delegated to the Design Coordinators, except as noted in Table 82.1A where: (a) the mandatory standard has been delegated to the District Director and (b) the mandatory standards in Chapters 600 through 670 requires the approval of the State Pavement Engineer, and may involve coordination with the Design Coordinator.

The current procedures and documentation requirements pertaining to the approval process for those exceptions to mandatory design standards as well as the dispute

resolution process are contained in Chapter 21 of the Project Development Procedures Manual (PDPM).

Design exception approval must be obtained pursuant to the instructions in PDPM Chapter 9.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) allowed significant delegation to the states by FHWA to approve and administer portions of the Federal-Aid Transportation Program. SAFETEA-LU further allowed delegation to the State DOT's and in response to this a Joint Stewardship and Oversight Agreement (JSOA) document between FHWA and Caltrans was signed. The JSOA outlines the process to determine specific project related delegation to the Department. The JSOA requires, FHWA approval of exceptions to mandatory design standards related to the 13 controlling criteria on all Interstate projects whether FHWA has oversight responsibilities or not. FHWA approval should be sought as early in the project development process as possible. However, formal FHWA approval shall not be requested until the appropriate Caltrans representative has approved the design exception.

FHWA approval is not required for exceptions to "Caltrans-only" mandatory standards. Table 82.1A identifies these mandatory standards.

For local facilities crossing the State right of way see Index 308.1.

- (2) *Advisory Standards.* The authority to approve exceptions to advisory standards has been delegated to the District Directors. A list of advisory standards is provided in Table 82.1B. Proposals for exceptions from advisory standards can be discussed with the Design Coordinators during development of the approval documentation. The responsibility for the establishment of procedures for review, documentation, and long term retention of approved exceptions from advisory standards has also been delegated to the District Directors.

- (3) *Decisions Requiring Other Approvals.* The authority to approve specific decisions identified in the text are also listed in Table 82.1C. The form of documentation or other instructions are provided as directed by the approval authority.
- (4) *Local Agencies.* Cities and counties are responsible for the design decisions they make on transportation facilities they own and operate. The responsible local entity is delegated authority to exercise their engineering judgment when utilizing the applicable design guidance and standards, including those for bicycle facilities established by Caltrans pursuant to the Streets and Highways Code Sections 890.6 and 890.8 and published in this manual. For further information on this delegation and the delegation process, see the Caltrans Local Assistance Procedures Manual, Chapter 11.

82.3 FHWA and AASHTO Standards and Policies

The standards in this manual generally conform to the standards and policies set forth in the AASHTO publications, "A Policy on Geometric Design of Highways and Streets" (2001) and "A Policy on Design Standards-Interstate System" (2005). A third AASHTO publication, the latest edition of the "Roadside Design Guide", focuses on creating safer roadsides. These three documents, along with other AASHTO and FHWA publications cited in 23 CFR Ch 1, Part 625, Appendix A, contain most of the current AASHTO policies and standards, and are approved references to be used in conjunction with this manual.

AASHTO policies and standards, which are established as nationwide standards, do not always satisfy California conditions. When standards differ, the instructions in this manual govern, except when necessary for FHWA project approval (Index 108.3, Coordination with the FHWA).

The use of publications and manuals that are developed by organizations other than the FHWA and AASHTO can also provide additional guidance not covered in this manual. The use of such guidance coupled with sound engineering judgment is to be exercised in collaboration with the guidance in this manual.

82.4 Mandatory Procedural Requirements

Required procedures and policies for which Caltrans is responsible, relating to project clearances, permits, licenses, required tests, documentation, value engineering, etc., are indicated by use of the word "must". Procedures and actions to be performed by others (subject to notification by Caltrans), or statements of fact are indicated by the word "will".

82.5 Effective Date for Implementing Revisions to Design Standards

Revisions to design standards will be issued with a stated effective date. It is understood that all projects will be designed to current standards unless an exception has been approved in accordance with Index 82.2.

On projects where the project development process has started, the following conditions on the effective date of the new or revised standards will be applied:

- For all projects where the PS&E has not been finalized, the new or revised design standards shall be incorporated unless this would impose a significant delay in the project schedule or a significant increase in the project engineering or construction costs. The Design Coordinator or individual delegated authority must make the final determination on whether to apply the new or previous design standards on a project-by-project basis for roadway features.
- For all projects where the PS&E has been submitted to Headquarters Office Engineer for advertising or the project is under construction, the new or revised standards will be incorporated only if they are identified in the Change Transmittal as requiring special implementation.

For locally-sponsored projects, the Oversight Engineer must inform the funding sponsor within 15 working days of the effective date of any changes in mandatory or advisory design standards as defined in Index 82.2.

82.6 Design Information Bulletins and Other Caltrans Publications

In addition to the design standards in this manual, Design Information Bulletins (DIBs) establish policies and procedures for the various design specialties of the Department that are in the Division of Design. Some DIBs may eventually become part of this manual, while others are written with the intention to remain as design guidance in the DIB format. References to DIBs are made in this manual by the “base” DIB number only and considered to be the latest version available on the Department Design website. See the Department Design website for further information concerning DIB numbering protocol and postings.

Caution must be exercised when using other Caltrans publications, which provide guidelines for the design of highway facilities, such as HOV lanes. These publications do not contain design standards; moreover, the designs suggested in these publications do not always meet Highway Design Manual Standards. Therefore, all other Caltrans publications must be used in conjunction with this manual.

82.7 Traffic Engineering

The Division of Traffic Operations maintains engineering policy, standards, practices and study warrants to direct and guide decision-making on a broad range of design and traffic engineering features and systems, which are provided to meet the site-specific safety and mobility needs of all highway users.

The infrastructure within a highway or freeway corridor, segment, intersection or interchange is not “complete” for drivers, bicyclists and pedestrians unless it includes the appropriate traffic control devices; traffic safety systems; operational features or strategies; and traffic management elements and or systems. The presence or absence of these traffic elements and systems can have a profound effect on safety and operational performance. As such, they are commonly employed to remediate performance deficiencies and to optimize the overall performance of the “built” highway system.

For additional information visit the Division of Traffic Operations website at <http://www.dot.ca.gov/hq/trafficops/>

**Table 82.1A
Mandatory Standards**

CHAPTER 100	BASIC DESIGN POLICIES	Topic 208	Bridges, Grade Separation Structures, and Structure Approach Embankment
Topic 101	Design Speed	Index 208.1	Bridge Width
Index 101.1	Technical Reductions of Design Speed	208.4	Bridge Sidewalk (Width)
101.1	Selection of Design Speed - Local Facilities ⁽²⁾	208.10	Barriers on Structures with Sidewalks
101.1	Selection of Design Speed - Local Facilities - with Connections to State Facilities	208.10	Bridge Approach Railings ⁽¹⁾
101.2	Design Speed Standards		
Topic 104	Control of Access	CHAPTER 300	GEOMETRIC CROSS SECTION
Index 104.4	Protection of Access Rights ⁽¹⁾	Topic 301	Traveled Way Standards
CHAPTER 200	GEOMETRIC DESIGN AND STRUCTURE STANDARDS	Index 301.1	Lane Width
Topic 201	Sight Distance	301.2	Class II Bikeway Lane Width ⁽¹⁾
Index 201.1	Stopping Sight Distance Standards	301.3	Cross Slopes – New Construction
Topic 202	Superelevation	301.3	Cross Slopes – Resurfacing or widening
Index 202.2	Standards for Superelevation	301.3	Cross Slopes – Unpaved Roadway
202.7	Superelevation on City Streets and County Roads ⁽²⁾	301.3	Algebraic Differences in Cross Slopes
Topic 203	Horizontal Alignment	Topic 302	Shoulder Standards
Index 203.1	Horizontal Alignment - Local Facilities ⁽²⁾	Index 302.1	Shoulder Width
203.1	Horizontal Alignment and Stopping Sight Distance	302.1	Shoulder Width with Rumble Strip
203.2	Standards for Curvature – Minimum Radius	302.2	Shoulder Cross Slopes -Bridge
203.2	Standards for Curvature – Lateral Clearance	302.2	Shoulder Cross Slopes – Left
		302.2	Shoulder Cross Slopes – Paved Median
		302.2	Shoulder Cross Slopes - Right
Topic 204	Grade	Topic 305	Median Standards
Index 204.1	Standards for Grade - Local Facilities ⁽²⁾	Index 305.1	Median Width – Conventional Highways ⁽¹⁾
204.3	Standards for Grade ⁽²⁾		
204.8	Vertical Falsework Clearances ⁽¹⁾		
Topic 205	Road Connections and Driveways		
Index 205.1	Sight Distance Requirements for Access Openings on Expressways		

(1) Caltrans-only Mandatory Standard.

(2) Authority to approve deviations from this Mandatory Standard is delegated to the District Director.

(3) Authority to approve deviations from this Mandatory Standard is delegated to the State Pavement Engineer.

**Table 82.1A
Mandatory Standards (Cont.)**

	305.1	Median Width – Freeways and Expressways ⁽¹⁾		309.5	Structures Across or Adjacent to Railroads - Vertical Clearance
Topic 307		Cross Sections for State Highways	Topic 310		Frontage Roads
Index	307.2	Shoulder Standards for Two-lane Cross Sections for New Construction	Index	310.1	Frontage Road Width Cross Section ^{(1), (2)}
Topic 308		Cross Sections for Roads Under Other Jurisdictions	CHAPTER 400		INTERSECTIONS AT GRADE
Index	308.1	Cross Section Standards for City Streets and County Roads without Connection to State Facilities ⁽²⁾	Topic 404		Design Vehicles
	308.1	Minimum Width of 2-lane Overcrossing Structures for City Streets and County Roads without Connection to State Facilities ^{(1), (2)}	Index	404.2	Design Vehicle–Traveled Way ⁽¹⁾
	308.1	Cross Section Standards for City Streets and County Roads with Connection to State Facilities ^{(1), (2)}	404.4		California Legal Design Vehicles on the National Network and on Terminal Access Routes ⁽¹⁾
	308.1	Two-Lane Local Road Lane Width for City Streets and County Roads within Interchange ⁽²⁾	Topic 405		Intersection Design Standards
	308.1	Multi-Lane Local Road Lane Width for City Streets and County Roads within Interchange ⁽²⁾	Index	405.1	Corner Sight Distance – Driver Set Back
	308.1	Shoulder Width Standards for City Streets and County Roads Lateral Obstructions ⁽²⁾		405.1	Corner Sight Distance at Public Road Intersections
	308.1	Shoulder Width Standards for City Streets and County Roads with Curbs and Gutter ⁽²⁾		405.1	Corner Sight Distance at Private Road Intersections
	308.1	Minimum Width for 2-lane Overcrossing at Interchanges ⁽²⁾		405.2	Left-turn Channelization - Lane Width
Topic 309		Clearances		405.2	Left-turn Channelization - Lane Width – Restricted Urban
Index	309.1	Horizontal Clearances and Stopping Sight Distance		405.2	Two-way Left-turn Lane Width
	309.1	Horizontal Clearances		405.3	Right-turn Channelization – Lane and Shoulder Width
	309.2	Vertical Clearances - Major Structures	CHAPTER 500		TRAFFIC INTERCHANGES
	309.2	Vertical Clearances - Minor Structures	Topic 501		General
	309.2	Vertical Clearances - Rural and Single Interstate Routing System	Index	501.3	Interchange Spacing ⁽¹⁾
	309.3	Horizontal Tunnel Clearances	Topic 502		Interchange Types
	309.3	Vertical Tunnel Clearances	Index	502.2	Isolated Off-Ramps and Partial Interchanges ⁽¹⁾
	309.4	Lateral Clearance for Elevated Structures ⁽¹⁾		502.3	Route Continuity ⁽¹⁾

- (1) Caltrans-only Mandatory Standard.
- (2) Authority to approve deviations from this Mandatory Standard is delegated to the District Director.
- (3) Authority to approve deviations from this Mandatory Standard is delegated to the State Pavement Engineer.

**Table 82.1A
Mandatory Standards (Cont.)**

Topic 504	Interchange Design Standards
Index 504.2	Location of Freeway Entrances & Exits ⁽¹⁾
504.2	Ramp Deceleration Lane and “DL” Distance ⁽¹⁾
504.3	Ramp Lane Width
504.3	Ramp Shoulder Width
504.3	Ramp Lane Drop Taper Past the Limit Line ⁽¹⁾
504.3	Metered Multi-Lane Ramp Lane Drop Taper Past the Limit Line ⁽¹⁾
504.3	Ramp Meters on Connector Ramps ⁽¹⁾
504.3	Lane Drop Transitions on Connector Ramps ⁽¹⁾
504.3	Distance Between Ramp Intersection and Local Road Intersection ⁽¹⁾
504.4	Freeway-to-freeway Connections – Shoulder Width – 1 and 2-Lane
504.4	Freeway-to-freeway Connections – Shoulder Width – 3-Lane
504.7	Minimum Weave Length ⁽¹⁾
504.8	Access Control along Ramps ⁽¹⁾
504.8	Access Control at Ramp Terminal ⁽¹⁾
504.8	Access Rights Opposite Ramp Terminals ⁽¹⁾

CHAPTER 610 PAVEMENT ENGINEERING CONSIDERATIONS

Topic 612	Pavement Design Life
Index 612.2	Design Life for New Construction and Reconstruction ^{(1), (3)}
612.3	Pavement Design Life for Widening Projects ^{(1), (3)}
612.5	Pavement Design Life for Pavement Roadway Rehabilitation Projects ^{(1), (3)}

Topic 613	Traffic Considerations
Index 613.5	Shoulder Traffic Loading Considerations ^{(1), (3)}

CHAPTER 620 RIGID PAVEMENT	
Topic 622 Engineering Requirements	
Index 622.4	Dowel Bars and Tie Bars for New or Reconstructed Rigid Pavements ^{(1), (3)}
Index 622.8	Transitions and Terminal Anchors for CRCP ^{(1), (3)}

Topic 625 Engineering Procedures for Pavement and Roadway Rehabilitation

Index 625.1	Limits of Paving on Resurfacing Projects ^{(1), (3)}
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Topic 626 Other Considerations

Index 626.2	Tied Rigid Shoulder Standards ^{(1), (3)}
626.2	Tied Rigid Shoulders or Widened Slab Standards ^{(1), (3)}
626.2	Tied Rigid Shoulders or Widened Slab at Ramps and Gore Standard ^{(1), (3)}

CHAPTER 630 FLEXIBLE PAVEMENT

Topic 633 Engineering Procedures for New & Reconstruction Projects

Index 633.1	Enhancements for Pavement Design Life Greater Than 20 Years ^{(1), (3)}
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Topic 635 Engineering Procedures for Flexible Pavement and Roadway Rehabilitation

Index 635.1	Limits of Paving on Resurfacing Projects ^{(1), (3)}
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CHAPTER 640 COMPOSITE PAVEMENTS

Topic 645 Engineering Procedures for Pavement and Roadway Rehabilitation

Index 645.1	Limits of Paving on Overlay Projects ^{(1), (3)}
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- (1) Caltrans-only Mandatory Standard.
- (2) Authority to approve deviations from this Mandatory Standard is delegated to the District Director.
- (3) Authority to approve deviations from this Mandatory Standard is delegated to the State Pavement Engineer.

**Table 82.1A
Mandatory Standards (Cont.)**

CHAPTER 700	MISCELLANEOUS STANDARDS	1003.1	Physical Barriers Adjacent to Class I Bikeways ^{(1), (2)}
Topic 701	Fences	1003.1	Class I Bikeway in Freeway Medians ^{(1), (2)}
Index 701.2	Fences on Freeways and Expressways ⁽¹⁾	1003.1	Class I Bikeway Design Speeds ^{(1), (2)}
CHAPTER 900	LANDSCAPE ARCHITECTURE	1003.1	Stopping Sight Distance ⁽²⁾
Topic 902	Planting Guidelines	1003.1	Obstacle Posts or Bollards in Bicycle Paths ⁽²⁾
Index 902.3	Trees In Conventional Highway Medians, Distance From Longitudinal End of Median ⁽¹⁾	CHAPTER 1100	HIGHWAY TRAFFIC NOISE ABATEMENT
902.3	The Planting of Trees in Conventional Highway Medians, Less Than 35 mph Posted Speeds ⁽¹⁾	Topic 1102	Design Criteria
902.3	The Planting of Trees in Conventional Highway Medians, 45 mph or Less Posted Speeds ⁽¹⁾	Index 1102.2	Horizontal Clearance to Noise Barrier
902.3	The Planting of Trees in Conventional Highway Medians, Greater Than 45 mph Posted Speeds ⁽¹⁾	1102.2	Noise Barrier on Safety Shape Concrete Barrier ⁽¹⁾
Topic 903	Safety Roadside Rest Area Design Standards and Guidelines		
Index 903.5	Rest Area Ramp Design		
Topic 904	Vista Point Standards and Guidelines		
Index 904.3	Vista Point Ramp Design		
CHAPTER 1000	BICYCLE TRANSPORTATION DESIGN		
Topic 1003	Design Criteria		
Index 1003.1	Class I Bikeway Widths ^{(1), (2)}		
1003.1	Class I Bikeway Shoulder Width ^{(1), (2)}		
1003.1	Class I Bikeway Horizontal Clearance ^{(1), (2)}		
1003.1	Class I Bikeway Structure Width ^{(1), (2)}		
1003.1	Class I Bikeway Vertical Clearance ^{(1), (2)}		
1003.1	Class I Bikeway Minimum Separation From Edge of Traveled Way ^{(1), (2)}		

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| <p>(1) Caltrans-only Mandatory Standard.</p> <p>(2) Authority to approve deviations from this Mandatory Standard is delegated to the District Director.</p> <p>(3) Authority to approve deviations from this Mandatory Standard is delegated to the State Pavement Engineer.</p> |
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**Table 82.1B
Advisory Standards**

CHAPTER 100	BASIC DESIGN POLICIES	202.7	Superelevation on City Streets and County Roads
Topic 101	Design Speed	Topic 203	Horizontal Alignment
Index 101.1	Selection of Design Speed – Local Facilities	Index 203.1	Horizontal Alignment – Local Facilities
101.1	Selection of Design Speed – Local Facilities – with Connections to State Facilities	203.3	Alignment Consistency and Design Speed
101.2	Design Speed Standards	203.5	Compound Curves
Topic 104	Control of Access	203.5	Compound Curves on One-Way Roads
Index 104.5	Relation of Access Opening to Median Opening	203.6	Reversing Curves – Transition Length
Topic 105	Pedestrian Facilities	203.6	Reversing Curves – Transition Rate
Index 105.2	Minimum Sidewalk Width – Next to a Building	Topic 204	Grade
105.2	Minimum Sidewalk Width – Not Next to a Building	Index 204.1	Standards for Grade – Local Facilities
105.5	New Construction, Two Curb Ramp Design	204.3	Standards for Grade
Topic 107	Roadside Installations	204.3	Ramp Grades
Index 107.1	Standards for Roadway Connections	204.4	Vertical Curves – 2 Percent and Greater
107.1	Number of Exits and Entrances Allowed at Roadway Connections	204.4	Vertical Curves – Less Than 2 Percent
CHAPTER 200	GEOMETRIC DESIGN AND STRUCTURE STANDARDS	204.5	Decision Sight Distance at Climbing Lane Drops
Topic 201	Sight Distance	204.6	Horizontal and Vertical Curves Consistency in Mountainous or Rolling Terrain
Index 201.3	Stopping Sight Distance on Sustained Grades	Topic 205	Road Connections and Driveways
201.7	Decision Sight Distance	Index 205.1	Access Opening Spacing on Expressways
Topic 202	Superelevation	205.1	Access Opening Spacing on Expressways – Location
Index 202.2	Superelevation on Same Plane for Rural Two-lane Roads	Topic 206	Pavement Transitions
202.2	Superelevation on Class II and III Bikeways	Index 206.3	Lane Drop Transitions
202.5	Superelevation Transition	206.3	Lane Width Reductions
202.5	Superelevation Runoff	Topic 208	Bridges, Grade Separation Structures, and Structure Approach Embankment
202.5	Superelevation in Restrictive Situations	Index 208.3	Decking of Bridge Medians
202.6	Superelevation of Compound Curves	208.6	Minimum Height of Pedestrian Undercrossings
		208.6	Class I Bikeways Exclusive Use

**Table 82.1B
Advisory Standards (Cont.)**

208.10	Protective Screening on Overcrossings	309.5	Structures Across or Adjacent to Railroads – Vertical Clearance
208.10	Bicycle Railing Locations	Topic 310	Frontage Roads
Topic 210	Earth Retaining Systems	Index 310.2	Outer Separation – Urban and Mountainous Areas
Index 210.6	Cable Railing	310.2	Outer Separation – Rural Areas
CHAPTER 300	GEOMETRIC CROSS SECTION	CHAPTER 400	INTERSECTIONS AT GRADE
Topic 301	Traveled Way Standards	Topic 403	Principles of Channelization
Index 301.2	Class II Bikeway Lane Width	Index 403.3	Angle of Intersection
301.3	Algebraic Differences of Cross Slopes at Various Locations	403.6	Optional Right-Turn Lanes
Topic 303	Curbs, Dikes, and Side Gutters	403.6	Right-Turn-Only Lane and Bike Lane
303.1	Use of Curb with Posted Speeds of 40 mph and Greater	Topic 404	Design Vehicles and Related Definitions
303.3	Dike Selection	Index 404.4	STAA Design Vehicles on the National Network and on Terminal Access Routes
303.4	Bulbout Design	404.4	California Legal Design Vehicle Accommodation
303.4	Bulbouts at Mid-block locations	404.4	45-Foot Bus and Motorhome Design Vehicle
303.4	Curb Face Setback at Bulbouts	Topic 405	Intersection Design Standards
Topic 304	Side Slopes	Index 405.1	Corner Sight Distance at Unsignalized Public Road Intersections
Index 304.1	Side Slopes 4:1 or Flatter	405.1	Decision Sight Distance at Intersections
304.1	18 ft Minimum Catch Distance	405.4	Traffic Island Pedestrian Refuge
Topic 305	Median Standards	405.5	Emergency Openings and Sight Distance
Index 305.1	Median Pedestrian Refuge Island	405.5	Median Opening Locations
305.1	Median Width Freeways and Expressways	405.10	Entry Speeds – Single and Multilane Roundabouts
305.1	Median With Conventional Highways	CHAPTER 500	TRAFFIC INTERCHANGES
305.2	Median Cross Slopes	Topic 504	Interchange Design Standards
Topic 308	Cross Sections for Roads Under Other Jurisdictions	Index 504.2	Ramp Entrance and Exit Standards
Index 308.1	Cross Section Standards for City Streets and County Roads without Connection to State Facilities	504.2	Collector-Distributor Deceleration Lane and “DL” Distance
Topic 309	Clearances	504.2	Paved Width at Gore
Index 309.1	Clear Recovery Zone	504.2	Contrasting Surface Treatment
309.1	Horizontal Clearance		
309.1	Safety Shaped Barriers at Retaining, Pier, or Abutment Walls		
309.1	High Speed Rail Clearance		

Table 82.1B
Advisory Standards (Cont.)

504.2	Auxiliary Lanes	504.3	Distance Between Successive Exits
504.2	Freeway Exit Nose Design Speed	504.4	Freeway-to-freeway Connections Design Speed
504.2	Decision Sight Distance at Exits and Branch Connections	504.4	Profile Grades on Freeway-to-freeway Connectors
504.2	Design Speed and Alignment Consistency at Inlet Nose	504.4	Single-lane Freeway-to-freeway Connector Design
504.2	Freeway Ramp Profile Grades	504.4	Single-lane Connector Widening for Passing
504.2	Differences in Pavement Cross Slopes at Freeway Entrances and Exits	504.4	Volumes Requiring Branch Connectors
504.2	Vertical Curves Beyond Freeway Exit Nose	504.4	Merging Branch Connector Design
504.2	Crest Vertical Curves at Freeway Exit Terminal	504.4	Diverging Branch Connector Design
504.2	Sag Vertical Curves at Freeway Exit Terminal	504.4	Merging Branch Connector Auxiliary Lanes
504.2	Ascending Entrance Ramps with Sustained Upgrades	504.4	Diverging Branch Connector Auxiliary Lanes
504.3	Ramp Terminus Design Speed	504.4	Freeway-to-freeway Connector Lane Drop Taper
504.3	Ramp Lane Drop Taper At 6-foot Separation Point	504.5	Auxiliary Lanes
504.3	Ramp Lane Drop Location	504.6	Mainline Lane Reduction at Interchanges
504.3	Metered Single-Lane Entrance Ramps Truck Volumes and Grades	504.8	Access Control at Ramp Terminal
504.3	Metered Multi-Lane Entrance Ramps Lane Drop		
504.3	Metered Multi-Lane Entrance Truck Volumes and Sustained Grades		
504.3	Ramp Terminals and Grade		
504.3	Ramp Terminals and Sight Distance		
504.3	Free Right-Turns at Ramp Terminals		
504.3	Distance between Ramp Intersection and Local Road Intersection		
504.3	Entrance Ramp Lane Drop		
504.3	Single-Lane Ramp Widening for Passing		
504.3	Two-lane Exit Ramps		
504.3	Two-lane Exit Ramps and Auxiliary Lanes		
504.3	Distance Between Successive On-ramps		

<p>CHAPTER 610</p> <p>Topic 612</p> <p>Index 612.6</p>	<p>PAVEMENT ENGINEERING CONSIDERATIONS</p> <p>Pavement Design Life</p> <p>Traffic Loading for Temporary Pavements and Detours</p>
<p>CHAPTER 620</p> <p>Topic 625</p> <p>Index 625.1</p>	<p>RIGID PAVEMENT</p> <p>Engineering Procedures for Pavement and Roadway Rehabilitation</p> <p>Repair of Existing Pavement Distresses</p>
<p>CHAPTER 630</p> <p>Topic 635</p> <p>Index 635.1</p>	<p>FLEXIBLE PAVEMENT</p> <p>Engineering Procedures for Flexible Pavement and Roadway Rehabilitation</p> <p>Repair of Existing Pavement Distresses</p>

Table 82.1B Advisory Standards (Cont.)

CHAPTER 640	COMPOSITE PAVEMENTS
Topic 645	Engineering Procedures for Pavement and Roadway Rehabilitation
Index 645.1	Repair of Existing Pavement Distresses
CHAPTER 700	MISCELLANEOUS STANDARDS
Topic 701	Fences
Index 701.2	Fences on Freeways and Expressways
CHAPTER 900	LANDSCAPE ARCHITECTURE
Topic 902	Planting Guidelines
Index 902.1	Planting on Freeway Medians
902.2	Sight Distance to Mature Planting
902.2	Clear Recovery Zone to Mature Planting
902.2	Minimum Setback of Trees
902.3	The Planting of Trees On Conventional Highway Roadsides, Various Posted Speeds and Conditions
Topic 904	Vista Point Standards and Guidelines
Index 904.3	Road Connections to Vista Points
CHAPTER 1000	BICYCLE TRANSPORTATION DESIGN
Topic 1003	Bikeway Design Criteria
Index 1003.1	Class I Bikeway Horizontal Clearance
1003.1	Class I Bikeway in State Highway or Local Road Medians

Table 82.1C
Decision Requiring Other Approvals

CHAPTER 100	BASIC DESIGN POLICIES	Topic 208.10	Bridge Barriers and Railing
		Index 208.10	Barrier Separation and Bridge Rail Selection
Topic 103	Design Designation	208.10	Concrete Barrier Type 80
Index 103.2	Design Period	208.10	Concrete Barrier Type 80SW
Topic 108	Coordination With Other Agencies	208.11	Deviations from Foundation and Embankment Recommendations
Index 108.2	Transit Loading Facilities – Location	210.4	Cost Reduction Incentive Proposals
108.2	Transit Loading Facilities - ADA		
108.3	Rail Crossings*		
108.3	Parallel Rail Facilities*		
108.5	Bus Rapid Transit – Location and ADA		
108.7	Coordination With the FHWA - Approvals		
Topic 110	Special Considerations		
Index 110.1	Overload Category		
110.8	Safety Review Items and Employee Exposure		
110.10	Proprietary Items		
110.10	Proprietary Items – On Structure		
110.10	Proprietary Items – National Highway System		
Topic 111	Material Sites and Disposal Sites		
Index 111.1	Mandatory Material Sites on Federal-aid Projects		
111.6	Mandatory Material Sites and Disposal Sites on Federal-aid Projects		
Topic 116	Bicyclists and Pedestrians on Freeway		
Index 116	Bicycles and Pedestrians on Freeways		
CHAPTER 200	GEOMETRIC DESIGN AND STRUCTURE STANDARDS	CHAPTER 300	GEOMETRIC CROSS SECTION
Topic 204	Grade	Topic 303	Curbs, Dikes, and Side Gutters
Index 204.8	Grade Line of Structures – Temporary Vertical Clearances	Index 303.4	Busbulbs
Topic 205	Road Connections and Driveways	Topic 304	Side Slopes
Index 205.1	Conversion of a Private Opening	Index 304.1	Side Slopes – Erosion Control
		304.1	Side Slopes – Structural Integrity
		309.2	Vertical Clearance on National Highway System
		309.2	Vertical Clearance Above Railroad Facilities
		309.5	Horizontal and Vertical Clearances at Railroad Structures
		CHAPTER 500	TRAFFIC INTERCHANGES
		Topic 502	Interchange Types
		Index 502.2	Single Point Interchange Interchanges
		502.2	Other Types of Interchanges
		Topic 503	Interchange Procedure
		Index 503.2	Interchange Geometrics
		Topic 504	Interchange Design Standards
		Index 504.3	HOV Preferential Lane
		504.3	Modification to Existing HOV Preferential Lanes
		504.3	Enforcement Areas and Maintenance Pullouts – Required Enforcement Area
		504.3	Enforcement Areas and Maintenance Pullouts – Removal

* Authority to approve deviations from this “Decision Requirement” is delegated to the District Director.

Table 82.1C
Decision Requiring Other Approvals (Cont.)

504.3	Enforcement Areas and Maintenance Pullouts - Length	CHAPTER 800	HIGHWAY DRAINAGE DESIGN
504.6	Mainline Lane Reduction	Topic 805	Preliminary Plans
CHAPTER 600	PAVEMENT ENGINEERING	Index 805.1	Requires FHWA Approval
Topic 604	Roles and Responsibilities for Pavement Engineering	805.2	Bridge Preliminary Report
Index 604.2	Standard Plans	805.4	Unusual Hydraulic Structures
604.2	Supplemental District Standards	805.5	Levees and Dams Formed by Highway Fills
Topic 606	Research and Special Designs	805.6	Geotechnical
Index 606.1	Research and Experimentation – Pilot Projects	Topic 808	Selected Computer Programs
606.1	Research and Experimentation – Special Designs	Index 808.1	Table 808.1
CHAPTER 610	PAVEMENT ENGINEERING CONSIDERATIONS	CHAPTER 820	CROSS DRAINAGE
Topic 614	Other Considerations	Topic 829	Other Considerations
Index 614.6	Compaction	Index 829.9	Dams
CHAPTER 620	RIGID PAVEMENT	CHAPTER 830	TRANSPORTATION FACILITY DRAINAGE
Topic 626	Other Considerations	Topic 837	Inlet Design
Index 626.2	Shoulder – Widened Slab	Index 837.2	Inlet Types
CHAPTER 700	MISCELLANEOUS STANDARDS	CHAPTER 850	PHYSICAL STANDARDS
Topic 701	Fences	Topic 853	Pipe Liners and Linings for Culvert Rehabilitation
Index 701.1	Fence Type and Location	Index 853.4	Alternative Pipe Liner Materials
701.2	Locked Gates - Maintenance Force Use	CHAPTER 870	CHANNEL AND SHORE PROTECTION – EROSION CONTROL
701.2	Locked Gates - Used by Utility Companies*	Topic 872	Planning and Location Studies
701.2	Locked Gates - Used by Other Public Agencies or by Non-Utility Entities – FHWA Approval Required on Interstates	Index 872.3	Site Consideration
Topic 706	Roadside Treatment	Topic 873	Design Concepts
Index 706.2	Vegetation Control	Index 873.1	Introduction
		873.3	Armor Protection
		CHAPTER 900	LANDSCAPE ARCHITECTURE
		Topic 901	General
		Index 901.1	Landscape Architecture Program - Approvals

* Authority to approve deviations from this “Decision Requirement” is delegated to the District Director.

Table 82.1C Decision Requiring Other Approvals (Cont.)

Topic 902	Planting Guidelines
Index 902.3	Median Planting
902.3	Tree Species in Conventional Highway Median
902.3	Planting of Large Trees in Medians
902.3	Planting on Barriers
Topic 903	Safety Roadside Rest Areas Standards and Guidelines
Index 903.1	Deviation From Minimum Standard
903.6	Wastewater Disposal
Topic 904	Vista Point Standards and Guidelines
Index 904.1	Site Selection
904.3	Sanitary Facilities
Topic 905	Park and Ride Standards and Guidelines
Index 905.1	Site Selection
CHAPTER 1000	BICYCLE TRANSPORTATION DESIGN
Topic 1003	Miscellaneous Criteria
Index 1003.5	Bicycle Path at Railroad Crossings
CHAPTER 1100	HIGHWAY TRAFFIC NOISE ABATEMENT
Topic 1101	General Requirements
Index 1101.2	Objective – Extraordinary Abatement

* Authority to approve deviations from this “Decision Requirement” is delegated to the District Director.

CHAPTER 100 BASIC DESIGN POLICIES

Topic 101 - Design Speed

Index 101.1 - Highway Design Speed

- (1) *General.* Highway design speed is defined as: "a speed selected to establish specific minimum geometric design elements for a particular section of highway". These design elements include vertical and horizontal alignment, and sight distance. Other features such as widths of pavement and shoulders, horizontal clearances, etc., are generally not directly related to highway design speed.

A highway carrying a higher volume of traffic may justify a higher design speed than a lower classification facility in similar topography, particularly where the savings in user operation and other costs are sufficient to offset the increased cost of right of way and construction. A lower design speed, however, should not be assumed for a secondary road where the topography is such that drivers are likely to travel at higher speeds.

It is preferable that the design speed for any section of highway be a constant value. However, during the detailed design phase of a project, situations may arise in which engineering, economic, environmental, or other considerations make it impractical to provide the minimum elements for other design standards (e.g., curve radius, stopping sight distance, etc.) established by the design speed. See Topic 82 for documenting localized exceptions to features preventing the standard design speed.

The cost to correct such restrictions may not be justified. Technically, this will result in a reduction in the effective design speed at the location in question. **Such technical reductions in design speed shall be discussed with and documented as required by the Design Coordinator.**

Where a reason for limiting speed is obvious to approaching drivers or bicyclists, these users are more apt to accept a lower operating

speed than where there is no apparent reason for it.

- (2) *Selection.* Selecting the design speed for a highway is part of the Project Development Team process. See the Project Development Procedures Manual for additional guidance.

- (a) Considerations--The chosen design speed, for a highway segment or project, needs to take into consideration the following:

- The selected design speed should be consistent with the operating speeds that are likely to be expected on a given highway facility. Drivers and bicyclists adjust their speed based on their perception of the physical limitations of the highway and its vehicular and bicycle traffic. In addition, bicycling and walking can be encouraged when bicyclists and pedestrians perceive an increase in safety due to lower vehicular speeds.
- In California the majority of State highway projects modify existing facilities. When modifying existing facilities, the design speed selected should reflect the observed motor vehicle speed (operating speed) or the anticipated operating speed upon completion of modifications. Generally the posted speed is a reliable indicator of operating speed although operating speeds frequently exceed posted speeds. Speed limits and speed zones are discussed in Chapter 2 of the California MUTCD, which include references to the California Vehicle Code.

For existing limited access highways and conventional highways in rural areas other than Main Streets, the selected design speed for these higher-speed facilities typically is 15 to 20 mph higher than the observed motor vehicle speed (operating speed).

For existing lower-speed conventional highways in urban areas and rural

highways that are Main Streets with observed or proposed operating speeds of 45 mph or less, the design speed should be selected to be consistent with the highway context which may discourage high-speed operating behavior. Select a design speed that is logical with respect to topography, operating speed (or anticipated operating speed if the corridor is being redesigned and the physical characteristics of the highway are being changed), adjacent land use, design volumes for all users, collision history, access control, and facility type.

- On projects where posted speeds or observational data is not available, the choice of design speed is influenced principally by whether the area is rural or urban, the character of terrain, economic considerations, environmental factors, type and anticipated volume of vehicular traffic, presence of non-motorized traffic, functional classification of the highway, existing and planned adjacent land use. A highway in level or rolling terrain justifies a higher design speed than one in mountainous terrain. As discussed under Topic 109, scenic values are also a consideration in the selection of a design speed.

(b) Freeways and Expressways--In addition to the considerations above, as high a design speed as feasible should be selected for use on freeways and expressways, which are higher-speed facilities.

(c) Conventional Highways

- (1) *State Highways.* In addition to the considerations above, the existing and planned highway context in terms of area place type, land use, types of users, etc. influence the selection of the appropriate design speed and should be taken into

account by the Project Development Team.

Consideration should also be given to Local Agency standards and transportation plans for the facility when selecting the design speed.

- (2) *Local Streets or Roads.* **Local streets or roads within the State right of way, including facilities which will be relinquished after construction (such as frontage roads), shall have minimum design speeds conforming to AASHTO standards, as per the functional classification of the facility in question. If the local agency having jurisdiction over the facility in question maintains design standards that exceed AASHTO standards, then the local agency standards should apply.**

Where the local facility connects to a freeway or expressway (such as ramp terminal intersections), the design speed of the local facility shall be a minimum of 35 miles per hour. However, the design speed should be 45 miles per hour when feasible.

Every effort should be made to avoid decreasing the design speed of a local facility through the State's right of way, and all due consideration should be given to local plans to upgrade or improve the facility in the near future.

101.2 Highway Design Speed Standards

Table 101.2 shows appropriate ranges of design speeds that shall be used for the various types of facilities, place types, and conditions listed. For additional guidance, see Index 101.1(2).

**Table 101.2
Vehicular Design Speed**

Facility Type	Design Speed (mph)
LIMITED ACCESS HIGHWAYS	
Freeways and expressways in mountainous terrain	50-80
Freeways in urban areas	55-80
Freeways and expressways in rural areas	70-80
Expressways in urban areas	50-70
CONVENTIONAL HIGHWAYS (2)	
Rural	
Flat terrain	55-70
Rolling terrain	50-60
Mountainous terrain	40-50
Main Streets – Cities, Towns, and Community Centers	30-40
Urban	
Arterials - Throughways	40-60
Arterials - Main Streets and Regional/Community Centers	30-40
Downtowns and City Centers	30
LOCAL FACILITIES (Within State right of way)	
Facilities crossing a freeway or expressway, connecting to a conventional highway or traversing a State facility	AASHTO (1)
Facilities connecting to a freeway or expressway	35 ^M /45 ^A
	M=Mandatory A=Advisory

- (1) If outside of State right of way and no specific local standards apply, the minimum design speed shall be 30 miles per hour.
- (2) For conventional highways eligible or designated as State scenic highways, see Index 109.2

Topic 102 - Design Capacity & Level of Service

102.1 Design Capacity (Automobiles)

Design capacity (automobiles) is the maximum volume of vehicle traffic for which a projected highway can provide a selected level of service. Design capacity varies with a number of factors, including:

- (a) Level of service selected.
- (b) Width of lanes.
- (c) Number of lanes.
- (d) Presence or absence of shoulders.
- (e) Grades.
- (f) Horizontal alignment.
- (g) Operating speed.
- (h) Lateral clearance.
- (i) Side friction generated by parking, drive ways, intersections, and interchanges.
- (j) Volumes of trucks, transit, recreational vehicles, bicycles and pedestrians.
- (k) Spacing and timing of traffic signals, and the required timing to accommodate pedestrian crossing

Level of Service (LOS) is largely related to speed and density among many variables. Freeways should be designed to accommodate the design year peak hour traffic volumes and to operate at a LOS determined by District Planning and/or Traffic Operations. For a rough approximation of the number of lanes required on a multilane freeway, use the following design year peak hour traffic volumes per lane at the specified LOS:

	Level of Service	Design Year Peak Hour of Vehicle Traffic Volume (Average Automobiles Per Lane Per Hour)
Urban	C-E	1400-2400
Rural	C-D	1000-1850

For conventional highways and expressways, District Planning and Traffic Operations should be consulted.

Automobile traffic volumes can be adjusted for the effect of grades and the mix of automobiles, trucks, and recreational vehicles if a more refined calculation is desired. In those cases, consult the "Highway Capacity Manual", published by the Transportation Research Board.

102.2 Design Capacity and Quality of Service (Pedestrians and Bicycles)

Sidewalks are to accommodate pedestrians at a Level of Service (LOS) equal to that of vehicles using the roadway, or better. More detailed guidance on design capacity for sidewalks is available in the "Highway Capacity Manual" (HCM), published by the Transportation Research Board. The HCM also has guidance regarding LOS for bicycle facilities for both on- and off-street applications. The LOS for on-street bicycle facilities should be equal to that of vehicles using the roadway or better. The design of off-street bicycle facilities can use the LOS methodology in the HCM when conditions justify deviations from the standards in Chapter 1000.

Topic 103 - Design Designation

103.1 Relation to Design

The design designation is a simple, concise expression of the basic factors controlling the design of a given highway. Following is an example of this expression:

$$\begin{aligned} \text{ADT (2015)} &= 9800 & D &= 60\% \\ \text{ADT (2035)} &= 20\,000 & T &= 12\% \\ \text{DHV} &= 3000 & V &= 70 \text{ mph} \\ \text{ESAL} &= 4\,500\,000 & \text{TI}_{20} &= 11.0 \end{aligned}$$

CLIMATE REGION = Desert

The notation above is explained as follows:

ADT (2015) -- The average daily traffic, in number of vehicles, for the construction year.

ADT (2035) -- The average daily traffic for the future year used as a target in design.

CLIMATE REGION -- Climate Region as defined in Topic 615. In addition to

establishing design requirements for the project, this information is used by the Resident Engineer during construction to determine which clauses in the Standard Specifications apply to the project.

DHV -- The two-way design hourly volume, vehicles.

D -- The percentage of the DHV in the direction of heavier flow.

ESAL -- The equivalent single axle loads forecasted for pavement engineering. See Topic 613.

T -- The truck traffic volume expressed as a percent of the DHV (excluding recreational vehicles).

TI_{20} -- Traffic Index used for pavement engineering. The number in the subscript is the pavement design life used for pavement design. See Index 613.3(3).

V -- Design speed in miles per hour.

Within a project, one design designation should be used except when:

- The design hourly traffic warrants a change in the number of lanes, or
- A change in conditions dictates a change in design speed.
- The design daily truck traffic warrants a change in the Traffic Index.

The design designation should be stated in Project Initiation Documents and Project Reports and should appear on the typical cross section for all new, reconstructed, or rehabilitation (including Capital Preventative Maintenance) highway construction projects.

103.2 Design Period

Geometric design of new facilities and reconstruction projects should normally be based on estimated traffic 20 years after completion of construction. With justification, design periods other than 20 years may be approved by the District Director with concurrence by the Design Coordinator.

Safety, Resurfacing, Restoration, and Rehabilitation (RRR), and operational improvement projects should be designed on the basis of current ADT.

Complimentary to the design period, various components of a project (e.g., drainage facilities, structures, pavement structure, etc.) have a design life that may differ from the design period. For pavement design life requirements, see Topic 612.

Topic 104 - Control of Access

104.1 General Policy

Control of access is achieved by acquiring rights of access to the highway from abutting property owners and by permitting ingress and egress only at locations determined by the State.

On freeways, direct access from private property to the highway is prohibited without exception. Abutting ownerships are served by frontage roads or streets connected to interchanges.

104.2 Access Openings

See Index 205.1 for the definition and criteria for location of access openings. The number of access openings on highways with access control should be held to a minimum. (Private property access openings on freeways are not allowed.) Parcels which have access to another public road or street as well as frontage on the expressway are not allowed access to the expressway. In some instances, parcels fronting only on the expressway may be given access to another public road or street by constructing suitable connections if such access can be provided at reasonable cost.

With the exception of extensive highway frontages, access openings to an expressway are limited to one opening per parcel. Wherever possible, one opening should serve two or more parcels. In the case of a large highway frontage under one ownership, the cost of limiting access to one opening may be prohibitive, or the property may be divided by a natural barrier such as a stream or ridge, making it necessary to provide an additional opening. In the latter case, it may be preferable to connect the physically separated portions with a low-cost structure or road rather than permit two openings.

104.3 Frontage Roads

(1) General Policy.

- (a) Purpose--Frontage roads are provided on freeways and expressways to:
- Control access to the through lanes, thus increasing safety for traffic.
 - Provide access to abutting land ownerships.
 - Provide or restore continuity of the local street or road systems.
 - Provide for bicycle and pedestrian traffic that might otherwise need to use the freeway.

(b) Economic Considerations--In general, a frontage road is justified on freeways and expressways if the costs of constructing the frontage road are less than the costs of providing access by other means. Right of way considerations often are a determining factor. Thus, a frontage road would be justified if the investment in construction and extra right of way is less than either the severance damages or the costs of acquiring the affected property in its entirety. Frontage roads may be required to connect parts of a severed property or to serve a landlocked parcel resulting from right of way acquisition.

(c) Access Openings--Direct access to the through lanes is allowable on expressways. When the number of access openings on one side of the expressway exceeds three in 1,600 feet, a frontage road should be provided (see Index 104.2).

(2) *New Alignment.* Frontage roads generally are not provided on freeways or expressways on new alignment since the abutting property owners never had legal right of access to the new facility. They may be provided, however, on the basis of considerations mentioned in (1) above.

(3) *Existing Alignment.* Where a freeway or expressway is developed parallel to an existing highway or local street, all or part of the existing roadway often is retained as a

frontage road. In such cases, if access to remainders of land on the side of the freeway or expressway right of way opposite the old road cannot be provided by other means, a frontage road must be constructed to serve the landlocked remainders or the remainders must be purchased outright. The decision whether to provide access or purchase should be based on considerations of cost, right of way impacts, street system continuity and similar factors (see (1) above).

- (4) *Railroad Crossings.* Frontage roads on one or both sides of a freeway or expressway on new alignment, owing to safety and cost considerations, frequently are terminated at the railroad right of way. When terminating a frontage road at the railroad crossing, bicycle and pedestrian traffic still needs to have reasonable access through the community.

Any new railroad grade crossings and grade separations, and any relocations or alterations of existing crossings must be cleared with the railroad and approved by the PUC.

- (5) *Frontage Roads Financed by Others.* Frontage roads which are not a State responsibility under this policy may be built by the State upon request of a local political subdivision, a private agency, or an individual. Such a project must be covered by an agreement under which the State is reimbursed for all construction, right of way, and engineering costs involved.

104.4 Protection of Access Rights

For proper control of acquired access rights, fencing or other approved barriers shall be installed on all controlled access highways except as provided in Index 701.2(3)(e).

104.5 Relation of Access Opening to a Median Opening

Access openings should not be placed within 300 feet of a median opening unless the access opening is directly opposite the median opening.

Details on access openings are given under Index 205.1.

104.6 Maintaining Local Community Access

When planning and designing a new freeway or expressway, the designer needs to consider the impacts of an access controlled facility on the local community. Closing non-expressway local road connections may negatively impact access for pedestrians, bicyclists and equestrians. A new facility may inadvertently sever local non-motorized access creating long out of direction travel. Designers need to coordinate with local agencies for access needs across an access controlled facility.

104.7 Cross References

- (a) Access Control at Intersections at Grade (see Index 405.6).
(b) Access Control at Interchanges (see Index 504.8).

Topic 105 - Pedestrian Facilities

105.1 General Policy

The California Vehicle Code Section 21949 has stated a policy for the Department to provide safe and convenient travel for pedestrians. Conventional highways can be used by pedestrians. Although the Department will work to provide safe and convenient pedestrian travel on these highways, not all of these highways will contain sidewalks and walkways. Connections between different modes of travel should be considered when designing highway facilities, as all people may become pedestrians when transferring to a transit based facility. Pedestrian use near transit facilities should be considered during the planning phase of transportation improvement projects. See DIB 82 for accessibility guidance of pedestrian facilities. See also Topics 115 and 116 for guidance regarding designing for bicycle traffic.

105.2 Sidewalks and Walkways

The design of sidewalks and walkways varies depending on the setting, standards, and requirements of local agencies. Sidewalks are desirable on conventional highways and on other areas of State highway right of way to serve pedestrians when warranted by sufficient population, density and development.

Coordination with the local agency that the State highway passes through is needed to determine the appropriate time to provide sidewalks.

Most local agencies in California have adopted varying design standards for urban and rural areas, as well as more specific requirements that are applicable to residential settings, downtowns, special districts, and other place types. These standards are typically tied to zoning requirements for land use established by local agencies. These land use decisions should take into account the ultimate need for public right of way, including the transportation needs of bicyclists and pedestrians. The minimum width of a sidewalk should be 8 feet between a curb and a building when in urban and rural main street place types. For all other locations the minimum width of sidewalk should be 6 feet when contiguous to a curb or 5 feet when separated by a planting strip. Sidewalk width does not include curbs. See Index 208.4 for bridge sidewalks. Using the minimum width may not be enough to satisfy the actual need if additional width is necessary to maintain an acceptable Level of Service (LOS) for pedestrians. Note that street furniture, buildings, utility poles, light fixtures and platoon generators, such as window displays and bus stops, can reduce the effective width of sidewalks and likewise the LOS of the walkway. Also, adequate width for curb ramps and driveways are other important accessibility considerations.

See Index 205.3(6) and the Standard Plans for sidewalk requirements at driveways.

See Index 208.6 for information on pedestrian overcrossings and undercrossings and Index 208.4 for sidewalks on bridges.

“A Policy on Geometric Design of Highways and Streets”, issued by AASHTO, and the “Highway Capacity Manual”, published by the Transportation Research Board contain pedestrian LOS criteria. These are means of measuring the ability of the existing pedestrian facilities to provide pedestrian mobility and to determine the need for improvements or expansions. If adequate capacity is not provided, pedestrian mobility may be seriously impeded.

Traffic volume-pedestrian warrants for sidewalks or other types of walkways along highways have not been established. In general, whenever the

roadside and land development conditions are such that pedestrians regularly move along a highway, those pedestrians should be furnished with a sidewalk or other walkway, as is suitable to the conditions. Sidewalks are typically within public right of way of the local agency or the State. When within the State highway right of way, the need for sidewalks becomes a shared interest, since the zoning, planned development, and growth are under the local agency’s purview. The State may assume financial responsibility for the construction of sidewalks and walkways under the conditions described below. See the Project Development Procedures Manual for further discussion of the State’s responsibility in providing pedestrian facilities.

- (1) *Replacement in Kind.* Where existing sidewalks are to be disturbed by highway construction, the replacement applies only to the frontages involved and no other sidewalk construction is authorized except:
 - (a) As part of a right of way agreement.
 - (b) Where the safety or capacity of the highway will be improved.
- (2) *Conventional Highways.* The roadway cross section usually provides areas for pedestrians. If the safety or capacity of the highway will be improved, the State may contribute towards the cost of building a pedestrian facility with a local agency project or fund it entirely with a State highway project. The city, county, or property owner whose adjacent development generated the pedestrian traffic may build sidewalks on State right of way under a permit in accordance with the route concept report.
- (3) *Freeway and other Controlled Access Facilities.* Sidewalks should be built across the freeway right of way on overcrossings and through undercrossings where necessary to connect with existing or planned sidewalks. Construction of planned sidewalks should be imminent. Within the foregoing criteria, sidewalks can be part of the original project or added later when the surrounding area develops.
- (4) *Overcrossing and Undercrossing Approaches.* Where sidewalks are planned on overcrossing

structures or under a structure, an area should be provided to accommodate future sidewalks.

- (5) *School Pedestrian Walkways.* School pedestrian walkways may be identified along a route used by school pedestrians that is not limited to crossing locations, but includes where physical conditions require students to walk in or along rural or suburban roadways.
- (6) *Frontage Roads.* Sidewalks may be built along frontage roads connecting local streets that would otherwise dead end at the freeways. Such sidewalks can be new or replacements of existing facilities. Sidewalks may not be needed on the freeway side of frontage roads except where connections must be made to pedestrian separations or other connections where appropriate.
- (7) *Separated Cross Streets.* Sidewalks may be built on separated cross streets where reconstruction of the cross street is made necessary by the freeway project and where the criteria of paragraph (3) above apply.
- (8) *Transit Stops.* Sidewalks should be built to connect transit stops to local streets.
- (9) *Vehicular Tunnels.* Sidewalks and pedestrian facilities may be built as part of vehicular tunnels which do not require ventilation as part of the tunnel structure. Contact the Division of Engineering Services - Structure Design (DES-SD), regarding allowable conditions.
- (10) *Maintenance.* The State is responsible for maintaining and replacing damaged sidewalks within the right of way except:
 - (a) Where the sidewalk was placed by a private party under encroachment permit that requires the permittee to maintain the sidewalk, but only if the original permittee still owns the abutting property.
 - (b) Where the city or county has placed nonstandard sidewalks with colored or textured surfaces, or meandering alignment. See Maintenance Manual for additional discussion on State's maintenance responsibilities regarding sidewalks.

105.3 Pedestrian Grade Separations

- (1) Pedestrian grade separation takes the form of pedestrian overcrossings or undercrossings. These grade separations are suitable for crossing freeways, rivers, railroads, canyons and other obstacles for which no other crossing opportunities exist.

See Index 208.6 for design guidance for pedestrian and bicycle overcrossings and undercrossings.

The need for a pedestrian grade separation is based on a study of the present and future needs of a particular area or community. Each situation should be investigated and considered on its own merits. The study should cover pedestrian generating sources in the area, pedestrian crossing volumes, type of highway to be crossed, location of adjacent crossing facilities, circuitry, zoning, land use, sociological and cultural factors, and the predominant age of persons expected to utilize the facility.

Pedestrian patterns should be maintained across freeway routes where these patterns have been previously established. Where vehicular crossings are inadequate for pedestrians, separate structures should be provided. In general, if a circuitous route is involved, a pedestrian separation may be justified even though the number of pedestrians is small.

State participation in the financing of pedestrian separations at ramp terminals is not normally justified because of the crash history at these locations. Exceptions to this general policy should be considered only in special circumstances where no less expensive alternative is feasible.

Where a pedestrian grade separation is justified, an overcrossing is preferred. Undercrossings tend to provide less visibility which provides more opportunities for vandalism and criminal activity. Consideration may be given to an undercrossing when specifically requested in writing by a local agency. Unobstructed visibility should be provided through the structure and approaches.

See Index 105.4 for discussion of provisions for persons with disabilities.

(2) *Financing.*

- (a) **Freeways**--Where the pedestrian grade separation is justified prior to award of the freeway contract, the State should pay the full cost of the pedestrian facility. In some cases, construction of the separation may be deferred; however, where the need has been established to the satisfaction of the Department prior to award of the freeway contract, the State should pay the entire cost of the separation.

Local jurisdictions have control (by zoning and planning) of development that influences pedestrian traffic patterns. Therefore, where a pedestrian grade separation is justified after the award of a freeway contract, the State's share of the total construction cost of the separation should not exceed 50 percent. The State must enter into a cooperative agreement with the local jurisdiction on this basis.

- (b) **Conventional Highways**--Grade separations are not normally provided for either cars or pedestrians on conventional highways. However, in those rare cases where pedestrian use is extensive, where it has been determined that placement and configuration of the grade separation will result in the majority of pedestrians using it, and where the local agency has requested in writing that a pedestrian separation be constructed, an overcrossing may be considered. The State's share of the total construction cost of the pedestrian facility should not exceed 50 percent. The State must enter into a cooperative agreement with the local jurisdiction on this basis.

105.4 Accessibility Requirements

(1) *Background.*

The requirement to provide equivalent access to facilities for all individuals, regardless of disability, is stated in several laws adopted at both the State and Federal level. Two of the most notable references are The Americans

with Disabilities Act of 1990 (ADA) which was enacted by the Federal Government and took effect on January 26, 1992, and Section 4450 of the California Government Code.

(a) **Americans with Disabilities Act Highlights.**

- Title II of the ADA prohibits discrimination on the basis of disability by state and local governments (public entities). This means that a public entity may not deny the benefits of its programs, activities and services to individuals with disabilities because its facilities are inaccessible. A public entity's services, programs, or activities, when viewed in their entirety, must be readily accessible to and usable by individuals with disabilities. This standard, known as "program accessibility," applies to all existing facilities of a public entity.
- Public entities are not necessarily required to make each of their existing facilities accessible. Public entities may achieve program accessibility by a number of methods (e.g., providing transit as opposed to structurally accessible pedestrian facilities). However, in many situations, providing access to facilities through structural methods, such as alteration of existing facilities and acquisition or construction of additional facilities, may be the most efficient method of providing program accessibility.
- Where structural modifications are required to achieve program accessibility, a public entity with 50 or more employees is required to develop a transition plan setting forth the steps necessary to complete such modifications.
- In compliance with the ADA, Title 28 of the Code of Federal regulations (CFR) Part 35 identifies all public entities to be subject to the requirements for ADA regardless of

funding source. It further states that the Uniform Federal Accessibility Standards (UFAS) and the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) are acceptable design guidelines that may be used. However, FHWA has directed Caltrans to use the ADAAG as the Federal design guidelines for pedestrian accessibility.

(b) California Government Code 4450 et seq. Highlights.

- Sections 4450 (through 4461) of the California Government Code require that buildings, structures, sidewalks, curbs, and related facilities that are constructed using any State funds, or the funds of cities, counties, or other political subdivisions be accessible to and usable by persons with disabilities.

(2) *Policy.*

It is Caltrans policy to:

- Comply with the ADA and the Government Code 4450 et seq. by making all State highway facilities accessible to people with disabilities to the maximum extent feasible. In general, if a project on State right of way is providing a pedestrian facility, then accessibility must be addressed.

(3) *Procedures.*

- (a) The engineer will consider pedestrian accessibility needs in the Project Initiation Documents (PSRs, PSSRs, etc.) for all projects where applicable.
- (b) All State highway projects administered by Caltrans or others with pedestrian facilities must be designed in accordance with the requirements in Design Information Bulletin 82, "Pedestrian Accessibility Guidelines for Highway Projects."
- (c) The details of the pedestrian facilities and their relationship to the project as a whole

should be discussed with the Design Coordinator or Design Reviewer for the application of DIB 82, the guidance of this manual, as well as other required design guidance.

ADA compliance must be recorded on the Ready-to-List certification for State-administered projects. Appropriate project records should document the fact that necessary review and approvals have been obtained as required above.

In addition to the above mentioned Design procedures, the District's have established procedures for certifying that the project "as-built" complies with the ADA standards in DIB 82 before a project can achieve Construction Contract Acceptance (CCA) or before the Notice of Completion is provided for a permit project.

105.5 Guidelines for the Location and Design of Curb Ramps

- (1) *Policy.* On all State highway projects adequate and reasonable access for the safe and convenient movement of persons with disabilities are to be provided across curbs that are constructed or replaced at pedestrian crosswalks. This includes all marked and unmarked crosswalks, as defined in Section 275 of the Vehicle Code.

Access should also be provided at bridge sidewalk approaches and at curbs in the vicinity of pedestrian separation structures.

Where a need is identified at an existing curb on a conventional highway, a curb ramp may be constructed either by others under encroachment permit or by the State.

- (2) *Location Guidelines.* When locating curb ramps, designers must consider the position of utilities such as power poles, fire hydrants, street lights, traffic signals, and drainage facilities.

On new construction, two curb ramps should be installed at each corner as shown on the Standard Plans. The usage of the one-ramp design should be restricted to those locations where the volume of pedestrians and vehicles making right turns is low. This will reduce

the potential frequency of conflicts between turning vehicles and persons with disabilities entering the common crosswalk area to cross either street.

Ramps and/or curb openings should be provided at midblock crosswalks and where pedestrians cross curbed channelization or median islands at intersections. Often, on traffic signalization, channelization, and similar projects, curbs are proposed to be modified only on portions of an existing intersection. In those cases, consideration should be given to installing retrofit curb ramps on all legs of the intersection.

- (3) *Ramp Design.* Curb ramp designs should conform to current Standard Plans. See Index 105.4(3) for review procedures.

Topic 106 - Stage Construction and Utilization of Local Roads

106.1 Stage Construction

- (1) *Cost Control Measures.* When funds are limited and costs increase, estimated project costs often exceed the amounts available in spite of the best efforts of the engineering staff. At such times the advantages of reducing initial project costs by some form of stage construction should be considered by the Project Delivery Team as an alternative to deferring the entire project. Stage construction may include one or more of the following:
- (a) Shorten the proposed improvement, or divide it into segments for construction in successive years;
 - (b) Reduce number of lanes for initial construction. For example, a 4-lane freeway in a rural area with low current traffic volumes might be staged for two lanes initially with capacity adequate for at least 10 years after construction. Similarly, a freeway might be constructed initially four or six lanes wide with provision for future widening in the median to meet future traffic needs.
 - (c) Stage pavement structure. For flexible pavement, this could be done by reducing the surface course thickness with

provision for a future overlay to bring the pavement to full design depth. For rigid pavement, the base and subbase layers could initially be built (if the base is built with HMA) and then overlaid later with a Portland cement concrete slab. In each case, life-cycle cost should be considered before using a staging option.

- (d) Down scope geometric design features. This last expedient should be considered only as a last resort; geometric features such as alignment, grade, sight distance, weaving, or merging distance, are difficult and expensive to change once constructed. All nonstandard features need to comply with Index 82.2

A choice among cost reducing alternatives should be made only after weighing the benefits and disadvantages of each, particularly as they apply to interchange designs, which have a substantial effect on cost. See Index 502.3(2) for design considerations regarding freeway interchanges.

106.2 Utilization of Local Roads

In the construction of freeways or other highways by stages or construction units, it frequently becomes necessary to use portions of the local road system at one or more stages prior to completion of the whole route. Usually the local road is used as a traversable connection between the newly completed segment and the existing State highway.

Where such use of a local road is required, it may be handled by:

- (a) Temporarily adopting the local road system as a traversable State highway, or
 - (b) Designating the local road system as a detour until the next or final stage is constructed.
- (1) *Temporary Adoption of Local Roads as State Routes.* Temporary adoption of a local road system as a traversable route requires CTC action. Temporary adoption should be implemented where, for example, one unit of the freeway construction has been completed and the District wishes to route all users over the new roadway without waiting for

completion of the next succeeding units, and the use of local roads is necessary to connect the freeway with the old State highway. Temporary adoption is useful where construction of the next freeway unit is a number of years in the future.

Such a temporary CTC adoption makes it legally possible to relinquish the old highway portion superseded by relocation.

Normally, the Department will finance any needed improvement required to accommodate all users during the period the local road system is a traversable State route. Financing by the local agency is not required. However, adoption of the local road by the CTC must precede State financing and construction of the proposed improvements.

When a local facility is adopted as a traversable route, the Department is responsible for all maintenance costs of the local facility unless otherwise provided for under the terms of a cooperative agreement. The Department normally would not assume maintenance until the road is in use as a connection or, when necessary, until the award of an improvement contract.

Formal concurrence of the local agency must be obtained before an adoption action is presented to the CTC.

If the local agency wants more improvements than are needed to accommodate all users during the period when the local road is used as a State highway connection, betterments are to be financed by the local agency. In such cases a cooperative agreement would be necessary to define the responsibilities of each party for construction and maintenance.

- (2) *Local Roads Used as Detours.* In lieu of temporary adoption by the CTC, a local road may be designated a detour to serve as a connection between the end of State highway construction and the old State highway following completion of a State highway construction unit and pending completion of the next unit. Local road detours are useful if the adjoining construction unit is scheduled in a few years or less and the local road connection is short and direct. Adoption by

the CTC is not required when a local road is designated as a temporary detour.

Under Section 93 of the Streets and Highways Code, the Department can finance any needed improvements required to accommodate the detour of all users during the period the local road is utilized to provide continuity for State highway users. A cooperative agreement is usually required to establish terms of financing, construction, maintenance, and liability. If the local agency wants more than the minimum work needed to accommodate users on the local road during its use as a State highway, such betterments are to be financed by the local agency.

Section 93 also makes the Department responsible for restoration of the local road or street to its former condition at the conclusion of its use as a detour. The Department is responsible for all reasonable additional maintenance costs incurred by local agencies attributable to the detour. If a betterment is requested by the local agency as a part of restoration it should be done at no cost to the Department.

Topic 107 - Roadside Installations

107.1 Roadway Connections

All connections to vista points, truck weighing or brake inspection stations, safety rest areas, park and ride lots, transit stations or any other connections used by the traveling public, should be constructed to standards commensurate with the standards established for the roadway to which they are connected. On freeways this should include standard acceleration and deceleration lanes and all other design features required by normal ramp connections (Index 504.2). On conventional highways and expressways, the standard public road connection should be the minimum connection (Index 405.7).

Only one means of exit and one means of entry to these installations should be allowed.

107.2 Maintenance and Police Facilities on Freeways

Roadside maintenance yards and police facilities other than truck weighing installations and

enforcement areas are not to be provided with direct access to freeways. They should be located on or near a cross road having an interchange which provides for all turning movements. This policy applies to all freeways including Interstate Highways.

Maintenance Vehicle Pullouts (MVPs) provide parking for maintenance workers and other field personnel beyond the edge of shoulder. This improves safety for field personnel by separating them from traffic. It also frees up the shoulder for its intended use. The need and location of MVPs should be determined by the PDT at project initiation. MVPs should only be provided if it has been determined that maintenance access from outside the state right of way through an access gate or a maintenance trail within the state right of way is not feasible. Where frequent activity of field personnel can be anticipated, such as at a signal control box (See Index 504.3 (2)(j)) or at an irrigation controller, the MVP should be placed upstream of the work site, so that maintenance vehicles can help shield field personnel on foot. If the controller or roadside feature is located within the clear recovery zone, relocating it outside the clear recovery zone should be considered (See Index 309.1). The shoulder adjacent to MVPs should be wide enough for a maintenance vehicle to use for acceleration before merging onto the traveled way. If adequate shoulder width is unattainable, sufficient sight distance from the MVP to upstream traffic should be provided to prevent maintenance vehicles from disrupting traffic flow. When considering drainage alongside a MVP, it is preferable to provide a flow line around the MVP rather than along the edge of shoulder to collect the drainage before the MVP. This will prevent ponding between the MVP and edge of shoulder. See Standard Plan H9 for a typical MVP layout plan and section detail.

107.3 Location of Border Inspection Stations

Other agencies require vehicles entering California to stop at buildings maintained by these agencies for inspection of vehicles and cargoes. No such building, parking area, or roadway adjacent to the parking area at these facilities should be closer than 30 feet from the nearest edge of the ultimate traveled way of the highway.

Topic 108 - Coordination With Other Agencies

108.1 Divided Nonfreeway Facilities

Per Section 144.5 of the Streets and Highways Code, advance notice is required when a conventional highway, which is not a declared freeway, is to be divided or separated into separate roadways, if such division or separation will result in preventing traffic on existing county roads or city streets from making a direct crossing of the State highway at the intersection. In this case, 30 days notice must be given to the City Council or Board of Supervisors having jurisdiction over said roads or streets.

The provisions of Section 144.5 of the Streets and Highways Code are considered as not applying to freeway construction, or to temporary barriers for the purpose of controlling traffic during a limited period of time, as when the highway is undergoing repairs, or is flooded. As to freeway construction, it is considered that the local agency receives ample notice, by virtue of the freeway agreement, of the manner in which all local roads will be affected by the freeway, and that the special notice would therefore be superfluous.

When the notice is required, a letter should be prepared and submitted to the appropriate authorities at least 60 days before road revision will occur. Prior to the submittal of the letter and before plans are completed, the appropriate authorities should be contacted and advised of contemplated plans. The timing of this notice should provide ample opportunity for consideration of any suggestions or objection made. In general, it is intended that the formal notice of intent which is required by law will confirm the final plans which have been developed after discussions with the affected authorities.

The PS&E package should document the date notice was given and the date of reply by the affected local agencies.

The Division of Design must be notified by letter as soon as possible in all cases where controversy develops over the closures to crossing traffic.

108.2 Transit Loading Facilities

(1) *Freeway Application.* These instructions are applicable to projects involving transit loading facilities on freeways as authorized in Section 148 of the Streets and Highways Code. Instructions pertaining to the provisions for mass public transportation facilities in freeway corridors, authorized in Section 150 of the Streets and Highways Code, are covered in other Departmental written directives.

(a) During the early phases of the design process, the District must send to the PUC, governing bodies of local jurisdictions, and common carriers or transit authorities operating in the vicinity, a map showing the proposed location and type of interchanges, with a request for their comments regarding transit loading facilities. The transmittal letter should state that transit loading facilities will be constructed only where they are in the public interest and where the cost is commensurate with the public benefits to be derived from their construction. It should also state that if the agency desires to have transit loading facilities included in the design of the freeway that their reply should include locations for transit stops and any supporting data, such as estimates of the number of transit passengers per day, which would help to justify their request.

(b) *Public Meeting and Hearings.* No public meeting or hearing is to be held when all of the contacted agencies respond that transit loading facilities are not required on the proposed freeway. The freeway should be designed without transit loading facilities in these cases.

Where any one of the agencies request transit loading facilities on the proposed freeway, the District should hold a public meeting and invite representatives of each agency.

Prior to the public meeting, the District should prepare geometric designs of the transit loading facilities for the purpose of making cost estimates and determining the

feasibility of providing the facilities. Transit loading facilities must be approved by the District Director with concurrence from the Design Coordinator (see Topic 82 for approvals).

(c) *Justification.* General warrants for the provision of transit loading facilities in terms of cost or number of passengers have not been established. Each case should be considered individually because the number of passengers justifying a transit loading facility may vary greatly between remote rural locations and high volume urban freeways.

Transit stops adjacent to freeways introduce security and operational concerns that may necessitate relocating the stop at an off-freeway location. These concerns go beyond having a facility located next to high speed traffic, but also entail the pedestrian route to the facility through a low density area removed from the general public.

It may be preferable for patrons to board and leave the bus or transit facility at an off-freeway location rather than use stairways or ramps to freeway transit stops. Where existing highways with transit service are incorporated into the freeway right of way, it may be necessary to make provisions for bus service for those passengers who were served along the existing highway. This may be accomplished either by providing freeway bus and/or transit loading facilities or by the bus leaving and re-entering the freeway at interchanges. See "A Policy on Geometric Design of Highways and Streets", AASHTO, and "Guide for Geometric Design of Transit Facilities on Highways and Streets", AASHTO for a discussion of transit design and bus stop guidelines.

(d) *Reports.* On projects where all the agencies contacted have expressed the view that transit stops are not needed, a report to the Division of Design is not required. However, a statement to the effect that the PUC, bus companies, and

local governmental agencies have been contacted regarding transit stops and have made no request for their provisions should be included in the final environmental document or the PS&E submittal, whichever is appropriate.

For projects where one or more of the agencies involved have requested transit loading facilities either formally or informally during public meeting(s), a complete report should be incorporated in the final environmental document. It should include:

- A map showing the section of freeway involved and the locations at which transit loading facilities are being considered.
- A complete discussion of all public meetings held.
- Data on type of transit service provided, both at present and after completion of the freeway.
- Estimate of cost of each facility, including any additional cost such as right of way or lengthening of structures required to accommodate the facility.
- Number of transit trips or buses per day and the number of on and off passengers per day served by the transit stops and the number estimated to use the proposed facilities.
- District's recommendation as to the provision of transit loading facilities. If the recommendation is in favor of providing transit loading facilities, drawings showing location and tentative geometric designs should be included.

(e) The DES-Structure Design has primary responsibility for the structural design of transit loading facilities involving structures. See Index 210.7. See also DIB 82 for instructions on submitting rail and transit station plans to the Department of General Services – Division of the State

Architect (DSA) for review and approval of pedestrian facilities with regard to accessibility features. Accessible paths of travel must be provided to all pedestrian facilities, including shelters, tables, benches, drinking fountains, telephones, vending machines, and information kiosks. The path of travel from designated accessible parking, if applicable, to accessible facilities should be as short and direct as practical, must have an even surface, and must include curb ramps, marked aisles and crosswalks, and other features as required to facilitate use of the facility by individuals using wheelchairs, walkers or other mobility aids. See the Department of General Services, Division of the State Architect, as well as the California Department of Transportation enforce the California Building Code (Title 24) for the various on-site improvements.

(f) A cooperative agreement should be used to document the understanding between the Department and any local agency which desires a transit facility. The agreement covers items such as funding, ownership, maintenance, and legal responsibility.

(g) Detailed design requirements can be obtained from the transit authority having jurisdiction over the transit facility. See Index 504.3(6) for design standards related to bus loading facilities on freeways.

(2) *Conventional Highway Application.* This guidance is applicable to projects involving transit loading facilities on conventional highways as authorized in Section 148 of the Streets and highways Code. Instructions pertaining to the provisions for Bus Rapid Transit (BRT) in conventional highway corridors are covered in other Departmental policy and directives.

(a) The selection of transit facilities on conventional highways should follow the general outline as noted above for transit facilities on freeways. Transit facilities shall be approved by the District Director as part of the authorizing document (PSR/PR, PR, PSSR, etc.).

- (b) A cooperative agreement should be used to document the understanding between the Department and any local agency which desires a transit facility. The agreement covers items such as funding, ownership, maintenance, and legal responsibility.
- (c) Detailed design requirements can be obtained from the transit authority having jurisdiction over the transit facility.
- (d) See also DIB 82 for instructions on submitting rail and transit station plans to the Department of General Services – Division of the State Architect (DS) for review and approval of pedestrian facilities with regard to accessibility features. Accessible paths of travel must be provided to all pedestrian facilities, including shelters, tables, benches, drinking fountains, telephones, vending machines, and information kiosks. The path of travel from designated accessible parking for persons with disabilities, if applicable, to accessible facilities should be as short and direct as practical, must have an even surface, and must include curb ramps, marked aisles, and crosswalks, and other features as required to facilitate use of the facility with wheelchairs, walkers and other mobility aides. See Topic 404 for guidance regarding the Design Vehicle, and Index 626.4(3) for structural section guidance for bus pads.

108.3 Commuter and Light Rail Facilities Within State Right of Way

- (1) *General.* These facilities may cross or operate parallel to a highway or other multi modal facility owned and operated by the Department. The following guidance covers all rail facilities, and all transportation facilities owned and operated by the Department. See the Project Development Procedures Manual for additional information and procedures regarding encroachments within State right of way. See Index 309.1(4) for high speed rail guidance.
- (2) *Rail Crossings.* Ideally, rail crossings of transportation facilities should be grade separated. Grade separations must not impact

the ability of the Department to operate and maintain its facilities, which includes the ability to expand the existing transportation facilities in the future. All rail crossings are to be approved by the District Director. See the California MUTCD for guidance regarding traffic controls for grade crossings.

- (3) *Parallel Rail Facilities.* Rail facilities may be sited within Department right of way when feasible alternatives do not exist for separate facilities. As necessary, rail facilities may be located within the median. If rail facilities are located in the median, they must not impact the ability of the Department to reasonably operate and maintain its facilities, which includes the ability to expand the existing transportation facilities in the foreseeable future. All parallel rail facilities are to be approved by the District Director.
- (4) *Design Standards.* Transit facilities are to be designed and constructed per the standards contained elsewhere in this manual and exceptions are to be documented as discussed in Chapter 80.
- (5) *Cooperative Agreements.* The design and construction of rail facilities within the Department right of way should be covered in a cooperative agreement. Subsequent maintenance and operations requirements should be addressed in a maintenance agreement or encroachment permit as necessary.

108.4 Bus Loading Facilities

- (1) *General.* A bus stop is a marked location for bus loading and unloading. Bus stops may be midblock, adjacent to, but before an intersection (near side) or adjacent to but after an intersection (far side). The far side location is preferred as pedestrians may cross the intersection behind the bus, allowing the bus to re-enter the travel stream following a break in traffic caused by the signal timing.
- (2) *Design Standards.* Transit facilities are to be designed and constructed per the standards contained elsewhere in this manual and exceptions are to be documented as discussed in Chapter 80.

Bus stops and busbays (see Index 303.4(3) for busbays) should have pavement structures designed in accordance with Index 626.4(3). See the “Guide for Geometric Design of Transit Facilities on Highways and Streets”, AASHTO, for guidance on the selection and design of transit loading facilities.

- (3) *Cooperative Agreements.* Close coordination with the transit provider(s) is required for the successful design and operation of bus stops and other transit facilities.

108.5 Bus Rapid Transit

For the purpose of design and coordination, Bus Rapid Transit (BRT) is to be considered the same as commuter and light rail facilities with regards to approvals and design guidance.

BRT often makes use of the existing infrastructure for its operation within State right of way. As a joint user of the State right of way, BRT may not eliminate pedestrian or bicycle facilities. Because of potential conflicts, BRT facilities located on conventional highways and expressways should follow, as appropriate, the guidance for traffic control in the California MUTCD for light rail facilities. Transit Cooperative Report Program (TCRP) Report Numbers 90, 117 and 118 have additional guidance on BRT planning, design, and implementation. BRT located on freeways should be designed in accordance with the HOV Guidelines.

- (1) *Design Standards.* Transit facilities are to be designed and constructed per the standards contained elsewhere in this manual, and exceptions are to be documented as discussed in Chapter 80.
- (2) *Cooperative Agreements.* The design and construction of BRT facilities within the Department right of way should be covered in a cooperative agreement. Subsequent maintenance and operations requirements should be addressed in a maintenance agreement or encroachment permit as necessary.

108.6 High-Occupancy Toll and Express Toll Lanes

- (1) *General.* This guidance is applicable to projects involving High-Occupancy Toll

(HOT) and Express Toll Lanes on freeways. These facilities are operated by a local agency under statutory authority or with the approval of the California Transportation Commission. The HOV Guidelines are to be consulted when considering the design and operation of these facilities.

- (2) *Design Standards.* HOT and Express Toll Lane facilities are to comply with the standards contained elsewhere in this manual. Exceptions are to be documented as discussed in Chapter 80. Therefore, caution must be exercised when using other Department publications such as the HOV Guidelines if conflicts in design standards are identified.
- (3) *Cooperative Agreements.* A cooperative agreement is to be used to document the understanding between the Department and any local agency which will operate the HOT or Express Toll Lane Facility. The agreement must cover items such as funding, design, construction, ownership, maintenance, and legal responsibility.

108.7 Coordination with the FHWA

FHWA representatives should be contacted as indicated by the Joint Stewardship and Oversight Agreement.

- (1) *General.* As early in the design process as possible, FHWA should be kept informed of proposed activities on Federal-aid routes. See the Appendix of the Project Development Procedures Manual for a complete list of FHWA involvement.
- (2) *Approvals.* The District Directors are responsible for obtaining formal FHWA approval for the following items on Federal-aid routes, see the Project Development Procedures Manual and the FHWA Joint Stewardship Oversight Agreement for a more complete list:
 - (a) Route Adoption. See the Project Development Procedures Manual for a discussion of procedures to be followed to NEPA and design approvals.
 - (b) Exceptions to design standards are required for all design elements which do not meet minimum standards related to

any of the FHWA's 13 controlling criteria for projects which are on the Interstate System. See Index 82.2.

- (c) Changes in access control lines, changes in locations of connection points, adding connection points, or deleting connection points on the Interstate System (even when no Federal money is involved).
- (d) Addition of or changes in locked gates under certain conditions See Index 701.2.
- (e) Partial interchanges on the Interstate system. See Index 502.2.
- (f) Design-life on Interstates System projects.

Normally, major nonparticipating items are identified at the time of design approval. Approximately twelve months prior to PS&E submittal, a project review should be arranged by the District with the Design Coordinator and the FHWA representative to discuss nonparticipating items and unusual or special design features to resolve any differences or to determine if additional FHWA approvals are necessary. The importance of early contact is emphasized to avoid delays when final plans are prepared.

For additional information, see the Project Development Procedures Manual.

Topic 109 - Scenic Values in Planning and Design

109.1 Basic Precepts

For any highway, having a pleasing appearance is an important consideration. Scenic values must be considered along with safety, utility, economy, and all the other factors considered in planning and design. This is particularly true of the many portions of the State Highway System situated in areas of natural beauty. The location of the highway, its alignment and profile, the cross section design, and other features should be in harmony with the setting.

109.2 Design Speed

The design speed should be carefully chosen as it is the key element which establishes standards for the horizontal alignment and profile of the highway.

These requirements in turn directly influence how well the highway blends into the landscape. Scenic values, particularly in areas of natural scenic beauty must play a part along with the other factors set forth under Index 101.1 in selecting a design speed.

109.3 Aesthetic Factors

Throughout planning and design consider the following:

- (a) The location of the highway should be such that the new construction will preserve the natural environment and will lead to and unfold scenic positions. In some cases, additional minor grading not required for roadbed alignment may expose an attractive view or hide an unsightly one.
- (b) The general alignment and profile of the highway should fit the character of the area traversed so that unsightly scars of excavation and embankment will be held to a minimum. Curvilinear horizontal alignment should be coordinated with vertical curvature to achieve a pleasing appearance.
- (c) Existing vegetation (e.g., trees, specimen plants, diminishing native species or historical plantings) should be preserved and protected to the maximum extent feasible during the planning, design, and construction of transportation projects. Whenever specimen or mature trees are present, especially in forested areas, a tree survey should be made to provide accurate data on the variety, condition, location, size, and ground elevations of trees affected.
- (d) Appropriate replacement planting should be provided when existing planting is removed. When native or specimen trees are removed, replacement planting should reflect the visual importance of the plantings lost. Where the visual impact of tree removal is substantial, replacement with large transplants or specimen size trees may be appropriate. If not, an appropriate quantity of smaller replacements may be required to ensure eventual survival of an adequate number of plants.

Provisions for watering and establishment of replacement planting should also be considered. The District Landscape Architect

should be consulted early in the planning and design process so that appropriate conservation and revegetation measures are incorporated.

- (e) Existing vegetation such as trees or large brush may be selectively thinned or removed to open up scenic vistas or provide a natural looking boundary between forest and cleared areas. Vegetation removal for aesthetic purposes should be undertaken only with the concurrence of the District Landscape Architect.
- (f) Vista points should be provided when views and scenery of outstanding merit occur and feasible sites can be found. (See Topic 904 for site selection criteria.)
- (g) Whenever feasible, wide medians and independent roadways should be provided on multilane facilities as these features add scenic interest and relieve the monotony of parallel roadways.
- (h) Bridges, tunnels, and walls merit consideration in lieu of prominent excavation and embankment slopes when costs of such alternates are not excessive.
- (i) Slopes should be flattened and rounded whenever practical and vegetation provided so that lines of construction are softened.
- (j) Structures should be located and designed to give the most pleasing appearance.
- (k) Scars from material sites should be avoided. Planting compatible with the surroundings should be undertaken to revegetate such scars when they are unavoidable.
- (l) Drainage appurtenances should be so located that erosion, sumps, and debris collection areas are hidden from view or eliminated when site conditions permit.
- (m) Interchange areas should be graded as flat as reasonable with slope rounding and contouring to provide graceful, natural looking appearance. The appearance can be further enhanced by planting a vegetative cover appropriate to the locality, being careful to maintain driver visibility.
- (n) In locations where graffiti has been excessive, concepts such as limiting accessibility,

planting, and surface treatments should be considered to deter graffiti.

- (o) Roadsides should be designed to deter weed growth along the traveled way, and to provide for mechanical litter collection.

Topic 110 - Special Considerations

110.1 Design for Overloaded Material Hauling Equipment

Sometimes bid costs can be reduced by allowing the hauling of overloads on a construction contract. The savings may warrant designing structures and structural sections of new roadways to carry the heavier loads and also reconstructing roadbeds used by overloaded material hauling equipment.

In general, hauling of overloads is restricted to the project limits. However, overloads are permitted on portions of existing highways which are to be abandoned, repaired or reconstructed with a new structural section, if the overloads do not affect the design of the reconstructed structural section.

Any overload requirements should be determined before detailed plans are prepared. The District should request from the Division of Engineering Services – Structures Design (DES - SD) the estimated additional cost of the structures to carry overloads and use this information in making economic comparisons.

Factors to be considered in making the comparisons should include the costs of strengthening structures, haul costs, amount of material to be hauled, repair or reconstruction of structural sections, construction of separate haul roads or structures, strengthening of the new structural section, sequence of construction operations, and other pertinent factors. In some cases, consideration should be given for requiring the contractor to construct a separate haul structure over a heavily traveled surface street when large quantities of material are involved.

The comparison and all factors leading to the decision should be complete, fully documented, and retained in the project files.

The design of structures for overloads will normally be governed by one of the following categories:

- (1) *Category 1.* Structures definitely planned to carry overloads. This category should be used only when the structures are to be constructed under a separate contract prior to a grading contract and the estimated savings in grading costs exceed the extra structure costs. The District must request the DES - SD to design for the permissible overloading.
- (2) *Category 2.* Structures which are designed to allow the contractor the option of strengthening to carry overloads. The contract plans will include alternative details for strengthening the structure and the contractor can decide at the time of bidding whether to haul around the structure, build his own haul road structures, use "legal load" equipment on the unstrengthened structure, or construct the structure in accordance with the strengthened alternative design. The District should notify the DOS regarding structures to have optional designs. Undercrossings, overheads, separations, and stream crossings are most likely to be in this category.
- (3) *Category 3.* Structures which will not be designed to carry overloads. Most overcrossing, ramp, and frontage road structures are in this category.

The District should consult with the DOS early in the design phase when determining the design overload category of each bridge in the project. Each case where hauling of overloads is permitted must be specifically described in the Special Provisions. Each structure designed under Categories 1 and 2 must also be designated in the Special Provisions. The design load must not exceed the weight limitation of Section 7-1.02, "Weight Limitations", of the Standard Specifications. The District Director or designated representative must approve the overload category for each structure.

110.2 Control of Water Pollution

Water pollution related to the construction of highways and to the drainage of completed highways should be limited to the maximum extent practicable. This objective should be considered

from the early planning, through the detailed design phase, to the end of construction of each project.

Proposed alterations of existing drainage patterns and creation of disturbed soil areas should consider the potential for erosion and siltation. Where interdisciplinary analysis (engineering, biology, geology, chemical) indicates that harmful physical, chemical, or biological pollution of streams, rivers, lakes, reservoirs, coastal waters, or groundwater may occur, preventive measures and practices will be required. These measures include temporary erosion control features during construction, scheduling of work, as well as the permanent facilities to be built under the contract. The control of erosion associated with permanent drainage channels and ditches is covered in Chapter 860, Open Channels.

The Department's Project Planning and Design Guide identifies the procedures and practices to be employed in order for projects to comply with the Storm Water Management Plan and the National Pollutant Discharge Elimination System Permit, issued by the State Water Resources Control Board.

Districts must initiate contact with the appropriate agencies responsible for water quality as early as feasible in development of transportation projects to ensure full identification of pollution problems, and to ensure full cooperation, understanding, and agreement between the Department and the other agencies. The agencies to be contacted will vary from project to project depending on the nature of the project, the aquatic resources present, and the uses of the water. The agencies that may be interested in a project include but are not limited to the following: U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, California Regional Water Quality Control Boards, California Department of Fish and Game, Flood Control Districts, and local water districts. The District Environmental Unit can provide assistance in determining which agencies should be contacted.

Recommendations for mitigation measures or construction and operational controls contained in the project's Storm Water Data Report should receive full consideration in the development of the project. The Department is legally bound to comply with the appropriate permits as outlined in the California Permit Handbook. The Department

is also legally bound to comply with any water quality mitigation measures specified in the project's environmental document. Plans and specifications should reflect water quality protection measures in a manner that is enforceable in contracts.

On almost all projects, early contact should be established between the District project development personnel, Landscape Architecture, biologists, geologists, and other specialists available in the Headquarters Environmental Program, the Division of Engineering Services (DES) Office of Structural Foundations, FHWA, or other Districts, to ensure optimum development of water quality control measures.

Because siltation resulting from erosion is recognized as a major factor in water pollution, continuous efforts should be made to improve erosion control practices.

(1) *Project Planning Phase.* When project planning studies are started, consideration should be given to the items in the following list:

- (a) Identify all waters in the vicinity of a highway project which might affect construction, maintenance and operational activities.

The environmental factors that might affect preconstruction activities should be looked into for the benefit of the resident engineer and contractor. An example would be relocation of drilling of pile foundations in a sensitive stream to prevent possible impacts.

- (b) Identify for each project all waters, both fresh and saline, surface and underground, where water quality may be affected by the proposed construction.
- (c) Determine if any watersheds, aquifers, wells, reservoirs, lakes, or streams are sources for domestic water supplies.
- (d) Determine if any sensitive fishery, wildlife, recreational, agricultural, or industrial aquatic resources are located in the vicinity of the project.

- (e) Consider possible relocation or realignment that could be made to avoid or minimize the possibility of pollution of existing waters.
 - (f) Identify variations in the erosive characteristics of the soils in the area, and consider relocation or grade changes that would minimize erosion.
 - (g) Where possible, avoid unstable areas where construction may cause future landslides.
 - (h) Identify construction season preference of regulatory agencies.
 - (i) Evaluate the need for additional right of way to allow for flatter, less erosive slopes.
- (2) *Design Phase.* During the design phase, the items listed above should again be considered. More specific items for consideration are presented in the following checklist:
- (a) Provide for the preservation of roadside or median vegetation beyond the limits of construction by special provisions and depiction on the plans.
 - (b) Design slopes as flat as is reasonable with slope rounding, landforming/geomorphic grading, contouring, or stepping to minimize erosion and to promote plant growth. Consider retaining walls when practical to reduce slope length and steepness. Include standard special provisions or approved special provisions which will require the contractor to remove or excavate, stockpile, and apply topsoil and/or duff on the final slope to promote plant growth. For information on landforming/geomorphic grading see: <http://www.dot.ca.gov/hq/LandArch/webinars/index.htm> and work with district landscape architecture.
 - (c) Provide erosion control to all soil areas to be disturbed by construction activities. Consider the need to require the contractor to apply permanent erosion control in phases, as slopes become substantially complete, instead of allowing all erosion control to be applied

at the end of the construction project. Prior to winterizing the project, the designer must plan for temporary erosion control on slopes not substantially complete. Native plants should be considered for all plantings.

If a highway planting project is anticipated immediately following roadway construction, disturbed soil areas cannot be left unprotected. The use of mulch could be considered as an erosion control method during the interim. Contact the District Landscape Architect for assistance.

- (d) When planning for temporary erosion control, consider the use of vegetation, mulches, fiber mats, fiber rolls, netting, dust palliatives, crust forming chemicals, silt fences, plastic sheets or any other procedure that may be necessary to prevent erosion. The District Storm Water Coordinator, District Landscape Architect, and the District Storm Water Unit can assist in the selection and design of temporary erosion control measures.
- (e) Design overside drains, surface, subsurface, and cross drains so that they will discharge in locations and in such a manner that surface and subsurface water quality will not be affected. The outlets may require aprons, bank protection, desilting basins, or energy dissipators.
- (f) Provide for adequate fish passage through highway culverts or under bridges when necessary to protect or enhance fishery resources.
- (g) Provide bank protection where the highway is adjacent to rivers, streams, lakes, or other bodies of water.
- (h) Where required, provide slope protection or channel lining, energy dissipators, etc. for channel changes.
- (i) Where the State has made arrangements for materials, borrow, or disposal sites, grading plans should be provided and revegetation required. Special provisions should require the contractor to furnish plans for grading and replanting of sites.
- (j) Check right of way widths for adequate space to reduce slope gradients and minimize slope angles, for rounding at tops of cuts and bottoms of fills, for adequate slope protection ditches and for incorporation of treatment control measures (e.g., infiltration basins, detention basins, traction sand traps). Also consider right of way or encroachment rights for temporary work such as desilting basins, stream diversion, or stream crossing protection.
- (k) All ditches should be designed to minimize erosion. These treatments include but are not limited to grass lining, fiber mats, rock lining (with or without geotextile underlayment), and paving. The District Hydraulics Unit can assist with the selection and design of ditch treatment. Consideration should be given to using soil stabilization materials in median ditches or other wide drainage areas that cannot be vegetated.
- (l) Temporary construction features for water pollution control that can be predicted should be made a part of the plans, specifications, and contract pay items. Such items as mulching and seeding of slopes, berms, dikes, ditches, pipes, dams, silt fences, settling basins, stream diversion channels, slope drains, and crossings over live streams should be considered. Since all contingencies probably cannot be foreseen, supplemental work funds should be set up for each project. Pay items for temporary erosion control should not be adjusted for increased or decreased quantity.
- (m) Special consideration should be given to using vegetated ditches to remove highway runoff pollutants. The District Hydraulics and Landscape Architecture Units can provide assistance in designing and constructing vegetated ditches.
- (n) Mandatory order of work clauses sometimes result in increased costs or

longer time limits, but they must be considered where their use would eliminate the expense of temporary construction or where they result in earlier protection of erodible areas, or improved handling of site runoff.

(3) *Abandonment and Destruction of Water Wells.*

The abandonment and destruction of water wells within the highway right of way must be handled in accordance with requirements established by statute and by agreement with the Department of Water Resources (DWR) to avoid pollution of underground water and ensure public safety. Sections 13700 to 13806 of the California Water Code deal, in general, with the construction and destruction of wells. Section 24400 to 24404 of the Health and Safety Code require that abandoned wells be covered, filled, or fenced for safety reasons. Statewide standards for construction, maintenance and destruction of water wells, monitoring wells and cathodic protection wells have been issued by the California DWR in Bulletin 74 - 81, "Water Well Standards: State of California", dated December, 1981, and Bulletin 74 - 81", dated January, 1990. Pursuant to these standards and interagency agreement with DWR, the following procedures are to be followed to determine requirements for abandonment and destruction of wells within State highway rights of way.

- (a) Before producing water wells within the highway right of way are abandoned, a determination should be made of the possible future uses of the wells. Such future uses include landscape irrigation, roadside rests, vista points, maintenance facilities, truck weighing facilities, and others. Also see Index 706.4.
- (b) The District Project Development and Right of Way Branches determine the location of water wells that will be affected by highway construction on a project basis.
- (c) The District submits a letter to the Director, Department of Water Resources, 1416 Ninth Street, Sacramento, CA. 95814 Attention: Water Resources

Evaluation Section, Division of Resources Development, listing the wells to be abandoned and any information that may be known about them. The letter should include the scheduled PS&E date and the anticipated advertising date for the project. Two copies of a map, or maps, showing the location of each well accurately enough so it can be located in the field should be included with the letter. A copy of this package should also be provided to Headquarters Construction.

- (d) DWR will investigate the wells and write a report recommending procedures to be used in destruction of the wells within the highway right of way. The interagency agreement provides for reimbursement of the DWR's cost for these investigations and reports.
- (e) DWR will forward its report to the District.
- (f) Provisions for destruction of abandoned wells occasioned by highway construction and planting projects must be included in the District PS&E report. The work, usually done by filling and sealing, normally should be included in the contract Special Provisions. Steps must be taken to insure that wells are left in a safe condition between the time the site is acquired by the State and the time the well is sealed.
- (g) In some cases, local ordinances or conditions will require the filling and sealing of the well prior to the highway contract in order to leave the well in a safe condition.
- (h) The contractor who does the work to abandon the well must file the Notice of Intent (Form DWR 2125) and the Water Well Drillers Report (Form DWR 188) required by the Department of Water Resources.
- (i) Also, under California Water Code Section 13801, after January 15, 1990, all cities and counties are required to have adopted ordinances that require prior acquisition of permits for all well

construction, reconstruction and destruction and requiring possession of an active C-57 contractors license as the minimum qualification for persons permitted to work on wells.

- (4) *Summary.* To prevent pollution of all waters that could be affected by a highway construction project, it is desirable to avoid involvement with the water or avoid the construction of erodible features. Since it is seldom possible to avoid all such features, the design of effective erosion and sediment control measures should be included with the project. Material resulting from erosion should either be discharged in locations where no negative environmental impacts will occur, or be deposited in locations that are accessible to maintenance forces for removal. District Landscape Architecture can provide technical assistance in assessing the impacts of erosion and in designing erosion control features.

Project Development personnel should ensure that all aspects of erosion control and other water quality control features considered during design are fully explained to the Resident Engineer. Such data is essential for review of the contractor's water pollution control program. Judgment must be used in differentiating between planned temporary protection features and work which the contractor must perform in order to fulfill their responsibility to protect the work from damage.

To reduce contract change orders and ensure erosion control goals are met, important protection should not be left to the contractor's judgment. It is desirable that all predictable temporary protection measures be incorporated in the plans and specifications and items for payment included in the contract items of work.

Topsoil should be stripped, stockpiled, and restored to disturbed slopes because existing soil nutrients and native seeds contained within the topsoil are beneficial for establishing vegetative cover and controlling erosion.

In addition, the abandonment of water wells must be given special attention in accordance with Section (3) above.

110.3 Control of Air Pollution

Air pollution associated with the construction of highways and to completed highway facilities should be held to the practical minimum. The designer should consider the impacts of haul roads, disposal sites, borrow sites, and other material sources in addition to construction within the highway right of way.

- (1) *Control of Dust.* Many of the items listed under Index 110.2, Control of Water Pollution, are applicable to dust control. Consideration should be given to these items and additional material presented in the following list:
- (a) See Index 110.2(2)(a), (c), (d), (k) and (n).
 - (b) Flat areas not normally susceptible to erosion by water may require erosion control methods such as planting, stabilizing emulsion, protective blankets, etc., to prevent wind erosion.
 - (c) Cut and or fill slopes can be sources of substantial wind erosion. They will require planting or other control measures even if water erosion is only a minor consideration.
 - (d) In areas subject to dust or sand storms, vegetative wind breaks should be considered to control dust. Use of soil sealant may also be considered.
 - (e) Special provisions should be used requiring the contractor to restore material, borrow, or disposal sites, and temporary haul roads to a condition such that their potential as sources of blowing dust or other pollution is no greater than in their original condition. Work for this purpose that can be predicted should be made a part of the PS&E, which should require submission of the contractors plan for grading, seeding, mulching or other appropriate action.

- (f) Stockpiling and respreading topsoil may speed revegetation of the roadside and reduce wind erosion.
- (2) *Control of Burning.* Health and Safety Code provisions and rules issued by Air Pollution Control Boards will preclude burning on most highway projects. Off-site disposal of debris must not create contamination problems and should not be specified simply as an expedient resolution of the problem without imposing adequate controls on how such disposal site is to be handled. Designers should seek disposal site locations within the right of way where it will be permissible to dispose of debris. Proper procedures, including compaction and burial, should be specified. Debris should not be disposed of within the normal roadway. Burying within the right of way should be done in such a fashion that the layers of debris will not act as a permeable layer or otherwise be detrimental to the roadway. Acceptable alternates based on economic, aesthetic, safety, and other pertinent considerations should be included in the contract if possible.

On projects where burning will not be permitted and disposal of debris within the right of way is not possible, optional disposal sites should be made available. Information on such site arrangements should be made available in the "Materials Information" furnished to prospective bidders. Reference is made to the applicable portion of Index 111.3 and 111.4 for handling this requirement. Special requirements for disposal of debris and final appearance of the disposal site should be covered in the Special Provisions. The intent of this instruction is that the designer should make sure that prospective bidders have adequate information on which to make a realistic bid on clearing and grubbing.

When feasible, tree trunks, branches, and brush should be reduced to chips and incorporated with the soil, spread on fill slopes, used as a cover mulch or disposed of in other ways compatible with the location. In forest areas where they will not look out of place, limbs and trunks of trees that are too large for chipping may be limbed and cut to

straight lengths and the pieces lined up at the toes of the slope. An earth cover may be necessary for aesthetic reasons, or to reduce fire hazards. Under certain conditions salvage of merchantable timber may be desirable, or may be required by right of way commitments. Whenever merchantable timber is to be salvaged, appropriate specifications should be provided. Stumps and unsightly clumps of debris should be chipped or buried in areas where they will not create future problems.

Care should be taken not to block drainage or to interfere with maintenance operations.

Before proposing chipping as the method of disposal, the designer should investigate to determine if plant disease or insect pests will be spread to disease-free or insect-free areas. Procedures to decontaminate such chips before use should be included in the contract if necessary. Designers should seek advice from local experts and County Agricultural Extension Offices to determine the extent of such problems and the procedures and chemicals to be specified.

The U.S. Forest Service and the State Division of Forestry should be contacted during the design stage to ascertain the requirements that these agencies will make upon any disposal methods to be used in areas under their control.

It will be noted that under certain limited conditions the prohibition against burning may be eliminated from the Special Provisions.

There will be some areas of the State where Air Pollution Control Boards may consider issuing a permit for open burning where the effect on air quality is expected to be negligible and few if any residents would be affected. The individual situation should be studied and appropriate special provisions prepared for each project to fully cover all possible methods of disposal of debris that will be available to the contractor.

The local Air Pollution Control Board should be contacted to determine the current regulations.

- (3) *Summary.* Special consideration should be given to the direction of prevailing winds or high-velocity winds in relation to possible sources of dust and downwind residential, business, or recreational areas. Every practical means should be incorporated in the design of the highway and in the provisions of the contract to prevent air pollution resulting from highway construction and operation.

110.4 Wetlands Protection

The Nation's wetlands are recognized on both the Federal and State level as a valuable resource. As such, there have been several legislative and administrative actions which provide for special consideration for the preservation of wetlands. These are embodied on the Federal level in Executive Order 11990, DOT Order 5660.1A, Section 404 of the Clean Water Act, including Section 404(b)(1) guidelines, and the NEPA 404 Integration Process for Surface Transportation Projects, and the August 24, 1993 Federal Wetlands Policy. Wetlands are covered on the State level by the Porter-Cologne Water Quality Act and the Resources Agency's Wetlands Policy. The District Environmental Unit can provide assistance with permitting strategies, identifying wetlands, determining project impacts, and recommending mitigation measures, in coordination with the District Landscape Architect.

110.5 Control of Noxious Weeds - Exotic and Invasive Species

Highway corridors provide the opportunity for the transportation of exotic and invasive weed species through the landscape. Species that have the ability to harm the environment, human health or the economy are of particular concern. In response to the impact of exotic and invasive species, Executive Order 13112 was signed, which directs Federal Agencies to expand and coordinate efforts to combat the introduction and spread of non-native plants and animals. Grading, excavation, and fill operations during construction may introduce invasive species or promote their spreading. Because of this, the FHWA implemented guidance for State Departments of Transportation for preventing the introduction and controlling the spread of invasive plant species on highway rights of way on transportation improvement projects.

District Environmental Unit and Landscape Architecture can provide assistance in identifying invasive or exotic species which should be controlled, and in recommending mitigation or control methods to be included in appropriate highway improvement projects.

110.6 Earthquake Consideration

Earthquakes are naturally occurring events that have a high potential to cause damage and destruction. While it is not possible to completely assure earthquake proof facilities, every attempt should be made to limit potential damage and prevent collapse.

There are certain measures that should be considered when a project is to be constructed in or near a known zone of active faulting.

Early in the route location process, active and inactive faults should be mapped by engineering geologists. A general assessment of the seismic risk of various areas within the study zone should then be prepared. The DOS and Office of Structural Foundations are available to assist in the assessment of seismic risk.

Strong consideration must be given to the location of major interchanges. They must be sited outside of heavily faulted areas unless there are exceptional circumstances that make it impractical to do so. Where close seismic activity is highly probable, consideration should be given to avoiding complex multilevel interchanges in favor of simple designs with low skew, short span structures close to the original ground, and maximum use of embankment. Single span bridges which are designed to tolerate large movements are desirable.

Early recognition of seismic risk may lead the designer to modify alignment or grade in order to minimize high cuts, fills, and bridge structures in the area. Slopes should be made as flat as possible both for embankment stability and to reduce slide potential in cuts. Buttress fills can be constructed to improve cut stability. The DOS and the Office of Structural Foundations, should be consulted early when considering various alternatives to obtain recommendations for mitigating earthquake damage.

When subjected to an earthquake, fills may crack, slump, and settle. In areas of high water table,

liquefaction may cause large settlement and shifting of the roadway. It is not economically feasible to entirely prevent this damage. One possible mitigation for existing soils would be to have the contract Special Provisions provide for removal of loose and compressible material from fill foundation areas, particularly in canyons, sidehill fills, and ravines and for foundation preparation on existing hillsides at the transition between cut and fill.

No modification is necessary in the design of the pavement structural sections for the purpose of reducing damage due to future earthquakes. Normally it is not possible to reduce this damage, since the structural section cannot be insulated from movements of the ground on which it rests. In active fault areas, consideration should be given to the use of flexible pipes or pipes with flexible couplings for cross drains, roadway drainage and conduits.

Additional expenditure for right of way and construction to make highways and freeways more earthquake resistant in a known active fault area should be kept in balance with the amount of impact on the traveling public if the facility may be put out of service following a disastrous earthquake. Loss of a major interchange, however, may have a tremendous influence on traffic flow and because of the secondary life-safety and economic impacts some additional expenditure may be justified.

110.7 Traffic Control Plans

This section focuses mainly on providing for vehicular traffic through the work zone; however, providing for bicyclists, pedestrians, and transit through the work zone is also necessary when they are not prohibited.

A detailed plan for moving all users of the facility through or around a construction zone must be developed and included in the PS&E for all projects to assure that adequate consideration is given to the safety and convenience of motorists, transit, bicyclists, pedestrians, and workers during construction. Design plans and specifications must be carefully analyzed in conjunction with Traffic, Construction, and Structure personnel (where applicable) to determine in detail the measures required to warn and guide motorists, transit,

bicyclists, and pedestrians through the project during the various stages of work. Starting early in the design phase, the project engineer should give continuing attention to this subject, including consideration of the availability of appropriate access to the work site, in order that efficient rates of production can be maintained. In addition to reducing the time the public is exposed to construction operations, the latter effort will help to hold costs to a minimum.

The traffic control plans should be consistent with the California MUTCD, and the philosophies and requirements contained in standard lane closure plans developed by the Headquarters Division of Traffic Operations for use on State highways and should cover, as appropriate, such items as:

- Signing.
- Flagging.
- Geometrics of detours.
- Methods and devices for delineation and channelization.
- Application and removal of pavement markings.
- Placement and design of barriers and barricades.
- Separation of opposing vehicular traffic streams (See 23 CFR 630J).
- Maximum lengths of lane closures.
- Speed limits and enforcement.
- Use of COZEEP (see Construction Manual Section 2-215).
- Use of pilot cars.
- Construction scheduling.
- Staging and sequencing.
- Length of project under construction at any one time.
- Methods of minimizing construction time without compromising safety.
- Hours of work.
- Storage of equipment and materials.
- Removal of construction debris.

- Treatment of pavement edges.
- Roadway lighting.
- Movement of construction equipment.
- Access for emergency vehicles.
- Clear roadside recovery area.
- Provision for disabled vehicles.
- Surveillance and inspection.
- Needed modifications of above items for inclement weather or darkness.
- Evaluate and provide for as appropriate the needs of bicyclists and pedestrians (including ADA requirements; see Index 105.4).
- Provisions to accommodate continued transit service.
- Consideration of complete facility closure during construction.
- Consideration of ingress/egress requirements for construction vehicles.
- Any other matters appropriate to the safety objective.

Normally, not all the above items will be pertinent to any one traffic control plan. Depending on the complexity of the project and the volume of traffic affected, the data to be included in the traffic control plan can vary from a simple graphic alignment of the various sequences to the inclusion of complete construction details in the plans and special provisions. In any event, the plans should clearly depict the exact sequence of operation, the construction details to be performed, and the traveled way to be used by all modes of traffic during each construction phase. Sufficient alignment data, profiles, plan dimensions, and typical sections should be shown to ensure that the contractor and resident engineer will have no difficulty in providing traffic-handling facilities.

In some cases, where the project includes permanent lighting, it may be helpful to install the lights as an early order of work, so they can function during construction. In other cases, temporary installations of high-level area lighting may be justified.

Temporary roadways with alignment and surfacing consistent with the standards of the road which has just been traveled by the motorist should be provided if physically and economically possible.

Based on assessments of safety benefits, relative risks and cost-effectiveness, consideration should be given to the possibility of including a bid item for continuous traffic surveillance and control during particular periods, such as:

- (a) When construction operations are not in progress.
- (b) When lane closures longer than a specified length are delineated by cones or other such nonpermanent devices, whether or not construction operations are in progress.
- (c) Under other conditions where the risk and consequences of traffic control device failure are deemed sufficient.

Potentially hazardous working conditions must be recognized and full consideration given to the safety of workers as well as the general public during construction. This requirement includes the provision of adequate clearance between public traffic and work areas, work periods, and lane closures based on careful consideration of anticipated vehicle traffic volumes, and minimum exposure time of workers through simplified design and methods.

If a Transportation Management Plan (TMP) is included in the project, the traffic control plans (TCP) may need to be coordinated with the public information campaign and the transportation demand management elements. Any changes in TMP or TCP must be made in harmony for the plans to succeed. The "TMP Guidelines", available from HQ, Traffic Operational Systems Branch, should be reviewed for further guidance.

Traffic control plans along with other features of the design should be reviewed by the District Safety Review Committee prior to PS&E as discussed in Index 110.8.

The cost of implementing traffic control plans must be included in the project cost estimate, either as one or more separate pay items or as extra work to be paid by force account.

It is recognized that in many cases provisions for traffic control will be dependent on the way the contractor chooses to execute the project, and that the designer may have to make some assumptions as to the staging or sequence of the contractor's operations in order to develop definite temporary traffic control plans. However, safety of the public and the workers as well as public convenience demand that designers give careful consideration to the plans for handling all traffic even though a different plan may be followed ultimately. It is simpler from a contract administration standpoint to change a plan than to add one where none existed. The special provisions should specify that the contractor may develop alternate traffic control plans if they are as sound or better than those provided in the contract PS&E.

See Section 2-30, Traffic, of the Construction Manual for additional factors to be considered in the preparation of traffic control plans.

110.8 Safety Reviews

Formal safety reviews during planning, design and construction have demonstrated that safety-oriented critiques of project plans help to ensure the application of safety standards. An independent team not involved in the design details of the project is generally able to conduct reviews from a fresh perspective. In many cases, this process leads to highly cost-effective modifications that enhance safety for motorists, bicyclists, pedestrians, and highway workers without any material changes in the scope of the project.

(1) *Policy.* During the planning stage all projects must be reviewed by the District Safety Review Committee prior to approval of the appropriate project initiation document (PSR, PSSR, NBSSR, etc.).

During design, each major project with an estimated cost over the Minor A limit must be reviewed by the District Safety Review Committee.

Any project, regardless of cost, requiring a Traffic Control Plan must be reviewed by the District Safety Review Committee. During construction, the detection of the need for safety-related changes is the responsibility of construction personnel, as outlined in the Construction Manual.

Safety concepts that are identified during these safety reviews which directly limit the exposure of employees to vehicular and bicycle traffic shall be incorporated into the project unless deletion is approved by the District Director.

(2) *Procedure.* Each District must have a Safety Review Committee, composed of at least one engineer from the Construction, Design, Maintenance, and Traffic functions and should designate one of the members as chairperson. Committee members should familiarize themselves with current standards and instructions on highway safety so that they can identify items in need of correction.

The Committee should conduct at least two design safety reviews of each major project. The Design Project Engineer has the basic responsibility to notify the committee chairperson when a review is needed. The chairperson should schedule a review and coordinate participation by appropriate committee members.

Reviews, evaluating safety from the perspectives of the motorists, bicyclists, and pedestrians, should include qualitative and/or quantitative safety considerations of such items as:

- Exposure of employees to vehicular and bicycle traffic.
- Traffic control plans.
- Transportation Management Plans.
- Traversability of roadsides.
- Elimination or other appropriate treatment of fixed objects.
- Susceptibility to wrong-way moves.
- Safety of construction and maintenance personnel.
- Sight distance.
- ADA design.
- Guardrail.
- Run off road concerns.
- Superelevation, etc.

- Roadside management and maintenance reduction.
- Access to facilities from off of the freeway.
- Maintenance vehicle pull-out locations.

The objective is to identify all elements where safety improvement may be practical and indicate desirable corrective measures. Reviews should be scheduled when the report or plans are far enough along for a review to be fruitful, but early enough to avoid unnecessary delay in the approval of the report or the completion of PS&E.

A simple report should be prepared on the recommendations made by the Safety Committee and the response by the Design Project Engineer. The reports should be included in the project files.

110.9 Value Analysis

The use of Value Analysis techniques should begin early in the project development process and be applied at various milestones throughout the PS&E stage to reduce life-cycle costs. See the Project Development Procedures Manual for additional information.

110.10 Proprietary Items

The use of proprietary items is discouraged in the interest of promoting competitive bidding. If it is determined that a proprietary item is needed and beneficial to the State, their use must be approved by the District Director or by the Deputy District Director of Design (if such approval authority has been specifically delegated by the District Director). The Deputy Division Chief of Engineering Services, Structure Design, must approve the use of proprietary items on structures and other design elements under their jurisdiction. The Department's guidelines on how to include proprietary items in contract plans are covered in the Office Engineer's Ready to List and Construction Contract Award Guide (RTL Guide) under "Proprietary Products."

On projects that utilize federal funds, the use of proprietary items requires an additional approval through a Public Interest Finding (PIF). A PIF is approved by the Federal Highway Administration

(FHWA) Division Office for "High Profile Projects" or by the Division of Budgets, California Federal Resources Engineer for Delegated Projects, in accordance with the Stewardship Agreement. Additional information on the PIF process can be found through the Division of Budgets, Office of Federal Resources.

The use of proprietary materials, methods, or products will not be approved unless:

- (a) There is no other known material of equal or better quality that will perform the same function, or
- (b) There are overwhelming reasons for using the material or product in the public's interest, which may or may not include cost savings, or
- (c) It is essential for synchronization with existing highway or adjoining facilities, or
- (d) Such use is on an experimental basis, with a clearly written plan for "follow-up and evaluation."

If the proprietary item is to be used experimentally and there is Federal participation, the request for FHWA approval must be submitted to the Chief, Office of Resolution of Necessity, Encroachment Exceptions, and Resource Conservation in the Division of Design. The request must include a Construction Evaluated Work Plan (CEWP), which indicates specific functional managers, and units, which have been assigned responsibility for objective follow-up, evaluation, and documentation of the effectiveness of the proprietary item.

110.11 Conservation of Materials and Energy

Paving materials such as cement, asphalt, and rock products are becoming more scarce and expensive, and the production processes for these materials consume considerable energy. Increasing evidence of the limitation of nonrenewable resources and increasing worldwide consumption of most of these resources require optimal utilization and careful consideration of alternates such as the substitution of more plentiful or renewable resources and the recycling of existing materials.

- (1) *Rigid Pavement.* The crushing and reuse of old rigid pavement as aggregate in new rigid or flexible pavement does not now appear to

be a cost-effective alternate, primarily because of the availability of good mineral aggregate in most areas of California. However, if this is a feasible option, because of unique project conditions or the potential lack of readily available materials, it may be included in a cost comparison of alternate solutions.

- (2) *Flexible Pavement.* Recycling of existing flexible pavement must be considered, in all cases, as an alternative to placing 100 percent new flexible pavement.
- (3) *Use of Flexible Pavement Grindings, Chunks and Pieces.* When constructing transportation facilities, the Department frequently uses asphalt in mixed or combined materials such as flexible pavement. The Department also uses recycled flexible grindings and chunks. There is a potential for these materials to reach the waters of the State through erosion or inappropriate placement during construction. Section 5650 of the Fish and Game Code states that it is unlawful to deposit asphalt, other petroleum products, or any material deleterious to fish, plant life, or bird life where they can pass into the waters of the State. In addition, Section 1601 of the Fish and Game Code requires notification to the California Department of Fish and Game (DFG) prior to construction of a project that will result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake designated by the DFG.

The first step is to determine whether there are waters of the State in proximity to the project that could be affected by the reuse of flexible pavement. Waters of the State include: (1) perennial rivers, streams, or lakes that flow or contain water continuously for all or most of the year; or (2) intermittent lakes that contain water from time to time or intermittent rivers or streams that flow from time to time, stopping and starting at intervals, and may disappear and reappear. Ephemeral streams, which are generally exempt under provisions developed by the Department and DFG, are those that flow only in direct response to rainfall.

The reuse of flexible pavement grindings will normally be consistent with the Fish and Game Code and not require a 1601 Agreement when these materials are placed where they cannot enter the waters of the State. However, there are no set rules as to distances and circumstances applicable to the placement of asphaltic materials adjacent to waters of the State. Placement decisions must be made on case-by-case basis, so that such materials will be placed far enough away from the waters of the State to prevent weather (erosion) or maintenance operations from dislodging the material into State waters. Site-specific factors (i.e., steep slopes) should be given special care. Generally, when flexible pavement grindings are being considered for placement where there is a potential for this material to enter a water body, DFG should be notified to assist in determining whether a 1601 Agreement is appropriate. DFG may require mitigation strategies to prevent the materials from entering the Waters of the State. When in doubt, it is recommended that the DFG be notified.

If there is the potential for reused flexible materials to reach waters of the State through erosion or other means during construction, such work would normally require a 1601 Agreement. Depending on the circumstances, the following mitigation measures should be taken to prevent flexible grindings from entering water bodies:

- The reuse of flexible pavement grindings as fill material and shoulder backing must conform to the California Department of Transportation (Department) Standard Specifications, applicable manuals of instruction, contract provisions, and the MOU described below.
- Flexible chunks and pieces in embankment must be placed above the water table and covered by at least one foot of material.

A Memorandum of Understanding (MOU) dated January 12, 1993, outlines the interim agreement between the DFG and the Department regarding the use of asphaltic materials. This MOU provides a working

agreement to facilitate the Department's continued use of asphaltic materials and avoid potential conflicts with the Fish and Game Code by describing conditions where use of asphalt road construction material by the Department would not conflict with the Fish and Game Code.

Specific Understandings contained in the MOU are:

- Asphalt Use in Embankments

The Department may use flexible pavement chunks and pieces in embankments when these materials are placed where they will not enter the waters of the State.

- Use of flexible pavement grindings as Shoulder Backing

The Department may use flexible pavement grindings as shoulder backing when these materials are placed where they will not enter the waters of the State.

- Streambed Alteration Agreements

The Department will notify the DFG pursuant to Section 1601 of the Fish and Game Code when a project involving the use of asphaltic materials or crumbled, flaked, or ground pavement will alter or result in the deposition of pavement material into a river, stream, or lake designated by the DFG. When the proposed activity incorporates the agreements reached under Section 1601 of the Fish and Game Code, and is consistent with Section 5650 of the Fish and Game Code and this MOU, the DFG will agree to the use of these materials.

There may be circumstances where agreement between the DFG and the Department cannot be reached. Should the two agencies reach an impasse, the agencies enter into a binding arbitration process outlined in Section 1601 of the Fish and Game Code. However, keep in mind that this arbitration process does not exempt the Department from complying with the provisions of the Fish and Game Code. Also it should be noted that this process is time consuming, requiring as much as 72 days

or more to complete. Negotiations over the placement of flexible pavement grindings, chunks, and pieces are to take place at the District level as part of the 1601 Agreement process.

110.12 Tunnel Safety Orders

Projects and work activities that include human entry into tunnels, shafts or any of a variety of underground structures to conduct construction activities must address the requirements of the California Code of Regulations (CCR), Title 8, Subchapter 20 – Tunnel Safety Orders (TSO). Activities that can be considered of a maintenance nature, such as cleaning of sediment and debris from culverts or inspection (either condition inspection for design purposes or inspection as a part of construction close-out) of tunnels, shafts or other underground facilities are not affected by these regulations.

TSO requires the Department, as owner of the facility, to request the Department of Industrial Relations, Division of Occupational Safety and Health (Cal-OSHA), Mining and Tunneling Unit, to review and classify tunnels and shafts for the potential presence of flammable gas and vapors prior to bidding. The intent of the TSO regulations are to protect workers from possible injury due to exposure to hazardous conditions. Failure to comply is punishable by fine. The complete TSO regulations are available at the following website: (<http://www.dir.ca.gov/title8/sub20.html>), with Sections 8403 and 8422 containing information most applicable to project design.

The TSO regulations require classification whenever there is human entry into a facility defined as a tunnel or entry into, or very near the entrance of, a shaft. Some of the common types of activities where human entry is likely and that will typically require classification include:

- Pipe jacking or boring operations
- Culvert rehabilitation
- Large diameter pile construction, as described in the following text
- Pump house vaults
- Cut-and-cover operations connected to ongoing underground construction and are covered in a

manner that creates conditions characteristic of underground construction

- Well construction
- Cofferdam excavations
- Deep structure footings/shafts/casings, as described in the following text

Virtually any project that will lead to construction or rehabilitation work within a pipe, caisson, pile or underground structure that is covered by soil is subject to the TSO regulations. This typically applies to underground structures of 30 inches or greater diameter or shaft excavations of 20 feet or more in depth. Since a shaft is defined as any excavation with a depth at least twice its greatest cross section, the regulations will apply to some structure footing or cofferdam excavations.

Cut and cover operations (typical of most pipe, junction structure and underground vault construction) do not fall under the TSO regulations as long as worker entry to the pipe or system (usually for grouting reinforced concrete pipe, tightening bolts on structural plate pipe, etc.) is conducted prior to covering the facility with soil. Connecting new pipe to existing buried pipe or structures does fall under the TSO regulations unless the existing pipe system is physically separated by a bulkhead to prevent entry into the buried portion. Designers must either incorporate requirements for such separation of facilities into the PS&E or they must obtain the required classification from Cal-OSHA. For any project that requires classification, specifications must be included that alert the Contractor to the specific location and classification that Cal-OSHA has provided.

The TSO regulations should be viewed as being in addition to, and not excluding, other requirements as may apply to contractor or Department personnel covered in the Construction Safety Orders (see CCR, Title 8, Subchapter 4, Article 6 at <http://www.dir.ca.gov/title8/sub4.html>), safety and health procedures for confined spaces (see Chapter 14 of the Caltrans Safety Manual), or any other regulations that may apply to such work.

Prior to PS&E submittal on a project that includes any work defined in CCR Section 8403, a written request must be submitted for classification to the

appropriate Mining and Tunneling (M&T) Unit office. Each M&T Unit office covers specific counties as shown on Figure 110.12. Classification must be obtained individually for each separate location on a project. For emergency projects or other short lead-time work, it is recommended that the appropriate M&T Unit office be contacted as soon as possible to discuss means of obtaining classification prior to the start of construction activities.

The request must include all pertinent and necessary data to allow the M&T Unit to classify the situation. The data specified under paragraph (a) of Section 8422 (complete text of Section 8422 reprinted below) is typical of new construction projects, however for culvert rehabilitation and other type of work affecting an existing facility, not all of the indicated items are typically available or necessary for submittal. The appropriate M&T Unit office should be contacted for advice if there is any question regarding data to submit.

In many instances it may not be known during design if there will be human entry into facility types that would meet the definition of a tunnel or shaft. If there is any anticipation that such entry is likely to occur, classification should be requested. As permit acquisition is typically the responsibility of the District, it is imperative that there be close coordination between District and Structures Design staff regarding the inclusion of any facilities in the structures PS&E that could be defined as a tunnel or shaft and have potential for human entry. The following text is taken directly from Section 8422:

8422 Tunnel Classifications

- (a) When the preliminary investigation of a tunnel project is conducted, the owner or agency proposing the construction of the tunnel shall submit the geological information to the Division for review and classification relative to flammable gas or vapors. The preliminary classification shall be obtained from the Division prior to bidding and in all cases prior to actual underground construction. In order to make the evaluation, the following will be required:
 - (1) Plans and specifications;
 - (2) Geological report;

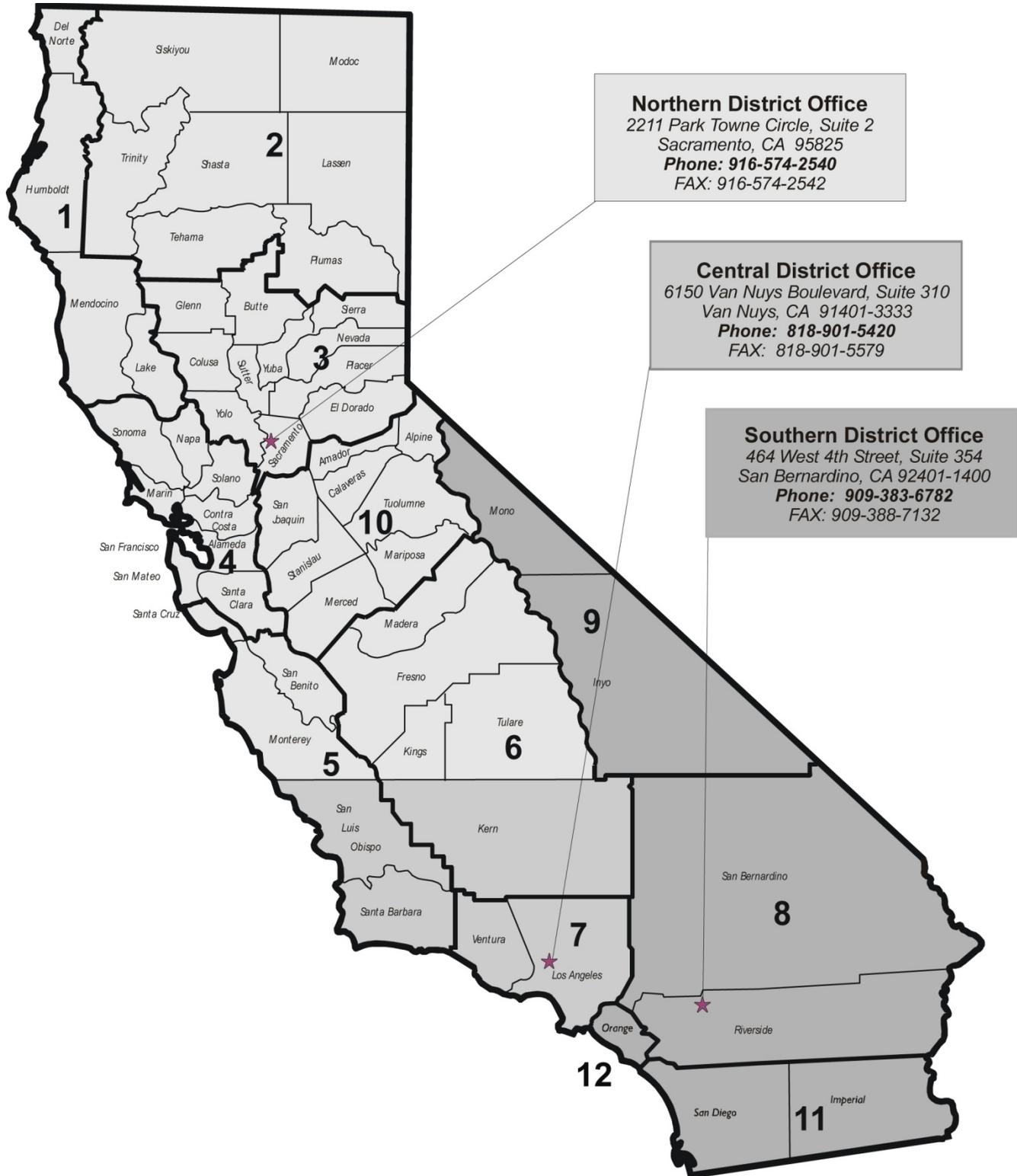
- (3) Test bore hole and soil analysis log along the tunnel alignment;
 - (4) Proximity and identity of existing utilities and abandoned underground tanks.
 - (5) Recommendation from owner, agency, lessee, or their agent relative to the possibility of encountering flammable gas or vapors;
 - (6) The Division may require additional drill hole or other geologic data prior to making gas classifications.
- (b) The Division shall classify all tunnels or portions of tunnels into one of the following classifications:
- (1) Nongassy, which classification shall be applied to tunnels where there is little likelihood of encountering gas during the construction of the tunnel.
 - (2) Potentially gassy, which classification shall be applied to tunnels where there is a possibility flammable gas or hydrocarbons will be encountered.
 - (3) Gassy, which classification shall be applied to tunnels where it is likely gas will be encountered or if a concentration greater than 5 percent of the LEL of:
 - (A) flammable gas has been detected not less than 12 inches from any surface in any open workings with normal ventilation.
 - (B) flammable petroleum vapors that have been detected not less than 3 inches from any surface in any open workings with normal ventilation.
 - (4) Extrahazardous, which classification shall be applied to tunnels when the Division finds that there is a serious danger to the safety of employees and:

Flammable gas or petroleum vapor emanating from the strata has been ignited in the tunnel; or

 - (A) A concentration of 20 percent of the LEL of flammable gas has been detected not less than 12 inches from any surface in any open working with normal ventilation; or
 - (B) A concentration of 20 percent of LEL petroleum vapors has been detected not less than three inches from any surface in any open workings with normal ventilation.
- (c) A notice of the classification and any special orders, rules, special conditions, or regulations to be used shall be prominently posted at the tunnel job site, and all personnel shall be informed of the classification.
- (d) The Division shall classify or reclassify any tunnel as gassy or extrahazardous if the preliminary investigation or past experience indicates that any gas or petroleum vapors in hazardous concentrations is likely to be encountered in such tunnel or if the tunnel is connected to a gassy or extrahazardous excavation and may expose employees to a reasonable likelihood of danger.
- (e) For the purpose of reclassification and to ensure a proper application of classification, the Division shall be notified immediately if a gas or petroleum vapor exceeds any one of the individual classification limits described in subsection (b) above. No underground works shall advance until reclassification has been made.
- (1) A request for declassification may be submitted in writing to the Division by the employer and/or owner's designated agent whenever either of the following conditions occur:
 - (A) The underground excavation has been completed and/or isolated from the ventilation system and/or other excavations underway, or
 - (B) The identification of any specific changes and/or conditions that have occurred subsequent to the initial classification criteria such as geological information, bore hole sampling results, underground tanks or utilities, ventilation system, air quality records, and/or evidence of no intrusions of explosive gas or vapor into the underground atmosphere.

NOTE: The Division shall respond within 10 working days for any such request. Also, the Division may request additional information and/or require specific conditions in order to work under a lower level of classification.

Figure 110.12
California Mining and Tunneling Districts



Topic 111 - Material Sites and Disposal Sites

111.1 General Policy

The policies and procedures concerning material sites and disposal sites are listed below. For further information concerning selection and procedures for disposal, staging and borrow sites, see DIB 85.

- (a) Materials investigations and environmental studies of local materials sources should be made to the extent necessary to provide a basis for study and design. Location and capacity of available disposal sites should be determined for all projects requiring disposal of more than 10,000 cubic yards of clean material. Sites for disposal of any significant amount of material in sensitive areas should be considered only where there is no practical alternative.
- (b) Factual information obtained from such investigations should be made readily available to prospective bidders and contractors.
- (c) The responsibility for interpreting such information rests with the contractor and not with the State.
- (d) Generally, the designation of optional material sites or disposal sites will not be included in the special provisions. Mandatory sites must be designated in the special provisions or Materials Information Handout as provided in Index 111.3 of this manual and Section 2-1.03 of the Standard Specifications. A disposal site within the highway right of way (not necessarily within the project limits) should be provided when deemed in the best interest of the Department as an alternative to an approved site for disposal of water bearing residues generated by grinding or grooving operations, after approval is obtained from the Regional Water Quality Control Board (RWQCB) having jurisdiction over the area.
- (e) Material agreements or other arrangements should be made with owners of material sites whenever the absence of such arrangements would result in restriction of competition in bidding, or in other instances where it is in the State's interest that such arrangements be made.
- (f) The general policy of Caltrans is to avoid specifying mandatory sources unless data in support of such sources shows certain and substantial savings to the State. Mandatory sources must not be specified on Federal-aid projects except under exceptional circumstances, and prior approval of the FHWA is required. Supporting data in such cases should be submitted as early as possible. This policy also applies to disposal sites.
- (g) It is the policy of Caltrans to cooperate with local authorities to the greatest practicable extent in complying with environmental requirements for all projects. Any corrective measures wanted by the local authorities should be provided through the permit process. Any unusual requirements, conditions, or situations should be submitted to the Division of Design for review (see Indexes 110.2 and 110.3).
- (h) The use of any materials site requires compliance with environmental laws and regulations, which is normally a part of the project environmental documentation. If the need for a site occurs after approval of the project environmental document, a separate determination of environmental requirements for the materials site may be required.
- (i) If the materials site is outside the project limits and exceeds 1-acre in size, or extraction will exceed 1,000 cubic yards, it must comply with the Surface Mining and Reclamation Act of 1975 (SMARA) and be included on the current "AB 3098 List" published by the Department of Conservation before material from that site can be used on a State project. There are limited exceptions to this requirement and the District Materials Engineer should be consulted.

111.2 Investigation of Local Materials Sources

- (1) *Extent of Explorations.* Possible sources of materials should be investigated to the extent necessary to assure that the design of each project is based on the most economical use of available materials compatible with good environmental design practices. Where it can be reasonably assumed that all required

materials can be most economically obtained from commercial sources on the current "AB 3098 List", it should be unnecessary to investigate other sites. In all other cases material sites should be investigated. Exploration of materials sources should not be restricted to those properties where the owner expresses willingness to enter into agreement with the State. Unless it is definitely known that the owner will under no circumstances permit removal of materials, the site should be considered as a possible source of local materials.

- (2) *Geotechnical Design Report or Materials Report.* The Geotechnical Design Report or Materials Report should include complete information on all sites investigated and should discuss the quality, cost, SMARA status, and availability of materials from commercial plants on the current "AB 3098 List". Sufficient sampling of sites must be performed to indicate the character of the material and the elevation of the ground water surface, and to determine changes in the character of the material, both laterally and vertically. Sampling must be done in such a manner that individual samples can be taken from each horizon or layer. Composite samples of two or more different types of material are unsatisfactory, as there is no assurance that the materials would be so combined if the materials source were actually used. Testing of blends of two or more types of materials is permissible, provided the test report clearly indicates the combination tested. The test report must clearly indicate the location of the sample and the depth represented. The fact that materials sites are not designated in the Special Provisions does not reduce the importance of thorough exploration and testing.

As tabulations of test data for local materials will be furnished to prospective bidders, and the test reports may be examined by bidders if they so request, it is important that only factual data be shown on the test report and that no conclusions, opinions, or interpretation of the test data be included. Under "Remarks", give only the pertinent factual information regarding the scalping, crushing,

blending, or other laboratory processing performed in preparing samples for testing, and omit any comments as to suitability for any purpose. Any discussion of the quality, suitability, or quantity of material in local materials sites necessary for design purposes should be included in the Geotechnical Design Report or Materials Report, and not noted on the test reports. For any potential materials source explored or tested, all boring and test data must be furnished, including those tests which indicate unsuitable or inferior material.

Materials information to be furnished bidders may include data on a materials source previously investigated for the same project or some other project provided all of the following conditions are met:

- (a) There has been no change in test procedures subsequent to the time the earlier tests were made.
- (b) The materials source has not been altered by stream action, weathering, or other natural processes.
- (c) The material sampled and represented by the tests has not been removed.
- (d) There has been no change in SMARA status, or inclusion or exclusion on the "AB 3098 List".

It will be necessary for each District to maintain a filing system such that all preliminary test reports for potential materials sites are readily accessible. This will necessitate preparation of test reports covering all preliminary tests of materials. It will also be essential to maintain some type of materials inventory system, whereby sites in the vicinity of any project can be readily identified and the test reports can be immediately accessible. Filing only by numerical or chronological order will not be permissible.

111.3 Materials Information Furnished to Prospective Bidders

- (1) *Materials Information Compilation.* It is the intent that all test data applicable to material sites for a project be furnished to prospective bidders. To obtain uniformity in the

"handouts" furnishing this information to prospective bidders, the District Materials Unit should develop the "handout" and the following information must be included:

- (a) A cover page entitled, "Materials Information", should show District, County, Route, kilometer post limits, and geographical limits. There should be a note stating where the records, from which the information was compiled, may be inspected. Also, an index, listing investigated material sites, and disposal sites, maps, test reports, tabulation sheets, SMARA status, and agreements is to be shown on the cover page.
- (b) A vicinity map showing the location of investigated materials sites and disposal sites in relation to the project.
- (c) A map of each material site showing the location and identification of boring or test pits.
- (d) A tabulation of the test data for each material site, showing complete information on the location, depth, and processing of each sample tested, together with all test results.
- (e) Copies of all options or agreements with owners of the material sites, if such arrangements have been made.
- (f) Soil survey sheets or suitable terrain maps showing borings and tests along the highway alignment.
- (g) A tabulation of which sites comply with environmental laws and regulations and are included on the current "AB 3098 List".
- (h) Material site grading and reclamation plan and disposal site grading plans, if they have been prepared.
- (i) Copies of local use permits and clearances (when they have been obtained by the State) such as environmental clearances, mining permits, Forest Service Fire Regulations, water quality control clearances, etc. If documents are of unusual length, a statement should be

included that they have been obtained and are available for inspection at the District office or Sacramento Plans Counter.

Maps, test reports, and other data included in the "Materials Information" must be factual, and should not include any comments, conclusions, or opinions as to the quality, quantity, suitability, depth, or area of the materials in any material site or along the highway.

Reproducible copies of all material to be included in the "Material Information" package should be submitted to the Office Engineer.

The Office Engineer will reproduce the "Materials Information," and copies will be available to prospective bidders upon request in the same manner that plans and special provisions are furnished.

111.4 Materials Arrangements

Materials agreements or other arrangements must be made in accordance with the policy stated under Index 111.1(e).

The determination of when and where materials agreements or other arrangements are to be obtained is the responsibility of the District, see Section 8.25.00.00 of the Right of Way Manual.

The District should also determine the maximum royalty that can be paid economically on the basis of availability of competitive sources.

In preparing agreements, guaranteed quantity provisions should not be included, as the opportunity exists for possible token removal, with the result that the State would be required to pay for the guaranteed quantity even though the material would not actually be removed. Also, requirements that the State perform construction work on the owner's property, such as fences, gates, cattle guards, roads, etc., should be included only when the cost of such items and possible resulting benefits have been properly considered in the derivation of the royalty.

111.5 Procedures for Acquisition of Material Sites and Disposal Sites

These instructions establish procedures to be followed in the purchase of material sites and

disposal sites when such purchase is deemed necessary by the District. The steps to be taken are listed in order as follows:

(1) *General Procedure.*

(a) A District report proposing and establishing the necessity for purchase of the site is required. The report should contain the following information:

- The project or projects on which the site is to be used and programming of proposed construction.
- The location and description of the property, zoning, and site restoration/reclamation proposals including necessary vicinity and site maps.
- The amount and quality of material estimated to be available in the site and amount needed for the project or projects, or amount of excess material to be disposed of and the capacity of the site or sites.
- An economic analysis using the estimated purchase price and value of land after removal of material or deposit of excess material. The total estimated savings over other possible alternatives must be clearly demonstrated. Alternatives must be shown from the standpoint of what would have to be done if the site was not purchased. Alternatives could be changes in location or grade as well as alternative sources of material.
- A statement as to whether or not the use of the site should be mandatory, with a separate statement regarding the effect for each proposed project for which mandatory use of the site is considered necessary, including complete justification for the mandatory specification (see Index 111.6). Three copies of each map or other attachment, folded letter size, are required for mandatory sites on all Federal-aid projects.

- A statement of the type of environmental documentation.
- Other justification.

Send one copy to the Division of Design and one copy to DES Materials Engineering and Testing Services for information.

- (b) If the project or projects are to have Federal aid, the District will prepare a request, with supporting environmental clearance, for FHWA approval to specify the source as mandatory. One copy of this request should be sent to the Office Engineer and one copy to Division of Design.
- (c) If the estimated purchase price is over \$300,000, the District should include the item in the STIP and corresponding budget.
- (d) When the proposed purchase has been approved, the Project Engineer should notify the District Division of Right of Way, District Environmental Division and the District Materials Unit and request that Right of Way purchase the site (or obtain a Materials Agreement; the Materials Unit should assist in the development of the agreement) and the Environmental Division obtain environmental authorization to proceed.
- (e) The District must include the cost of purchase in the proper fiscal year program and/or budget as part of the District targets.
- (f) After budgeting, the District must submit an expenditure authorization to cover purchase of the site. This could be concurrent if the project is added to the budget during a fiscal year. The expenditure authorization request should be processed through the District Project Management and Administration Units and obtain District Director approval.
- (g) After issuance of an expenditure authorization, the District Division of Right of Way will complete purchase of the site.

- (2) *Material and Disposal Sites in Federal Lands.* The applicable sections of the Federal Highway Act of 1958 for procurement of borrow or disposal sites, Sections 107(d) and 317, are set forth in Section 8.18.02.00 of the Right of Way Manual; Section 107(d) applies to the Interstate System while Section 317 applies to other Federal-aid highways. Whenever Federal public lands are required for a material or a disposal site, and after preliminary negotiations at the local level with the Federal agency having jurisdiction, the District must submit a letter report to the FHWA. This report should observe the requirements of Index 111.5 of this manual and Section 8.18.02.03 of the Right of Way Manual.

Following submittal of the proposal by the District to the FHWA, the latter, acting on behalf of the State transmits the proposal with a favorable recommendation to the Federal agency having control of the site. See Section 8.18.02.03 of the Right of Way Manual.

111.6 Mandatory Material Sites and Disposal Sites on Federal-aid Projects

The contract provisions must not specify a mandatory site for the disposal of surplus excavated materials unless a particular site is needed for environmental reasons or the site is found to be the most economical for one or more Federal-aid projects. All points listed in Index 111.5(1)(a) and (b) must be covered and one copy of all attachments submitted. Supporting data must be submitted to the FHWA during the project planning phase or early in the project design phase as almost all cases of mandatory sites must go to the FHWA for decision.

Section 635.407 of 23 CFR 635D states in part:

"The designation of a mandatory material source may be permitted based on environmental considerations, provided the environment would be substantially enhanced without excessive cost."

"The contract provisions ... shall not specify mandatory a site for the disposal of surplus excavated materials unless there is a finding by the State highway agency with the concurrence of the FHWA Division

Administrator that such placement is the most economical except that the designation of a mandatory site may be permitted based on environmental considerations, provided the environment would be substantially enhanced without excessive cost."

Topic 112 - Contractor's Yard and Plant Sites

112.1 Policy

The Project Engineer should, during the design phase of a project, consider the need and availability of sites for the contractor's yards and materials plants. This is particularly important in areas where dust, noise, and access problems could limit the contractor in obtaining sites on their own in a timely manner. Asphalt concrete recycling projects pose special problems of material storage, access, and plant location; see Index 110.11. Temporary storage areas should be considered for grooving and grinding projects. As a general rule, the use of material sites designated in the Special Provisions should be optional. Should the materials site be desired, the contractor shall provide notice to the Resident Engineer within a designated time period after approval of the contract (30 days would be a minimum, but not more than 60 days except in unusual situations). All environmental requirements must be satisfied and local permits must be obtained prior to submittal of the PS&E. Right of Way, Permits, and Environmental units must be informed early in the process. The contractor will be allowed to use these sites only for work on the designated project(s).

112.2 Locating a Site

The Project Engineer should consult with District Division of Right of Way concerning appropriately sized parcels currently being held in the airspace inventory, nearby property held by Caltrans for future construction, or as excess land. If such space is available in the vicinity of the project, the District Environmental Division should be consulted to determine what environmental requirements are necessary for the use of these properties for the intended purpose. If sufficient space does not appear to be available for yard or plant, the Project Engineer must see that the

appropriate wording is placed in the contract Special Provisions.

Topic 113 - Geotechnical Design Report

113.1 Policy

The Project Engineer must review the project initiation document and Preliminary Geotechnical Design Report, if any, to ascertain the scope of geotechnical involvement for a project. A Geotechnical Design Report (GDR) is to be prepared by the Roadway Geotechnical Engineering Branches of the Division of Engineering Services, Geotechnical Services (DES-GS) (or prepared by a consultant with technical oversight by DES-GS) for all projects that involve designs for cut slopes, embankments, earthwork, landslide remediation, retaining walls, groundwater studies, erosion control features, subexcavation and any other studies involving geotechnical investigations and engineering geology. A GDR is not required for projects that solely include those design features described in Index 114.1.

113.2 Content

The GDR is to conform to the “Guidelines for Geotechnical Reports” which is prepared by the Office of Structural Foundations.

113.3 Submittal and Review

Final copies of the GDR are to be submitted to the Project Engineer, District Materials Unit, and the Division of Design. For consultant developed reports, the GDR is to be submitted to DES-GS for review and approval. DES-GS will then transmit the approved GDR to the Project Engineer, District Materials Unit, and the Division of Design.

Topic 114 - Materials Report

114.1 Policy

A Materials Report must be prepared for all projects that involve any of the following components:

- Pavement structure recommendations and/or pavement studies
- Culverts (or other drainage materials)

- Corrosion studies
- Materials disposal sites
- Side prone areas with erosive soils

The Materials Report may be either a single report or a series of reports that contains one or several of the components listed above. Materials Reports are prepared for Project Initiation Documents, Project Reports, and PS&E. Materials Report(s) are signed and stamped with an engineers seal by the engineer in responsible charge for the findings and recommendations. The District Materials Engineer will either prepare the Materials Report or review and accept Materials Report(s) prepared by others. The Material Report is signed by the Registered Engineer that prepared the report.

114.2 Requesting Materials Report(s)

The Project Engineer (or equivalent) is responsible for requesting a Materials Report. The District Materials Engineer can assist the Project Engineer in identifying what components need to be addressed, when to request them, and what information is needed. At a minimum, the following information needs to be included in all requests:

- (1) *Project location.*
- (2) *Scope of work.* Project Engineer should spell out the type of work to be done that will affect materials. If pavements are involved, state type of pavement work. Provide type of project, such as new construction, widening, or rehabilitation. Note if culverts will be installed, extended, or replaced. Note if material or disposal sites are needed, see Topic 111 for criteria.
- (3) *Proposed design life for pavements and culverts.*
- (4) *Design Designation.* Include for projects involving pavement structural enhancements. Does not apply to pavement preservation activities.
- (5) *Special Considerations or Limitations.* Include any information that may affect the materials recommendations. Examples include traffic management requirements or environmental restrictions.

114.3 Content

All Materials Reports must contain the location of the project, scope of work, and list of special conditions and assumptions used to develop the report. Materials Reports must contain the following information when the applicable activity is included in the scope of the project.

- (1) *Pavement.* The Materials Report must document the design designation and climate zone or climate data used to prepare the report and recommendations. Document studies, tests, and cores performed to collect data for the report. Include deflection studies for flexible pavement rehabilitation projects (see Index 635.1). Also include pavement structure recommendations. The report should also outline special material requirements that should be incorporated such as justifications for using (or not using) particular materials in the pavement structure.
- (2) *Drainage Culverts or Other Materials.* The Materials Report must contain a sufficient number of alternatives that materially meet or exceed the culvert design life (and other drainage related) standards for the Project Engineer to establish the most maintainable, constructable, and cost effective alternative in conformance with FHWA regulations (23 CFR 635D).
- (3) *Corrosion.* Corrosion studies are necessary when new culverts, culvert rehabilitation, or culvert extensions are part of the scope of the project. Studies should satisfy the requirements of the “Corrosion Guidelines”. Copies of the guidelines can be obtained from the Corrosion Technology Branch in DES Materials Engineering and Testing Services or on the DES Materials Engineering and Testing Services website.
- (4) *Materials or Disposal Sites.* See Topic 111 “Material and Disposal Sites” for conditions when sites need to be identified and how to document.

114.4 Preliminary Materials Report

Because resources and/or time are sometimes limited, it is not always possible to complete all the tests and studies necessary for a final Materials

Report during the planning/scooping phase. In these instances, a Preliminary Materials Report may be issued using the best information available and good engineering judgment. Accurate traffic projections and design designations are still required for the Preliminary Materials Report. Preliminary Materials Reports should not be used for project reports or PS&E development. When used, Preliminary Materials Reports must document the sources of information used and assumptions made. It must clearly state that the Preliminary Materials Report is to be used for planning and initial cost estimating only and not for final design. The Department Pavement website contains supplemental guidance for developing preliminary pavement structures.

114.5 Review and Retention of Records

A copy of the Draft Materials Report is to be submitted for review and comment to the District Materials Engineer. The District Materials Engineer reviews the document for the Department to assure that it meets the standards, policies, and other requirements found in Department manuals, and supplemental district guidance (Index 604.2(2)). If it is found that the document meets these standards, the District Materials Engineer accepts the Materials Report. If not, the report is returned with comments to the submitter.

After resolution of the comments, a final copy of the Materials Report is submitted to the District Materials Engineer who then furnishes it to the Project Engineer. The original copy of the Materials Report must be permanently retained in the District’s project history file and be accessible for review by others when requested.

Topic 115 - Designing for Bicycle Traffic

115.1 General

Under the California Vehicle Code, bicyclists generally have the same rights and duties that motor vehicle drivers do when using the State highway system. For example, they make the same merging and turning movements, they need adequate sight distance, they need access to all destinations, etc. Therefore, designing for bicycle traffic and designing for motor vehicle traffic are similar and based on the same fundamental

transportation engineering principles. The main differences between bicycle and motor vehicle operations are lower speed and acceleration capabilities, as well as greater sensitivity to out of direction travel and steep uphill grades. Design guidance that addresses the safety and mobility needs of bicyclists on Class II bikeways (bike lanes) is distributed throughout this manual. See Chapter 1000 for additional bicycle guidance for Class I bikeways (bike paths) and Class III bikeways (bike routes).

All city, county, regional and other local agencies responsible for bikeways or roads except those freeway segments where bicycle travel is prohibited shall equal or exceed the minimum bicycle design criteria contained in this and other chapters of this manual (see the Streets and Highways Code, Section 891). The decision to develop bikeways should be made in consultation and coordination with local agencies responsible for bikeway planning to ensure connectivity and network development.

Generally speaking, bicycle travel can be enhanced by bikeways or improvements to the right-hand portion of roadways, where bicycles are required to travel. When feasible, a wider shoulder than minimum standard should be considered since bicyclists are required to ride to as far to the right as possible, and shoulders provide bicyclists an opportunity to pull over to let faster traffic pass.

All transportation improvements are an opportunity to improve safety, access, and mobility for the bicycle mode of travel.

Topic 116 - Bicyclists and Pedestrians on Freeways

116.1 General

Seldom is a freeway shoulder open to bicycle, pedestrian or other non-motorized travel, but they can be opened for use if certain criteria assessing the safety and convenience of the freeway, as compared with available alternate routes, is met. However, a freeway should not be opened to bicycle or pedestrian use if it is determined to be incompatible. The Headquarters Traffic Liaison and the Design Coordinator must approve any proposals to open freeways to bicyclists, pedestrian

or other non-motorized use. See the California MUTCD and CVC Section 21960.

When a new freeway segment is to remain open or existing freeway segment is to be reopened to these modes, it is necessary to evaluate the freeway features for their compatibility with safe and efficient travel, including:

- Shoulder widths
- Drainage grates; see Index 1003.5(2)
- Expansion joints
- Utility access covers on shoulders
- Frequency and spacing of entrance/exit ramps
- Multiple-lane entrance/exit ramps
- Traffic volumes on entrance/exit ramps and on lanes merging into exit ramps
- Sight distance at entrance/exit ramps
- Freeway to freeway interchanges
- The presence and design of rumble strips
- Longitudinal edges and joints

If a freeway segment has no suitable non-freeway alternative and is closed because certain features are considered incompatible, the feasibility of eliminating or reducing the incompatible features should be evaluated. This evaluation may include removal, redesign, replacement, relocation or retrofitting of the incompatible feature, or installation of signing, pavement markings, or other traffic control devices.

Where no reasonable, convenient and safe non-freeway alternative exists within a freeway corridor, the Department should coordinate with local agencies to develop new routes, improve existing routes or provide parallel bicycle and pedestrian facilities within or adjacent to the freeway right of way. See Project Development Procedures Manual Chapter 1, Article 3 (Regional and System Planning) and Chapter 31 (Nonmotorized Transportation Facilities) for discussion of the development of non-freeway transportation alternatives.

CHAPTER 300 GEOMETRIC CROSS SECTION

The selection of a cross section is based upon the joint use of the transportation corridor by vehicles, including trucks, public transit, cyclists and pedestrians. Designers should recognize the implications of this sharing of the transportation corridor and are encouraged to consider not only vehicular movement, but also movement of people, distribution of goods, and provision of essential services. Designers need also to consider the plan for the future of the route, consult Transportation Concept Reports for state routes.

Topic 301 - Traveled Way Standards

The traveled way width is determined by the number of lanes required to accommodate operational needs, terrain, safety and other concerns. The traveled way width includes the width of all lanes and bike lanes, but does not include the width of shoulders, sidewalks, curbs, dikes, gutters, or gutter pans. See Topic 307 for State highway cross sections, and Topic 308 for road cross sections under other jurisdictions.

Index 301.1 – Lane Width

The minimum lane width on two-lane and multilane highways, ramps, collector-distributor roads, and other appurtenant roadways shall be 12 feet, except as follows:

- **For conventional State highways with posted speeds less than or equal to 40 miles per hour and AADTT (truck volume) less than 250 per lane that are in urban, city or town centers (rural main streets), the minimum lane width shall be 11 feet.** The preferred lane width is 12 feet. See Index 81.3 for place type definitions.

Where a 2-lane conventional State highway connects to a freeway within an interchange, the lane width shall be 12 feet.

Where a multilane State highway connects to a freeway within an interchange, the

outer most lane of the highway in each direction of travel shall be 12 feet.

- For highways, ramps, and roads with curve radii of 300 feet or less, widening due to offtracking in order to minimize bicycle and vehicle conflicts must be considered. See Index 404.1 and Table 504.3A.
- For lane widths on roads under other jurisdictions, see Topic 308.

301.2 Class II Bikeway (Bike Lane) Lane Width

(1) *General.* **Class II bikeways (bike lanes), for the preferential use of bicycles, may be established within the roadbed and shall be located immediately adjacent to a traffic lane as allowed in this manual.** Typical Class II bikeway configurations are illustrated in Figure 301.2A. A bikeway located behind on-street parking, physical separation, or barrier within the roadway is not a Class II bikeway (bike lane); see Index 1003.1 Class I Bikeway (Bike Path) for standards and design guidance. **The minimum Class II bike lane width shall be 4 feet, except where:**

- Adjacent to on-street parking, the minimum bike lane should be 5 feet.
- Posted speeds are greater than 40 miles per hour, the minimum bike lane should be 6 feet, or
- **On highways with concrete curb and gutter, a minimum width of 3 feet measured from the bike lane stripe to the joint between the shoulder pavement and the gutter shall be provided.**

Class II bikeways may be included as part of the shoulder width See Topic 302.

As grades increase, downhill bicycle speeds can increase, which increases the width needed for the comfort of bicycle operation. If bicycle lanes are to be marked, additional width should be provided to accommodate these higher bicycle speeds. See Index 204.5(4) for guidance on accommodating bicyclists on uphill grades where a Class II bikeway is not included.

If bike lanes are to be located on one-way streets, they may be placed on either or both sides of the street. When only one bicycle lane is provided, it should be located on the side of the street that presents the lowest number of conflicts for bicyclists which facilitates turning movements and access to destinations on the street.

- (2) *On-Street Parking Adjacent to Class II Bikeways.* Parking adjacent to bike lanes is discussed in subsection (1) above and addressed in Table 302.1, Note (7). Part-time bike lanes with part-time on-street parking is discouraged. This type of bike lane may only be considered if the majority of bicycle travel occurs during the hours of parking prohibition. When such an installation is being considered refer to the California MUTCD and traffic operations for direction regarding proper signing and marking.
- (3) *Reduction of Cross Section Elements Adjacent to Class II Bikeways.* There are situations where it may be desirable to reduce the width of the lanes in order to add or widen bike lanes or shoulders. In determining the appropriateness of narrower traffic lanes, consideration should be given to factors such as motor vehicle speeds, truck volumes, alignment, bike lane width, sight distance, and the presence of on-street parking. When on-street parking is permitted adjacent to a bike lane, or on a shoulder where bicycling is not prohibited, reducing the width of the adjacent traffic lane may allow for wider bike lanes or shoulders, to provide greater clearance between bicyclists and driver-side doors when opened.

301.3 Cross Slopes

- (1) *General.* The purpose of sloping on roadway cross sections is to provide a mechanism to direct water (usually from precipitation) off the traveled way. Undesirable accumulations of water can lead to hydroplaning or other problems which can increase accident potential. See Topics 831 and 833 for hydroplaning considerations. For roadways with three (3) lanes or more sloped in the same direction, see topic 833.2.

(2) *Standards.*

- (a) **The standard cross slope to be used for new construction on the traveled way for all types of surfaces shall be 2 percent.**
- (b) **For resurfacing or widening (only when necessary to match existing cross slope), the minimum shall be 1.5 percent and the maximum shall be 3 percent.** However, the cross slope on 2-lane and multilane HMA highways should be increased to 2 percent if the cost is reasonable.
- (c) **On unpaved roadway surfaces, including gravel and penetration treated earth, the cross slope shall be 2.5 percent to 5.0 percent.**

On undivided highways with two or more lanes in a normal tangent section, the high point of the crown should be centered on the pavement and the pavement sloped toward the edges on a uniform grade.

For rehabilitation and widening projects, the maximum algebraic difference in cross slope between adjacent lanes of opposing traffic for either 2-lane or undivided multilane highways should be 6 percent. For new construction, the maximum shall be 4 percent.

On divided highway roadbeds, the high point of crown may be centered at, or left of, the center of the traveled way, and preferably over a lane line (tent sections). This strategy may be employed when adding lanes on the inside of divided highways, or when widening an existing "crowned" 2-lane highway to a 4-lane divided highway by utilizing the existing 2-lane pavement as one of the divided highway roadbeds.

The maximum algebraic difference in cross slope between same direction traffic lanes of divided highway roadbeds should be 4 percent.

The maximum difference in cross slope between the traveled way and the shoulder should not exceed 8 percent. This applies to

new construction as well as pavement overlay projects.

At freeway entrances and exits, the maximum difference in cross slope between adjacent lanes, or between lanes and gore areas, should not exceed 5 percent.

Topic 302 - Highway Shoulder Standards

302.1 Width

The shoulder widths given in Table 302.1 shall be the minimum continuous usable width of paved shoulder on highways. Typically, on-street parking areas in urbanized areas is included in the shoulder.

Class II bikeways are typically part of the shoulder width, see Index 301.2. **Where rumble strips are placed in the shoulder, the shoulder shall be a minimum of 4 feet width to the right of the grooved rumble strip when a vertical element, such as curb or guardrail is present or a minimum of 3 feet width when a vertical element is not present.** Shoulder rumble strip must not be placed in the Class II bike lane. Consult the District Traffic Safety Engineer during selection of rumble strip options and with the California MUTCD for markings in combination with rumble strip. Also see Standard Plans for rumble strip details.

See Design Information Bulletin Number 79, for 2R, 3R, certain storm damage, protective betterment, operational, and safety projects on two-lane conventional highways and three-lane conventional highways.

See Index 308.1 for shoulder width requirements on city streets or county roads. See shoulder definition, Index 62.1(8).

See Index 1102.2 for shoulder width requirements next to noise Barriers.

When shoulders are less than standard width, see Index 204.5(4) for bicycle turnout considerations.

302.2 Cross Slopes

- (1) **General - When a roadway crosses a bridge structure, the shoulders shall be in the same plane as the adjacent traveled way.**
- (2) **Left Shoulders - In depressed median sections, shoulders to the left of traffic shall be sloped at 2 percent away from the traveled way.**

In paved median sections, shoulders to the left of traffic shall be designed in the plane of the traveled way. Maintenance paving beyond the edge of shoulder should be treated as appropriate for the site, but consideration needs to be given to the added runoff and the increased water depth on the pavement (see discussion in Index 831.4(5) "Hydroplaning").

- (3) **Right Shoulders-** In normal tangent sections, **shoulders to the right of traffic shall be sloped at 2 percent to 5 percent away from the traveled way.**

The above flexibility in the design of the right shoulder allows the designer the ability to conform to regional needs. Designers shall consider the following during shoulder cross slope design:

- In most areas a 5 percent right shoulder cross slope is desired to most expeditiously remove water from the pavement and to allow gutters to carry a maximum water volume between drainage inlets. The shoulders must have adequate drainage interception to control the "water spread" as discussed in Table 831.3 and Index 831.4. Conveyance of water from the total area transferring drainage and rainwater across each lane and the quantity of intercepting drainage shall also be a consideration in the selection of shoulder cross slope. Hydroplaning is discussed in Index 831.4 (5).
- In locations with snow removal operations it is desirable for right shoulders to slope away from traffic in the same plane as the traveled way. This design permits the snowplowing crew to remove snow from

**Table 302.1
Mandatory Standards for Paved
Shoulder Widths on Highways**

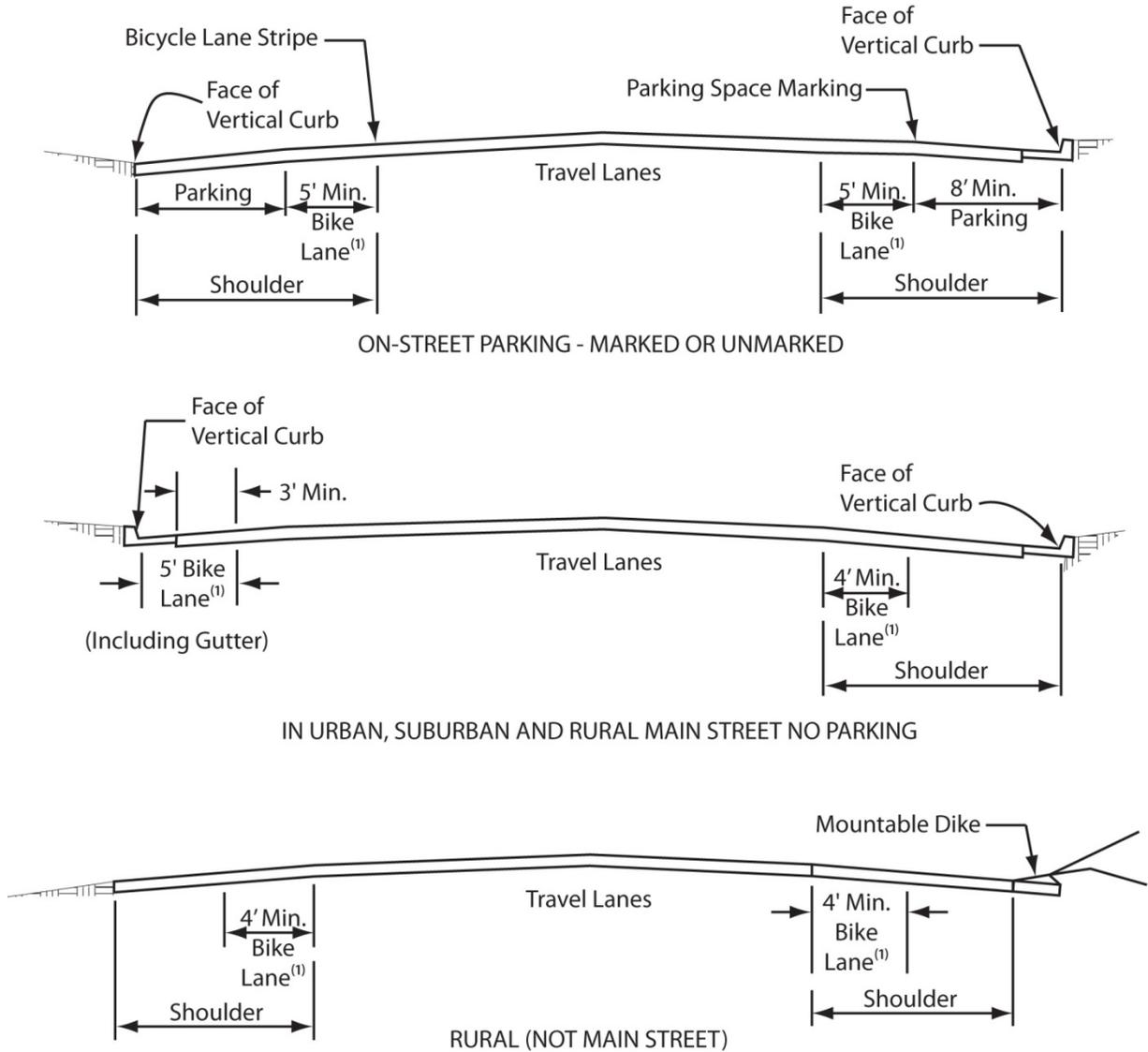
Highway Type	Paved Shoulder Width (ft)	
	Left	Right ⁽⁸⁾
Freeways & Expressways		
2 lanes ⁽¹⁾	--	8 ⁽⁶⁾
4 lanes ⁽¹⁾	5	10
6 or more lanes ⁽¹⁾	10	10
Auxiliary lanes	--	10
Freeway-to-freeway connections		
Single and two-lane connections	5	10
Three-lane connections	10	10
Single-lane ramps	4 ⁽²⁾	8
Multilane ramps	4 ⁽²⁾	8 ⁽³⁾
Multilane undivided	--	10
Collector-Distributor	5	10
Conventional Highways		
Multilane divided		
4-lanes	5	8 ⁽⁷⁾
6-lanes or more	8	8 ⁽⁷⁾
Urban areas with posted speeds less than or equal to 45 mph and curbed medians	2 ⁽⁴⁾	8 ⁽⁷⁾
Multilane undivided	--	8 ⁽⁷⁾
2-lane		
RRR	See Index 307.3	
New construction	See Table 307.2	
Slow-moving vehicle lane	--	4 ⁽⁵⁾
Local Facilities		
Frontage roads	See Index 310.1	
Local facilities crossing State facilities	See Index 308.1	

NOTES:

- (1) Total number of lanes in both directions including separate roadways (see Index 305.6). If a lane is added to one side of a 4-lane facility (such as a truck climbing lane) then that side shall have 10 feet left and right shoulders. See Index 62.1.
- (2) May be reduced to 2 feet upon concurrence from the Design Coordinator that a restrictive situation exists. 4 feet preferred in urban areas and/or when ramp is metered. See Index 504.3.
- (3) May be reduced to 2 feet or 4 feet (4 feet preferred in urban areas) in the 2-lane section of a non-metered ramp, which transitions from a single lane upon concurrence from the Design Coordinator that a restrictive situation exists. May be reduced to 2 feet in ramp sections having 3 or more lanes. See Index 504.3(b).
- (4) For posted speeds less than or equal to 35 mph, shoulder may be omitted (see Index 303.5(5)) except where drainage flows toward the curbed median.
- (5) On right side of climbing or passing lane section only. See Index 301.2(1) for minimum width if bike lanes are present.
- (6) 10-foot shoulders preferred.
- (7) Where on-street parking is allowed, 10 feet shoulder width is preferred. Where bus stops are present, 10 feet shoulder width is preferred for the length of the bus stop. If a Class II bikeway is present, minimum shoulder width shall be 8 feet where on street parking is provided plus the minimum required width for the bike lane.
- (8) Shoulders adjacent to abutment walls, retaining walls in cut locations, and noise barriers shall be not less than 10 feet wide. See Index 303.4 for minimum shoulder adjacent to bulbouts.

Figure 301.2A

Typical Class II Bikeway (Bike Lane) Cross Sections



NOTES:

- (1) See Index 301.2 for additional guidance.
- (2) For pavement marking guidance, see the California MUTCD, Section 9C.04.

the lanes and the shoulders with the least number of passes.

- For 2-lane roads with 4-foot shoulders, see Index 307.2.
- If shoulders are Portland cement concrete and the District plans to convert shoulders into through lanes within the 20 years following construction, then shoulders are to be built in the plane of the traveled way and to lane standards for width and structural section. (See Index 603.4).
- Deciding to construct pedestrian facilities and elements, where none exist, is an important consideration. Shoulders are not required to be designed as accessible pedestrian routes although it is legal for a pedestrian to traverse along a highway. In urban, rural main street areas, or near schools and bus stops with pedestrians present, pedestrian facilities should be constructed. In rural areas where few or no pedestrians exist, it would not be reasonable or cost effective to construct pedestrian facilities. This determination should involve the local agency and must be consistent with the design guidance provided in Topic 105 and in Design Information Bulletin 82, "Pedestrian Accessibility Guidelines for Highway Projects" for people with disabilities.

Shoulder slopes for superelevated curves are discussed in Index 202.2.

See Index 307.2 for shoulder slopes on 2-lane roads with 4-foot shoulders.

302.3 Safety Edge

The safety edge is a sloped edge that is placed at the edge of the paved roadbed to provide a smooth reentry for vehicles that leave the roadway. Its design is based on research performed by the FHWA. See Standard Plans for slope of safety edge and other construction details. The safety edge is placed on all traversable pavement edges irrespective of pavement types except for:

- Next to curbs, dikes, guardrails, barriers, walls, and landscape paving.

- Where the distance from the edge of the paved roadbed to the hinge point is less than 1 foot and there is not enough room to place the safety edge.
- Within 3 feet of driveways or intersections.
- Pavement overlays that are less than 0.15 feet thick.

See the Plans Preparation Manual and the Standard Plans for further information and details on the safety edge.

Topic 303 - Curbs, Dikes, and Side Gutters

303.1 General Policy

Curb (including curb with gutter pan), dike, and side gutter all serve specific purposes in the design of the roadway cross section. Curb is primarily used for channelization, access control, separation between pedestrians and vehicles, and to enhance delineation. Dike is specifically intended for drainage and erosion control where stormwater runoff cannot be cost effectively conveyed beyond the pavement by other means. Curb with gutter pan serves the purpose of both curb and dike. Side gutters are intended to prevent runoff from a cut slope on the high side of a superelevated roadway from running across the pavement and is discussed further in Index 834.3.

Aside from their positive aspects in performing certain functions, curbs and dikes can have undesirable effects. In general, curbs and dikes should present the least potential obstruction, yet perform their intended function. As operating speeds increase, lower curb and dike height is desirable. Curbs and dikes are not considered traffic barriers.

On urban conventional highways where right of way is costly and/or difficult to acquire, it is appropriate to consider the use of a "closed" highway cross section with curb, or curb with gutter pan. There are also some situations where curb is appropriate in freeway settings. The following criteria describe typical situations where curb or curb with gutter pan may be appropriate:

- (a) Where needed for channelization, delineation, or other means of improving traffic flow and safety.
- (b) At ramp connections with local streets for the delineation of pedestrians walkways and continuity of construction at a local facility.
- (c) As a replacement of existing curb with gutter pan and sidewalk.
- (d) On frontage roads on the side adjacent to the freeway to deter vehicular damage to the freeway fence.
- (e) When appropriate to conform to local arterial street standards.
- (f) Where it may be necessary to solve or mitigate operational deficiencies through control or restriction of access of traffic movements to abutting properties or traveled ways.
- (g) In freeway entrance ramp gore areas (at the inlet nose) when the gore cross slope exceeds standards.
- (h) At separation islands between a freeway and a collector-distributor to provide a positive separation between mainline traffic and collector-distributor traffic.
- (i) Where sidewalk is appropriate.
- (j) To deter vehicular damage of traffic signal standards.

Dike is appropriate where controlling drainage is not feasible via sheet flow or where it is necessary to contain/direct runoff to interception devices. On cut slopes, dike also protects the toe of slope from erosion. Dike may also be necessary to protect adjacent areas from flooding.

The use of curb should be avoided on facilities with posted speeds greater than or equal to 40 miles per hour, except as noted in Table 303.1. For projects where the use of curb is appropriate, it should be the type shown in Table 303.1.

303.2 Curb Types and Uses

Depending on their intended function, one of two general classifications of curb design is selected as appropriate. The two general classifications are vertical and sloped. Vertical curbs are nearly vertical (approximate batter of 1:4) and vary in

height from 4 inches to 8 inches. Sloped curbs (approximate batter of 2:3 or flatter) vary in height from 3 inches to 6 inches.

Sloped curbs are more easily mounted by motor vehicles than vertical curbs. Since curbs are not generally adequate to prevent a vehicle from leaving the roadway, a suitable traffic barrier should be provided where redirection of vehicles is needed. A curb maybe placed to discourage vehicles from intentionally entering the area behind the curb (e.g., truck offtracking). In most cases, the curb will not prevent an errant vehicle from mounting the curb.

Curb with gutter pan may be provided to enhance the visibility of the curb and thus improve delineation. This is most effective where the adjacent pavement is a contrasting color or material. B2-4 and B4 curbs are appropriate for enhancing delineation. Where curb with gutter pan is intended as delineation and has no drainage function, the gutter pan should be in the same plane as the adjacent pavement.

The curb sections provided on the Standard Plans are approved types to be used as stated below. The following types are vertical curb, (for information on side gutters, see Index 834.3):

- (1) *Types A1-6, A2-6, and A3-6.* These curbs are 6 inches high. Their main function is to provide a more positive deterrent to vehicles than provided by sloped curbs. Specifically, these curbs are used to separate pedestrians from vehicles, to control parking of vehicles, and to deter vehicular damage of traffic signal standards. They may also be used as raised median islands in low speed environments (posted speed \leq 35 miles per hour). These curbs do not constitute a barrier as they can be mounted except at low speeds and flat angles of approach.
- (2) *Types A1-8, A2-8, and A3-8.* These 8-inch high curbs may be used in lieu of 6-inch curbs when requested by local authorities, if the curb criteria stated under Index 303.1 are satisfied and posted speeds are 35 miles per hour or less. This type of curb may impede curbside passenger loading and may make it more difficult to comply with curb ramp design (see Design Information Bulletin

**Table 303.1
Selection of Curb Type**

Location	Posted Speeds (mph)		
	≤ 35	40	≥ 45
Freeways and Expressways			
Collector-distributor Roads	See Index 504.3(11)		
Ramps			
Conventional Highways			
- Frontage Roads (1)	A or B-6	B-6	B-4
- Traffic Signals	A or B-6	B-6	B-4
- Raised Traffic, Median Islands & Pedestrian Refuge Islands (2)	A or B-6	B-6	B-4 or D
- Adjacent to Sidewalks	A (3)	A-6	B-6
- Bulbouts/curb extensions	B-6	NA	NA
- Bridges (4)	H, A3, or B3	H or B3	B3

NOTES:

- (1) Based on the posted speed along the frontage road.
- (2) See Design Information Bulletin Number 80, "Roundabouts" for information on curbs at roundabouts.
- (3) Type A curb includes Types A1-6, A2-6, A1-8, and A2-8.
- (4) Type H curb typically used in conjunction with Type A curbs next to sidewalks on approach roadway.
Type A3 curbs typically used with corresponding Type A curbs on median island of approach roadway.
Type B3 curbs typically used with corresponding Type B curbs on approach roadway.

Number 82, “Pedestrian Accessibility Guidelines for Highway Projects”).

- (3) *Type H Curb.* This type may be used on bridges where posted speeds are 40 miles per hour or less and where it is desired to match the approach roadway curb. Type H curb is often incorporated into bridge barrier/sidewalk combination railings (See Index 208.10(4)).

These types are sloped curbs:

- (4) *Types B1, B2, and B3 Curbs* Types B1-6, B2-6, and B3-6 are 6 inches high. Type B1-4, B2-4, and B3-4 are 4 inches high. Since all have a 1:1½ slope or flatter on the face, they are mounted more easily than Type A curbs. Typical uses of these curbs are for channelization including raised median islands. B2 curb with gutter pan also serves as drainage control.
- (5) *Type B4 Curb.* Type B4 curb with gutter pan is 3 inches high and is typically used on ramp gores as described in Index 504.3(11). It may also be appropriate where a lower curb is desirable.
- (6) *Type D Curb.* Type D curb is 4 inches or 6 inches high and is typically used for raised traffic islands, collector-distributor separation islands, or raised medians when posted speeds equal or exceed 45 miles per hour.
- (7) *Type E Curb.* This essentially is a rolled gutter used only in special drainage situations.

Curbs with gutter pans, along with the shoulder, may provide the principal drainage system for the roadway. Inlets are provided in the gutter pan or curb, or both.

Gutter pans are typically 2 feet wide but may be 1 foot to 4 feet in width, with a cross slope of typically 8.33 percent to increase the hydraulic capacity. Gutter pan cross slopes often need to be modified at curb ramps in order to meet accessibility requirements. See Design Information Bulletin Number 82, “Pedestrian Accessibility Guidelines for Highway Projects” for accessibility standards. Warping of the gutter pan should be limited to the portion within 2 feet to 3 feet of the gutter flow line to minimize adverse driving effects.

Curbs and gutter pans are cross section elements considered entirely outside the traveled way, see Index 301.1.

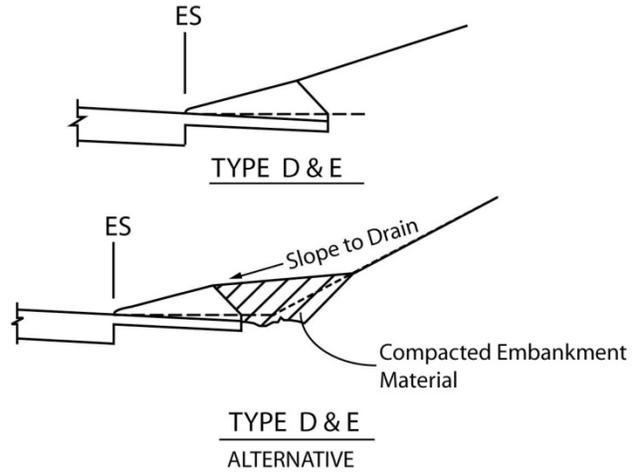
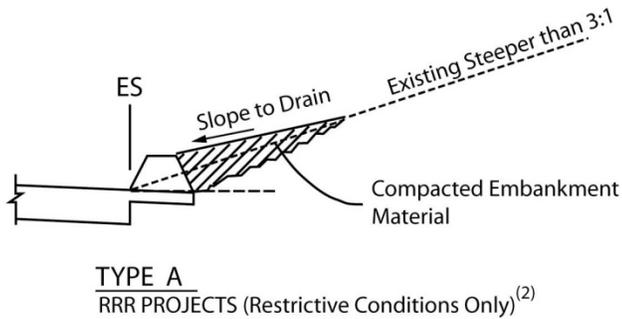
303.3 Dike Types and Uses

Use of dike is intended for drainage control and should not be used in place of curb. Dikes placed adjoining the shoulder, as shown in Figures 307.2, 307.4, and 307.5, provide a paved triangular gutter within the shoulder area. The dike sections provided on the Standard Plans are approved types to be used as stated below. Dikes should be selected as illustrated in Figure 303.3. Dikes should be designed so that roadway runoff is contained within the limits specified in Index 831.3. For most situations Type E dike is the preferred dike type as discussed below.

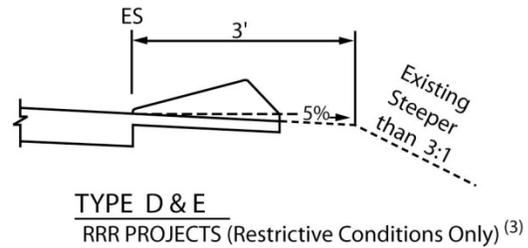
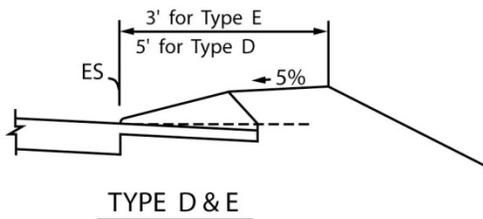
- (1) *Type A Dike.* The use of Type A dike should be avoided. For RRR projects, Type A dike may be used in cut sections with slopes steeper than 3:1 and where existing conditions do not allow for construction of the wider Type D or E dikes. Compacted embankment material should be placed behind the back of dike as shown in Figure 303.3.
- (2) *Type C Dike.* This low dike, 2 inches in height, may be used to confine small concentrations of runoff. The capacity of the shoulder gutter formed by this dike is small. Due to this limited capacity, the need for installing an inlet immediately upstream of the beginning of this dike type should be evaluated. This low dike can be traversed by a vehicle and allows the area beyond the surfaced shoulder to be used as an emergency recovery and parking area. The Type C dike is the only dike that may be used in front of guardrail. In such cases, it is not necessary to place compacted embankment material behind Type C dike.
- (3) *Type D Dike.* This 6-inch high dike provides about the same capacity as the Type A dike but has the same shape as the Type E dike. The quantity of material in the Type D dike is more than twice that of a Type E dike. It should only be used where there is a need to contain higher volumes of drainage. Compacted embankment material should be placed behind the back of dike as shown in

**Figure 303.3
 Dike Type Selection and Placement⁽¹⁾**

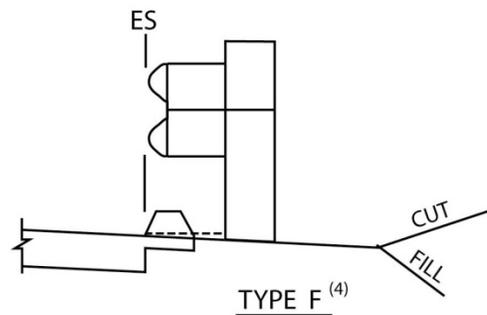
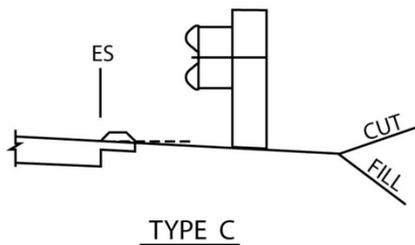
CUT SECTIONS



FILL SECTIONS



CUT/FILL SECTIONS



- Notes:**
- (1) See Standard Plans for additional information and details.
 - (2) See Index 303.3(1) for restrictive conditions.
 - (3) See Index 303.3(3) and Index 303.3(4) for restrictive conditions for Type D and Type E respectively.
 - (4) Use under MBGR when dike is necessary for drainage control.

Figure 303.3. For RRR projects that do not widen pavement, compacted embankment material may be omitted on existing fill slopes steeper than 3:1 when there is insufficient room to place the embankment material.

- (4) *Type E Dike.* This 4-inch high dike provides more capacity than the Type C dike. Because Type E dike is easier to construct than Type D dike, and has greater drainage capacity than Type C dike, it is the preferred dike type for most installations. Compacted embankment material should be placed behind the back of dike as shown in Figure 303.3. For RRR projects that do not widen pavement, compacted embankment material may be omitted on existing fill slopes steeper than 3:1 where there is insufficient room to place the embankment material.
- (5) *Type F Dike.* This 4-inch high dike is to be used where dike is necessary for drainage underneath a guardrail installation. This dike is placed directly under the face of metal beam guardrail installations.

303.4 Curb Extensions

- (1) *Bulbouts.* A bulbout is an extension of the sidewalk into the roadway when there is marked on-street parking, see Index 402.3. Bulbouts should comply with the guidance provided in Figures 303.4A and B; noting that typical features are shown and that the specific site conditions need to be taken into consideration. Bulbouts provide queuing space and shorten crossing distances, thereby reducing pedestrian conflict time with mainline traffic. By placing the pedestrian entry point closer to traffic, bulbouts improve visibility between motorists, bicyclists, and pedestrians. They are most appropriate for urban conventional highways and Rural Main Streets with posted speeds 35 miles per hour or less. Curb extensions are not to extend into Class II Bikeways (Bike Lanes). The corner curb radii should be the minimum needed to accommodate the design vehicle, see Topic 404.

When used, bulbouts should be placed at all corners of an intersection.

When used at mid-block crossing locations, bulbouts should be used on both sides of the street.

The curb face of the bulbout should be setback a minimum of 2 feet as shown in Figures 303.4A and B. See the California MUTCD for on-street parking signs and markings.

Landscaping and appurtenant facilities located within a bulbout are to comply per Topic 405.

Bulbouts are considered pedestrian facilities and as such, compliance with DIB 82 is required. Avoid bulbouts on facilities where highway grade lines exceed 5 percent.

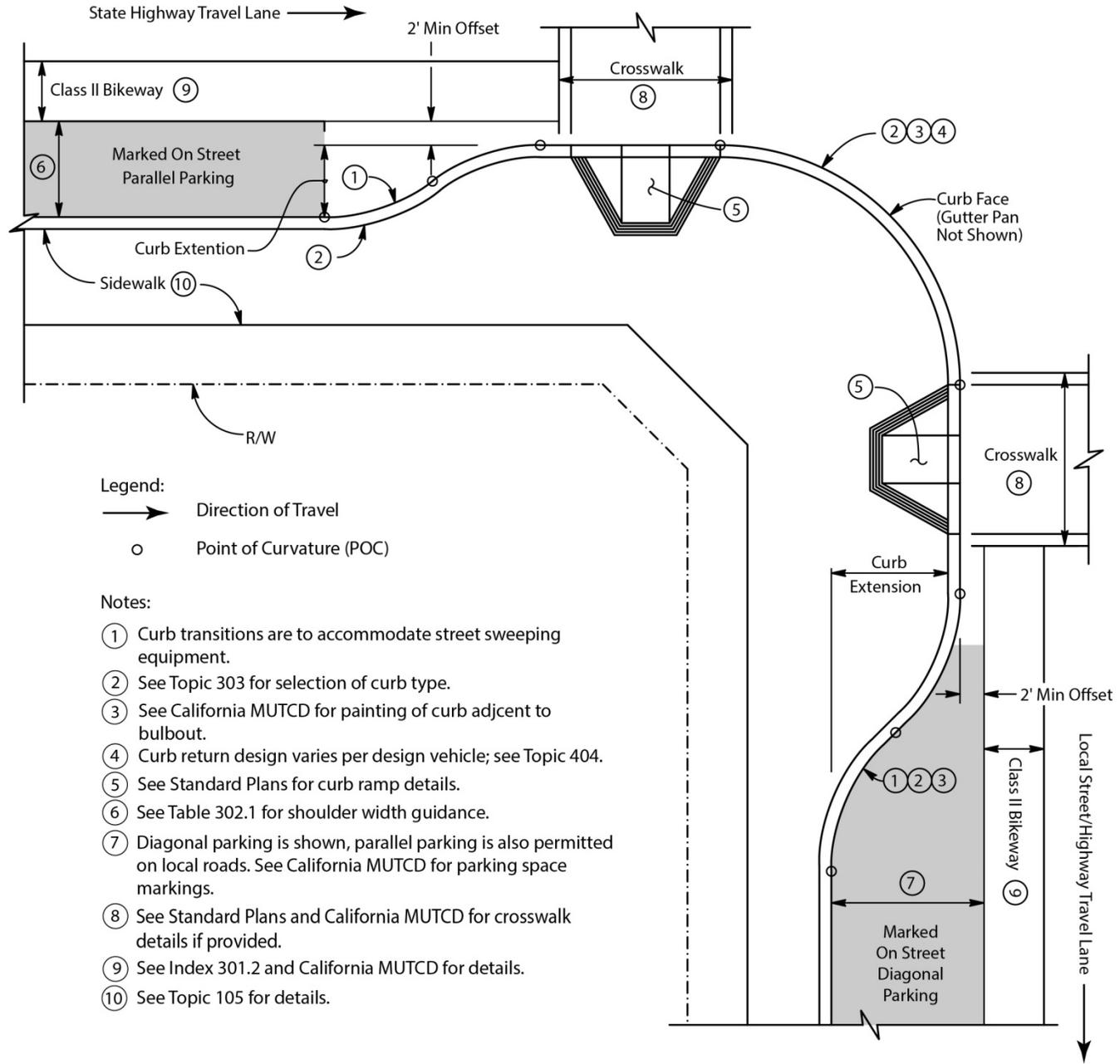
- (2) *Busbulbs.* A busbulb is a bulbout longer than 25 feet which facilitates bus loading and unloading, and provides for enhanced bus mobility. Busbulbs reduce bus dwell times and provide travel time benefits to transit passengers. However, busbulbs can restrict the mobility of vehicular and bicycle traffic because they allow the bus to stop in their traveled way to load and unload passengers. Therefore, their impact on the mobility of the vehicular and bicycle traffic using the facility must be taken into consideration, and pursuant to the California Vehicle Code, busbulbs or other transit stops which require a transit vehicle to stop in the traveled way require approval from the Department. In lieu of a busbulb, a busbay may be considered which will not impact the mobility of the vehicular and bicycle users of the facility.
- (3) *Busbays.* A busbay is an indentation in the curb which allows a bus to stop completely outside of vehicular and bicycle lanes. Busbays may be created by restricting on street parking.

303.5 Position of Curbs and Dikes

Curbs located at the edge of the traveled way may have some effect on lateral position and speed of moving vehicles, depending on the curb configuration and appearance. Curbs with low, sloped faces may encourage drivers to operate relatively close to them. Curbs with vertical faces may encourage drivers to slow down and/or shy away from them and, therefore, it may be desirable to incorporate some additional roadway width.

Figure 303.4A

Typical Bulbout with Class II Bikeway (Bike Lane)



All dimensions to curbs (i.e., offsets) are from the near edge of traveled way to bottom face of curb. All dimensions to dikes are from the near edge of traveled way to flow line. Curb and dike offsets should be in accordance with the following:

- (1) *Through Lanes.* The offset from the edge of traveled way to the face of curb or dike flow line should be no less than the shoulder width, as set forth in Table 302.1.
- (2) *Channelization.* Island curbs used to channelize intersection traffic movements should be positioned as described in Index 405.4.
- (3) *Separate Turning Lanes.* Curb offsets to the right of right-turn lanes in urban areas may be reduced to 2 feet if design exception approval for nonstandard shoulder width has been obtained in accordance with Index 82.2. No curb offset is required to the left of left-turn lanes in urban areas unless there is a gutter pan.
- (4) *Median Openings.* Median openings (Figure 405.5) should not be separated with curb unless necessary to delineate areas occupied by traffic signal standards.
- (5) *Urban Conventional Highways.* When the posted speed is less than or equal to 35 miles per hour, no median curb offset is required if there is no gutter pan.
- (6) *Structure Approach Slabs.* When a dike is required to protect the side slope from erosion, it should be placed on the structure approach and sleeper slabs as well as aligned to tie into the end of the structure railing. The guardrail alignment and edge of shoulder govern the positioning of the dike.

When the Type 14 structure approach slab is used, concrete dikes are preferred. Hot mixed asphalt dike will inevitably crack due to expansion and contraction at the approach/sleeper slab joint. A metal dike insert is used to carry the flow across the sealed joint. The insert acts as a water barrier to minimize erosion of the fill slope. Details of the metal dike insert are shown in the structure approach plans provided by the Division of Engineering Services, (DES).

- (7) *Bridges and Grade Separation Structures.* When both roadbeds of a curbed divided highway are carried across a single structure, the median curbs on the structure should be in the same location as on adjacent roadways.
- (8) *Approach Nose.* The approach nose of islands should also be designed utilizing a parabolic flare, as discussed in Index 405.4.

303.6 Curbs and Dikes on Frontage Roads and Streets

Continuous curbs or dikes are not necessarily required on all frontage roads. Where curbs or dikes are necessary for drainage control or other reasons, they should be consistent with the guidelines established in this topic and placed as shown on Figure 307.4. Local curb standards should be used when requested by local authorities for roads and streets that will be relinquished to them.

Topic 304 - Side Slopes

304.1 Side Slope Standards

Slopes should be designed as flat as is reasonable. For new construction, widening, or where slopes are otherwise being modified, embankment (fill) slopes should be 4:1 or flatter. Factors affecting slope design are as follows:

- (a) *Safety.* Flatter slopes provide better recovery for errant vehicles that may run off the road. A cross slope of 6:1 or flatter is suggested for high speed roadways whenever it is achievable. Cross slopes of 10:1 are desirable.

Embankment slopes 4:1 or flatter are recoverable for vehicles. Drivers who encroach on recoverable slopes can generally stop or slow down enough to return to the traveled way safely.

A slope which is between 3:1 and 4:1 is considered traversable, but not recoverable. Since a high percentage of vehicles will reach the toe of these slopes, the recovery area should be extended beyond the toe of slope. The AASHTO Roadside Design Guide should be consulted for methods of determining the preferred extent of the runout area.

Embankment slopes steeper than 3:1 should be avoided when accessible by traffic. District Traffic, and the AASHTO Roadside Design Guide should be consulted for methods of determining the preferred treatment.

Regardless of slope steepness, it is desirable to round the top of slopes so an encroaching user remains in contact with the ground. Likewise, the toe of slopes should be rounded to prevent users from nosing into the ground.

- (b) *Erosion Control.* Slope designs steeper than 4:1 must be approved by the District Landscape Architect in order to assure compliance with the regulations affecting Stormwater Pollution contained in the Federal Clean Water Act (see Index 82.4). Slope steepness and length are two of the most important factors affecting the erodibility of a slope. Slopes should be designed as flat as possible to prevent erosion. However, since there are other factors such as soil type, climate, and exposure to the sun, District Landscape Architecture and the District Stormwater Coordinator must be contacted for erosion control requirements.

A Storm Water Data Report (SWDR) documents project information and considerations pertaining to Storm Water Best Management Practices (BMPs) and Erosion Control methods. The SWDR is prepared and signed by key personnel (including the District Landscape Architect) at the completion of each phase of a project. By signing the SWDR, the District Landscape Architect approves compliance with the proposed slope designs.

- (c) *Structural Integrity.* Slopes steeper than 2:1 require approval of District Maintenance. The Geotechnical Design Report (See Topic 113) will recommend a minimum slope required to prevent slope failure due to soil cohesiveness, loading, slip planes and other global stability type failures. There are other important issues found in the Geotechnical Design Report affecting slope design such as the consistency of the soil likely to be exposed in cuts, identification of the presence of ground water, and recommendations for rock fall.
- (d) *Economics.* Economic factors such as purchasing right of way, imported borrow, and

environmental impacts frequently play a role in the decision of slope length and steepness. In some cases, the cost of stabilizing, planting, and maintaining steep slopes may exceed the cost of additional grading and right of way to provide a flatter slope.

- (e) *Aesthetics.* Flat, gentle, and smooth, well transitioned slopes are visually more satisfying than steep, obvious cuts and fills. In addition, flatter slopes are more easily revegetated, which helps visually integrate the transportation improvement within its surrounding environment. Contact the District Landscape Architect when preparing a contour grading plan.

In light grading where normal slopes catch in a distance less than 18 feet from the edge of the shoulder, a uniform catch point, at least 18 feet from the edge of the shoulder, should be used. This is done not only to improve errant vehicle recovery and aesthetics, but also to reduce grading costs. Uniform slopes wider than 18 feet can be constructed with large production equipment thereby reducing earthwork costs.

Transition slopes should be provided between adjoining cuts and fills. Such slopes should intersect the ground at the uniform catch point line.

In areas where heavy snowfall can be expected, consideration should be given to snow removal problems and snow storage in slope design. It is considered advisable to use flatter slopes in cuts on the southerly side of the roadway where this will provide additional exposure of the pavement to the sun.

304.2 Clearance From Slope to Right of Way Line

The minimum clearance from the right of way line to catch point of a cut or fill slope should be 10 feet for all types of cross sections. When feasible, at least 15 feet should be provided.

Following are minimum clearances recommended for cuts higher than 30 feet:

- (a) Twenty feet for cuts from 30 feet to 50 feet high.
- (b) Twenty-five feet for cuts from 50 feet to 75 feet high.

- (c) One-third the cut height for cuts above 75 feet, but not to exceed a width of 50 feet.

The foregoing clearance standards should apply to all types of cross sections.

304.3 Slope Benches and Cut Widening

The necessity for benches, their width, and vertical spacing should be finalized only after an adequate materials investigation. Since greater user benefits are realized from widening a cut than from benching the slope, benches above grade should be used only where necessary. Benches above grade should be used for such purposes as installation of horizontal drains, control of surface erosion, or intercepting falling rocks. Design of the bench should be compatible with the geotechnical features of the site.

Benches should be at least 20 feet wide and sloped to form a valley at least 1 foot deep with the low point a minimum of 5 feet from the toe of the upper slope. Access for maintenance equipment should be provided to the lowest bench, and if feasible to all higher benches.

In cuts over 150 feet in height, with slopes steeper than 1½:1, a bench above grade may be desirable to intercept rolling rocks. The Division of Engineering Services – Geotechnical Services (DES-GS) should be consulted for assistance in recommending special designs to contain falling and/or rolling rocks.

Cut widening may be necessary:

- (a) To provide for drainage along the toe of the slope.
- (b) To intercept and store loose material resulting from slides, rock fall, and erosion.
- (c) For snow storage in special cases.
- (d) To allow for planting.

Where the widened area is greater than that required for the normal gutter or ditch, it should be flush with the edge of the shoulder and sloped upward or downward on a gentle slope, preferably 20:1 in areas of no snow; and downward on a 10:1 slope in snow areas.

304.4 Contour Grading and Slope Rounding

Contour grading, slope rounding and topsoil replacement are important factors in roadside design to help make highway improvements compatible with the surrounding environment while comply with National Pollutant Discharge Elimination System permits (NPDES). Smooth, flowing contours that tie gracefully into the existing adjacent roadside and landforms are visually appealing and conducive to safe vehicle recovery (see Index 304.1), reduce the potential for erosion and stormwater runoff, and reduce roadside maintenance activities while contributing to the long term success of revegetation planting.

Contour grading plans are to be prepared to facilitate anticipated roadside treatments and future maintenance activities. These plans should show flattened slopes where right of way permits. The tops and ends of all cut slopes should be rounded. Rock cut slopes should be irregular where possible to provide a natural appearance and the tops and ends should also be rounded. All slope designs should include consideration of an application of local or imported topsoil and duff to promote the growth of vegetation, improve stormwater pollutant filtration and control erosion. The calculation of the final grade for a project needs to take into account the reapplication of topsoil and duff.

Local topsoil and duff material within the grading limits should be identified on the plans, removed or excavated, stockpiled, and reapplied. This is to be performed on all projects that include grading or earthwork unless the materials are determined to be unsuitable.

Coordinate the development of contour grading plans including, removal, stockpiling, suitability of material and application of topsoil and duff with the District Landscape Architect.

304.5 Stepped Slopes

Stepped cut slopes should be used to encourage material revegetation from the adjacent plants. Stepped slopes are a series of small benches 1 foot to 2 feet wide. Generally, stepped slopes can be used in rippable material on slopes 2:1 or steeper. Steps may be specified for slopes as flat as 3:1. Steps are provided to capture loose material, seed,

and moisture. Topsoil should be reapplied to stepped slopes to encourage revegetation.

For appearance, steps on small cuts viewed from the roadway should be cut parallel to the road grade. Runoff is minimized on steps cut parallel to roads with grades up to 10 percent, as long as the natural ravel from construction is left on the steps. Steps less than one-half full should not be cleaned.

High cuts viewed from surrounding areas should be analyzed before a decision is made to form steps parallel to the roadway or horizontal. In some cases, horizontal steps may be more desirable. Special study is also necessary when a sag occurs in the vertical alignment within the cut. In all cases at the ends of cuts, the steps should wrap around the rounded transition.

The detail or contract special provisions should allow about a 20 percent variation, expressed in terms of tenths of a foot. Some irregularity will improve the appearance of the slope by making it appear more natural.

In designing step width, the material's weathering characteristics should generally be considered. Widths over approximately 2 feet should be avoided because of prominence and excessive time to achieve a weathered and natural appearance. Contact the DES-GS and the District Landscape Architect for more information about the width of steps.

Topic 305 - Median Standards

305.1 Width

Median width is expressed as the dimension between inside edges of traveled way, including the inside shoulder. This width is dependent upon the type of facility, costs, topography, and right of way. Consideration may be given to the possible need to construct a wider median than prescribed in Cases (1), (2), and (3), below, in order to provide for future expansion to accommodate:

- (a) Public Transit (rail and bus).
- (b) Traffic needs more than 20 years after completion of construction.

Median width as presented in Case (1) below applies to new construction, projects to increase mainline capacity and to reconstruction projects.

Any recommendation to provide additional median width should be identified and documented as early as possible and must be justified in a Project Study Report and/or Project Report. Attention should be given to such items as initial costs, future costs for outside widening, the likelihood of future needs for added mixed flow or High-Occupancy Vehicle (HOV) lanes, traffic interruption, future mass transit needs and right of way considerations. (For instance, increasing median width may add little to the cost of a project where an entire city block must be acquired in any event.)

Median pedestrian refuge areas at intersections lessen the risk of pedestrian exposure to traffic. Where pedestrians are allowed to cross 4 or more lanes at a marked or unmarked crosswalk, a pedestrian refuge island should be provided. See Index 405.4(3) and DIB 82 for pedestrian refuge guidance.

If additional width is justified, the minimum median widths provided below should be increased accordingly.

Minimum median widths for the design year (as described below) should be used in order to accommodate the ultimate highway facility (type and number of lanes):

- (1) *Freeways and Expressways.*
 - (a) Urban Areas. Where managed lanes (HOV, Express, etc) or transit facilities are planned, the minimum median width should be 62 feet. Where there is little or no likelihood of managed lanes or transit facilities planned for the future, the minimum median width should be 46 feet. However, where physical and economic limitations are such that a 46-foot median cannot be provided at reasonable cost, the minimum median width for freeways and expressways in urban areas should be 36 feet.
 - (b) Rural Areas. The minimum median width for freeways and expressways in rural areas should be 62 feet.
- (2) *Conventional Highways.* Appropriate median widths for non-controlled access highways vary widely with the type of facility being designed. In Urban and Rural Main Street

areas, the minimum median width for multilane conventional highways should be 12 feet. However, this width would not provide room for left-turn lanes at intersections with raised curb medians, nor left-turn lanes in striped medians with room for pedestrian refuge areas. Posted speed and left shoulder width can also affect median width. See Table 302.1.

Medians refuge areas at pedestrian crosswalks and bicycle path crossings provide a space for pedestrians and bicyclists. They allow these users to cross one direction of traffic at a time. Where medians are provided, they should allow access through them for pedestrians and bicyclists as necessary. Bicycle crossings through paved medians should line up with the bicycle path of travel and not require bicyclists to utilize the pedestrian crosswalk. See Index 405.4 for additional requirements.

Where medians are provided for proposed future two-way left-turn lanes, median widths up to 14 feet may be provided to conform to local agency standards (see Index 405.2). **In rural areas the minimum median width for multilane conventional highways shall be 12 feet.** This provides the minimum space necessary to accommodate a median barrier and 5-foot shoulders. Whenever possible, and where it is appropriate, this minimum width should be increased to 30 feet or greater.

At locations where a climbing or passing lane is added to a 2-lane conventional highway, a 4-foot median (or “soft barrier”) between opposing traffic lanes should be used.

(3) *Facilities under Restrictive Conditions.* Where certain restrictive conditions, including steep mountainous terrain, extreme right of way costs, and/or significant environmental factors are encountered, the basic median widths above may not be attainable. Where such conditions exist, a narrower median, down to the limits given below, may be allowed with adequate justification. (See Index 307.5.)

(a) Freeways and Expressways. **In areas where restrictive conditions prevail the minimum median width shall be 22 feet.**

(b) Conventional Highways. Median widths should be consistent with requirements for two-way left-turn lanes or the need to construct median barriers (as discussed in Index 305.1(2)), but may be reduced or eliminated entirely in extreme situations.

The above stated minimum median widths should be increased at spot locations to accommodate the construction of bridge piers or other planned highway features while maintaining standard cross section elements such as inside shoulder width and horizontal clearance. If a bridge pier is to be located in a tangent section, the additional width should be developed between adjacent horizontal curves; if it is to be located in a curve, then the additional width should be developed within the limits of the curve. Provisions should be made for piers 6 feet wide or wider. Median widths in areas of multilevel interchanges or other major structures should be coordinated with the Division of Engineering Services, Structures Design (DES-SD).

Consideration should also be given to increasing the median width at unsignalized intersections on expressways and divided highways in order to provide a refuge area for large trucks attempting to cross the State route.

In any case, the median width should be the maximum attainable at reasonable cost based on site specific considerations of each project.

See Index 613.5(2)(b) for paved median pavement structure requirements.

305.2 Median Cross Slopes

Unsurfaced medians up to 65 feet wide should be sloped downward from the adjoining shoulders to form a shallow valley in the center. Cross slopes should be 10:1 or flatter; 20:1 being preferred. Slopes as steep as 6:1 are acceptable in exceptional cases when necessary for drainage, stage construction, etc. Cross slopes in medians greater than 65 feet should be treated as separate roadways (see Index 305.6).

Paved medians, including those bordered by curbs, should be crowned at the center, sloping towards the sides at the slope of the adjacent pavement.

305.3 Median Barriers

See Chapter 7 of the Traffic Manual.

305.4 Median Curbs

See Topic 303 for curb types and usage in medians and Index 405.5(1) for curbs in median openings.

305.5 Paved Medians

(1) *Freeways.*

- (a) 6 or More Lanes--Medians 30 feet wide or less should be paved.
- (b) 4 Lanes--Medians 22 feet or less in width should be paved. Medians between 22 feet and 30 feet wide should be paved only if a barrier is installed. With a barrier, medians wider than 30 feet should not normally be paved.

Where medians are paved, each half generally should be paved in the same plane as the adjacent traveled way.

(2) *Nonfreeways.* Unplanted curbed medians generally are to be surfaced with minimum 0.15 foot of Portland cement concrete.

For additional information on median cross slopes see Index 305.2.

305.6 Separate Roadways

- (1) *General Policy.* Separate grade lines are not considered appropriate for medians less than 65 feet wide (see Index 204.7).
- (2) *Median Design.* The cross sections shown in Figure 305.6 with a 23-foot graded area left of traffic are examples of median treatment to provide maneuvering room for out-of-control users. This optional treatment may be used where extra recovery area is desired (see Index 307.6).

See Index 302.1 for shoulder widths and Index 302.2 for shoulder cross slopes.

Topic 306 - Right of Way

306.1 General Standards

The right of way widths for State highways, including frontage roads to be relinquished, should provide for instillation, operation and maintenance

of all cross section elements needed depending upon the type of facility, including median, traffic lanes, bicycle lanes, outside shoulders, sidewalks, recovery areas, slopes, sight lines, outer separations, ramps, walls, transit facilities and other essential highway appurtenances. For minimum clearance from the right of way line to the catch point of a cut or fill slope, see Index 304.2. Fixed minimum widths of right of way, except for 2-lane highways, are not specified because dimensions of cross-sectional elements may require narrow widths, and right of way need not be of constant width. The minimum right of way width on new construction for 2-lane highways should be 150 feet.

306.2 Right of Way Through the Public Domain

Right of way widths to be obtained or reserved for highway purposes through lands of the United States Government or the State of California are determined by laws and regulations of the agencies concerned.

Topic 307 - Cross Sections for State Highways

307.1 Cross Section Selection

The cross section of a State highway is based upon the number of vehicles, including trucks, buses, bicycles, and safety, terrain, transit needs and pedestrians. Other factors such as sidewalks, bike paths and transit facilities, both existing and future should be considered. For 2-lane roads the roadbed width is influenced by the factors discussed under Index 307.2. The roadbed width for multilane facilities should be adequate to provide capacity for the design hourly volume based upon capacity considerations discussed under Index 102.1.

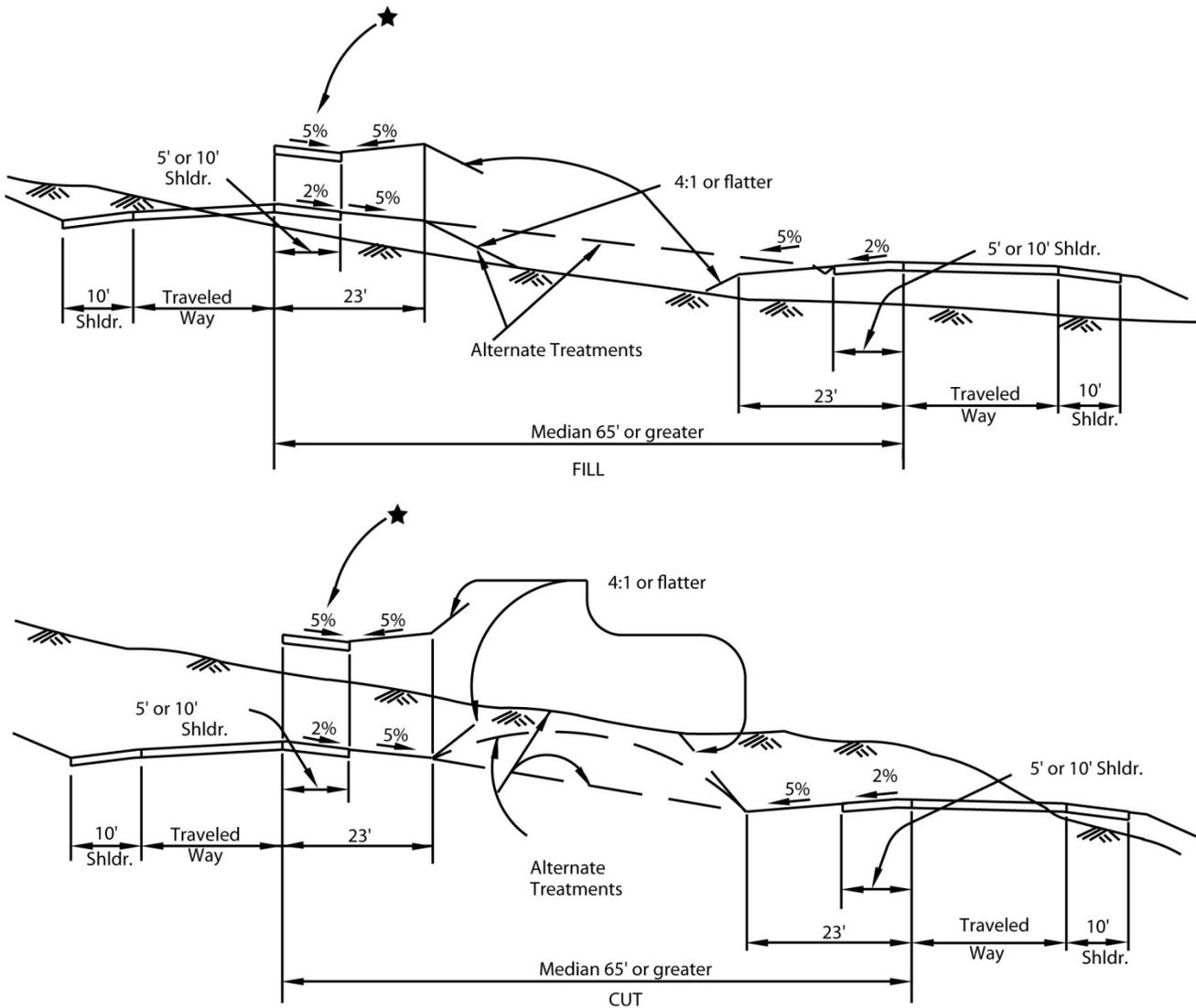
307.2 Two-lane Cross Sections for New Construction

These standards are to be used for highways on new alignment as well as on existing highways where the width, alignment, grade, or other geometric features are being upgraded.

A 2-lane, 2-way roadbed consists of a 24-foot wide traveled way plus paved shoulders. In order to provide structural support, the minimum paved

Figure 305.6

Optional Median Designs for Freeways with Separate Roadways



NOTES:

Left Paved Shoulder Width
 10' for 6-lane and 8-lane roadways
 5' for 4-lane roadways

Side Slopes
 See Index 304.1

★ Superelevated section

width of each shoulder should be 2 feet. Shoulders less than 4 feet are not adequate for bicycles. Where 4-foot shoulders are not possible, consideration should be given to providing turnouts for bicycles. See Index 204.5(4) for turnout information. See Topic 1003 and Index 301.2 for information on bicycle design criteria and Figure 307.2 for typical 2-lane cross sections.

Shoulder widths based on design year traffic volumes shall conform to the standards given in Table 307.2.

Table 307.2

Shoulder Widths for Two-lane Roadbed New Construction Projects

Two-way ADT (Design Year)	Shoulder Width ⁽¹⁾ (ft)
Less than 400	4 ⁽²⁾
Over 400	8 ⁽³⁾

NOTES:

- (1) See Index 302.1 for shoulder requirements when bike lanes are present.
- (2) Minimum bridge width is 32 feet (see Index 208.1).
- (3) See Index 405.3(2)(a) for shoulder requirements adjacent to right-turn only lanes.

On 2-lane roads with 4-foot shoulders, the shoulder slope may be increased to 7 percent for additional drainage capacity where a dike is used. A design exception to Index 302.2 will be required to document the decision to increase the slope.

Bicycles are not prohibited on conventional highways: therefore, where the shoulder width is 4 feet, the gutter pan width should be reduced to 1 foot, so 3 feet is provided between the traffic lane and the longitudinal joint at the gutter pan. Whenever possible, grate type inlets should not be located in bicycle paths of travel. See Index 837.2(2) for further grate guidance.

307.3 Two-lane Cross Sections for 2R, 3R, and other Projects

Standards and guidelines for two-lane cross sections on resurfacing and restoration (2R) projects and resurfacing, restoration, and rehabilitation (3R) projects are found in DIB 79 and Index 603.4. DIB 79 also includes screening criteria to determining whether the project fits 2R or 3R.

3R design criteria apply to all structure and roadway 3R projects on two-lane conventional highways and three-lane conventional highways not classified as multilane conventional highways.

3R design criteria also apply to certain storm damage, protective betterment, operational, and safety nonfreeway improvement projects that are considered spot locations as described in detail in DIB 79.

3R criteria apply to geometric design features such as lane and shoulder widths, horizontal and vertical alignment, stopping sight distance, structure width, cross slope, superelevation, side slope, clear recovery zone, curb ramps, pavement edge drop, dike, curb and gutter, and intersections. They may also apply to such features as bike lanes, sidewalk, and drainage.

307.4 Multilane Divided Cross Sections

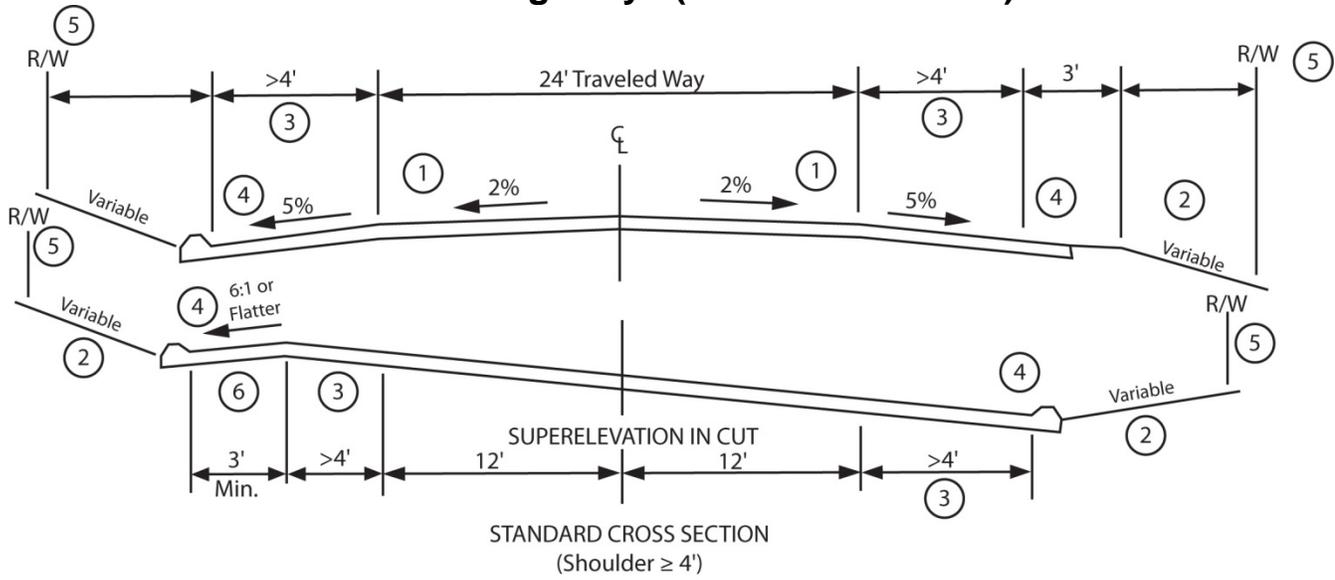
The general geometric features of multilane divided cross sections are shown in Figure 307.4.

Divided highways may be designed as two separate one-way roads where appropriate to fit the terrain. Economy, pleasing appearance, and safety are factors to be considered in this determination. The alignment of each roadway may be independent of the other (see Indexes 204.8 and 305.6). Optional median designs may be as shown on Figure 305.6.

307.5 Multilane All Paved Cross Sections with Special Median Widths

A multilane cross section with a narrow median is illustrated in Figure 307.5. This section is appropriate in special circumstances where a wider median would not be justified. It should not be considered as an alternative to sections with the

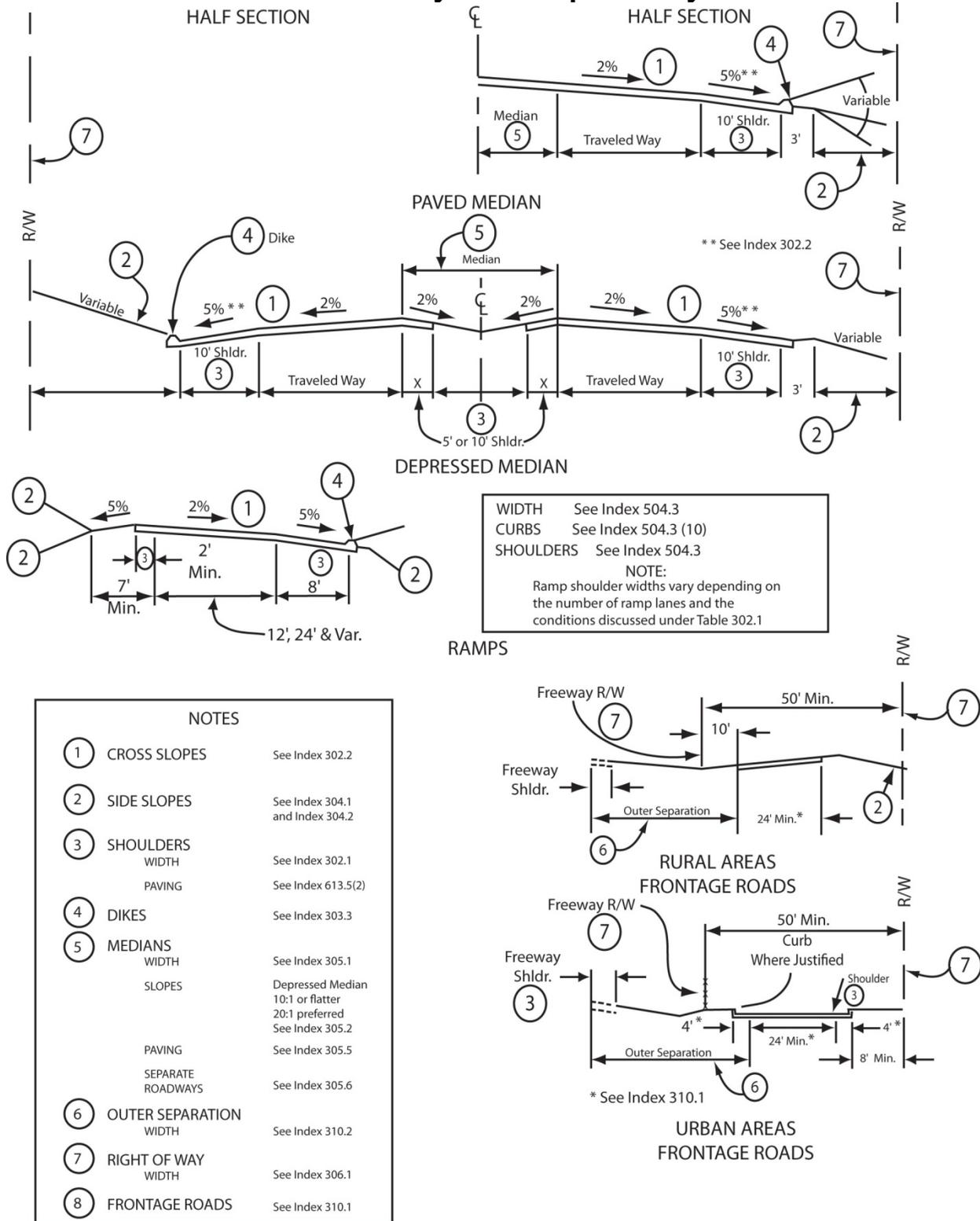
**Figure 307.2
Geometric Cross Sections for
Two-lane Highways (New Construction)**



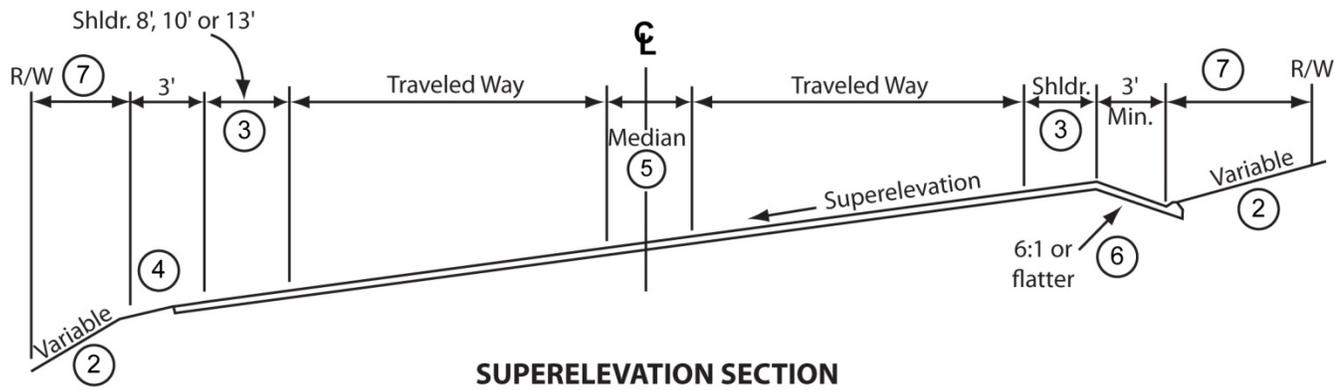
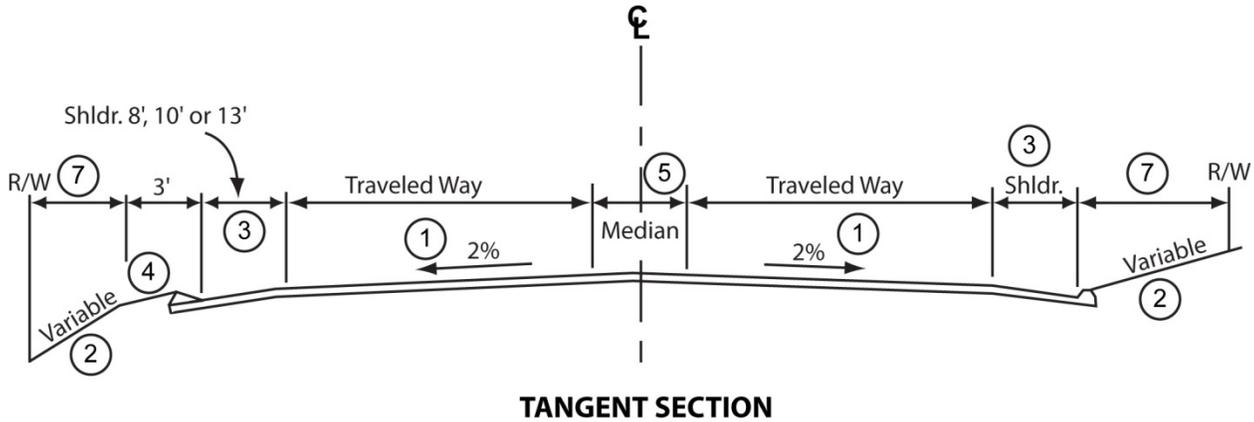
STANDARD CROSS SECTION
(Shoulder ≥ 4')

NOTES		
(1)	CROSS SLOPES	See Index 302.2
(2)	SIDE SLOPES	See Index 304.1
(3)	SHOULDER WIDTH	See Index 302.1
(4)	DIKES	See Index 303.3
(5)	RIGHT OF WAY	See Index 306.1
(6)	SIDE GUTTERS	See Index 834.3(3)

**Figure 307.4
Geometric Cross Sections for
Freeways and Expressways**



**Figure 307.5
Geometric Cross Sections for
All Paved Multilane Highways**



NOTES	
①	CROSS SLOPES See Index 302.2
②	SIDE SLOPES See Index 304.1
③	SHOULDERS See Index 302.1
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

median widths set forth under Index 305.1. It may be used under the following conditions:

- (a) Widening of existing facilities.
- (b) Locations where large excavation quantities would result if a multilane roadway cross section with a basic median width were used. Examples are steep mountainous terrain and unstable mountainous areas.
- (c) As an alternate cross section on 2-lane roads having frequent sight distance restrictions.

The median width should be selected in accordance with the criteria set forth in Index 305.1(3).

In general, the outside shoulder should be 8 feet wide (10 feet on freeways and expressways) as mandated in Table 302.1. Where large excavation quantities or other factors generate unreasonable costs, 4-foot shoulders may be considered.

However, a design exception is required except where 4-lane passing sections are constructed on 2-lane highways. Where the roadbed width does not contain 8-foot shoulders, emergency parking areas clear of the traveled way should be provided by using daylighted cuts and other widened areas which develop during construction.

307.6 Multilane Cross Sections for 2R and 3R Projects

3R projects on freeways, expressways, and multilane conventional highways are required to meet new construction standards.

For additional information on 2R and 3R projects, see DIB 79.

307.7 Reconstruction Projects

Reconstruction projects on freeways, expressways, and conventional highways are required to meet new construction standards.

Topic 308 - Cross Sections for Roads Under Other Jurisdictions

308.1 City Streets and County Roads

The width of local roads and streets that are to be reconstructed as part of a freeway project should conform to AASHTO standards if the local road or street is a Federal-aid route. Otherwise the cross section should match the width of the city street or

county road adjoining the reconstructed portion, or the cross section should satisfy the local agency's minimum standard for new construction.

Where a local facility within the State right of way crosses over or under a freeway or expressway but has no connection to the State facility, the minimum design standards for the cross section of the local facility within the State's right of way shall be those found in AASHTO. If the local agency has standards that exceed AASHTO standards, then the local agency standards should apply.

AASHTO standards for local roads and streets are given in AASHTO, A Policy on Geometric Design of Highways and Streets.

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.

See Chapter 1 of AASHTO, A Policy on Geometric Design of Highways and Streets, for additional information on the AASHTO functional classifications of rural and urban arterials, collector roads, and streets.

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 32 feet face of curb to face of curb.

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, and as shown below.

Where the 2-lane local facility connects to a freeway within an interchange, the lane width of the local facility shall be 12 feet.

Where a multilane local facility connects to a freeway within an interchange, the outer most lane in each direction of the local facility shall be 12 feet.

Shoulder width shall not be less than 5 feet when railings or other lateral obstructions are adjacent to the right edge of shoulder.

If gutter pans are used, then the minimum shoulder width shall be 3 feet wider than the width of the gutter pan being used.

The minimum width for two-lane overcrossing structures at interchanges shall be 40 feet curb-to-curb.

Topic 309 - Clearances

309.1 Horizontal Clearances for Highways

(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 and reduction of maintenance cost and exposure to workers, with the prudent expenditure of available funds.

Certain yielding types of fixed 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.

Horizontal 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 miles per hour 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, barrier 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-distributor 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-distributor roads, shall not be less than 10 feet per Table 302.1.**
- (c) **On conventional highways, frontage roads, city streets and county roads within the State right of way (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 foot 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 HQ Transportation Permit Program.

The HQ Transportation Permit Program must 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 miles per hour, 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.

- (5) *Other transportation facilities* Contraflow BRT, light rail facilities, and heavy rail facilities are considered fixed objects and the clearances noted in Index 309.1 apply.

Parallel BRT facilities are preferred to have the following minimum separation between lanes:

- Freeways and Expressways** – 4 feet
- Conventional Highways (see also Index 108.5)
 - Posted Speeds over 40 miles per hour – 4 feet
 - Posted Speeds equal or greater than 25 miles per hour and up to 45 miles per hour in an urban environment – 2 feet, with curbed separation, 4 feet with 2-foot curbed separation recommended.

** See “A Guide for HOT Lane Development”, FHWA, and Caltrans High Occupancy Vehicle Guidelines for additional information.

309.2 Vertical Clearances

(1) *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.**

- (2) *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 must be approved by FHWA in coordination with Surface Deployment and Distribution Command Tran-

Table 309.2A
Minimum Vertical Clearances

	Traveled Way	Shoulder
Freeways and Expressways, New Construction, Lane Additions, Reconstruction and Modification	16½ ft	16½ ft
Freeways and Expressways, Overlay Projects	16 ft	16 ft
All Projects on Conventional Highways and Local Facilities	15 ft	14½ ft
Sign Structures	18 ft	18 ft
Pedestrian, Bicycle Overcrossings, and Minor Structures	Standard + 2 ft See 309.2(2)	
Structures on the Rural and Single Interstate Routing System	See 309.2(3)	

Figure 309.2
Department of Defense
Rural and Single Interstate Routes

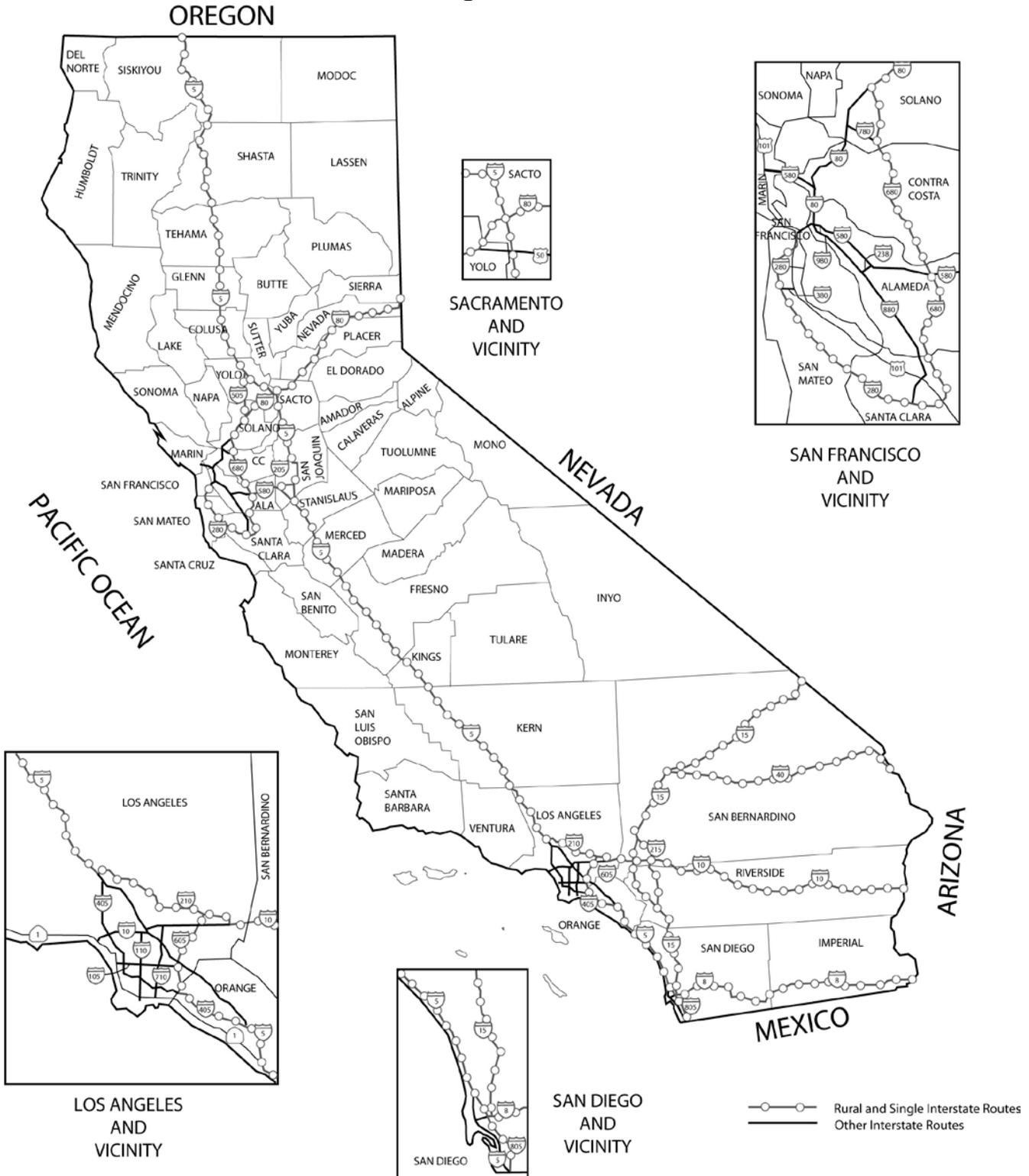


Table 309.2B
California Routes on the Rural and Single Interstate Routing System

ROUTE	FROM	TO
I-5	U. S. Border	I-805 just N. of U. S. Border
I-5	I-805 N. of San Diego	I-405 near El Toro
I-5	I-210 N. of Los Angeles	Oregon State Line
I-8	I-805 near San Diego	Arizona State Line
I-10	I-210 near Pomona	Arizona State Line
I-15	I-8 near San Diego	Nevada State Line
I-40	Junction at I-15 near Barstow	Arizona State Line
I-80	I-680 near Cordelia	Nevada State Line
I-205	Junction at I-580	Junction at I-5
I-210	I-5 N. of Los Angeles	I-10 near Pomona
I-215	I-15 near Temecula	I-15 near Devore
I-280	Junction at I-680 in San Jose	At or near south city limits of San Francisco to provide access to Hunter's Point
I-405	I-5 near El Toro	Palo Verde Avenue just N. of I-605
I-505	Junction at I-80	Junction at I-5
I-580	I-680 near Dublin	Junction at I-5
I-605	I-405 near Seal Beach	I-210
I-680	Junction at I-280 in San Jose	I-80 near Cordelia
I-805	I-5 just N. of U. S. Border	I-5 N. of San Diego

sportation Engineering Agency (SDDCTEA). 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/SDDCTEA notification. See <http://www.fhwa.dot.gov/design/090415.cfm>

- (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 4 inches 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 4 inches.

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 excessive clearances should be documented in the project files. Documentation must include reasons for exception including the railroad's justification for increased vertical clearance based on an analysis of engineering, operational and/or economic conditions at a

specific structure location with appropriate approval by the HQ Right of Way, Railroad Agreement Coordinator and concurrence by the FHWA.

See Index 1003.1(2) for guidance on Class I bikeway vertical clearance.

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. This clearance provides space for bicycle lanes or for bicyclists who want to use the shoulder.

- (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. The PUC requirements are minimums for all grade separated structures. The railroad clearances are much greater due to operational requirements.

- (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 4 inches 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. See Index 309.2(5)(b) for FHWA maximums. 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)).

Horizontal clearance from piers, abutments, and barriers shall be 25 feet minimum to centerline of track. For clearances less than 25 feet, the piers supporting bridges over the railroads are to be heavy construction or are to be protected by a reinforced concrete crash wall. Piers are to be considered heavy construction if they have a cross-sectional area equal to or greater than that required for the crash wall where the larger of its dimension is parallel to the track.

Crash walls for piers from 12 to 25 feet clearance from the centerline of track are to have a minimum height of 6 feet above the top of rail. Piers less than 12 feet clearance from the centerline of track are to have a minimum crash wall height of 12 feet above the top of rail. Horizontal clearances other than those stated above must be approved by the PUC and concurred by the affected railroad entity. Coordinate early in the design phase of the

project with the District Railroad Coordinator when railroad agreements are required.

For future planned track expansion, a minimum horizontal clearance distance of 20 feet between existing and future track centerlines shall be provided for freight tracks and 25 feet for commuter tracks. See Figure 309.5A for typical horizontal railroad clearances and Figure 309.5B for limits of permanent vertical clearance envelope for grade separated structures.

Code of Federal Regulations 646.212(a)(2) provides that if the railroad establishes to the satisfaction of the Department and FHWA that it has definite demand and plans for installation of additional tracks within a reasonable time, for grade separation structures, Federal funds may be used to provide space for more tracks than are in place.

Vertical clearance greater than 23 feet 4 inches may be approved on a site by site basis where justified by the railroad to the satisfaction of the Department and the FHWA. A railroad’s justification for increased vertical clearance should be based on an analysis of engineering, operational and/or economic conditions and the need for future tracks at a specific location. Contact the District Railroad Coordinator for further information.

**Table 309.5A
Minimum Vertical Clearances
Above Highest Rail**

Type of Structure	Type of Operation	
	Normal Freight	No Freight Cars Operated
Highway overhead and other structures including through railroad bridges.	23' – 4"	19' – 0"

At underpasses, General Order No. 26-D establishes a minimum vertical clearance of 15 feet above any public road, highway or

street. **However, the greater clearances specified under Index 309.2 shall be used.**

For at grade crossings, all curbs, including median curbs, should be designed with 10 feet of clearance from the track centerline measured normal thereto.

- (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 overhead is obtained at additional cost, Federal-aid funds may participate in the costs of such overhead designs that provide up to 18 feet 2 inches 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 At Grade.* All plans involving construction adjacent to railroads at grade 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 requirements when the planning phase 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. Index 308.1 gives width criteria for city streets and county roads. These widths are also applicable to frontage roads.

However, the minimum paved 2-lane cross section width including 4-foot shoulders without curb and gutter shall be:

- **32 feet if 12-foot lanes are to be provided;**
- **30 feet if 11-foot lanes are to be provided.**

The minimum paved 2-lane cross section width, including 5-foot shoulders and curb and gutter shall be:

- **34 feet if 12-foot lanes are to be provided;**
- **32 feet if 11-foot lanes are to be provided.**

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.

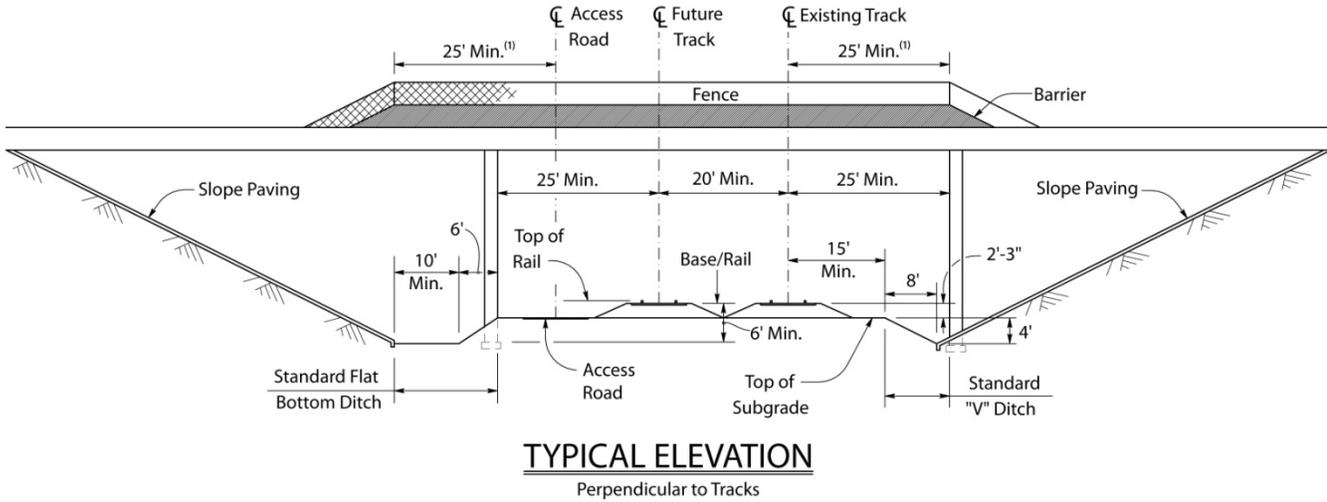
310.3 Headlight Glare

Care should be taken when designing new frontage roads to avoid the potential for headlight glare interfering with the vision of motorists, bicyclists, and pedestrians traveling in opposite directions on

the frontage roads and in the outer freeway lanes. Consideration should also be given to bike and pedestrians paths. To prevent headlight glare interference on new construction, the preferred measures are for wider outer separations, revised alignment and raised or lowered profiles.

Figure 309.5A

Typical Horizontal Railroad Clearance from Grade Separated Structures



NOTE:

The limits of the fence with barrier rail should extend to the limits of railroad right-of-way or a minimum of 25 feet beyond the centerline of the outermost existing track, future track, or access roadway, whichever is greater.

Figure 309.5B

Permanent Railroad Clearance Envelope

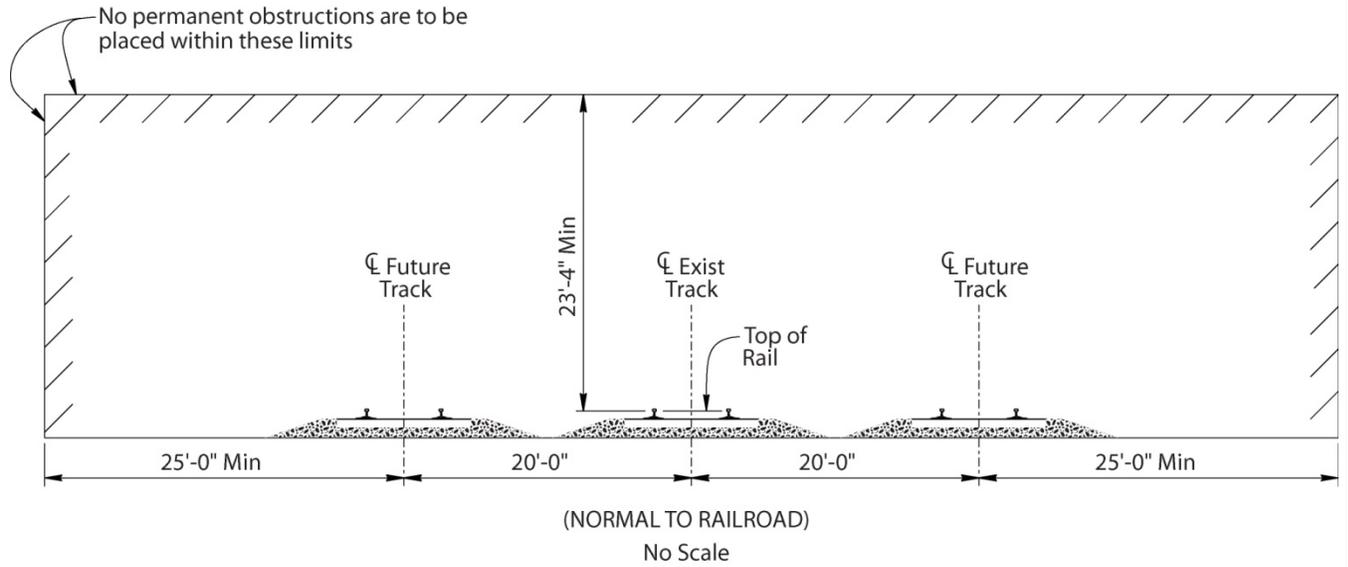


Table 309.5B

**Minimum Horizontal Clearances to
Centerline of Nearest Track**

Type of Structure	Off-track Maintenance Clearance	Tangent Track Clearance	Normal Curved Track ⁽¹⁾ Clearance	Curved Track Clearances When Space is Limited ⁽¹⁾	
				Curves of 0° to 12°	Curves of 12° or more
Through rail-road bridge	None	8' - 0" ⁽²⁾⁽⁴⁾	9' - 0" ⁽²⁾⁽⁴⁾		
Highway overhead and other structures	18' - 0" clear to face of pier or abutment on side railroad requires for equipment road.	8' - 6" ⁽⁴⁾	9' - 6" ⁽⁴⁾	8' - 6" ⁽³⁾ (Min.)	8' - 6" + ½" ⁽³⁾ per degree of curve.
Curbs		10' - 0"			

NOTES:

- (1) The minimum, in general, is one foot greater than for tangent track.
- (2) With approval of P.U.C.
- (3) Greater clearance necessary if walkway is required.
- (4) Collision walls may be required. See Index 309.5(1).

Section 9B. For pavement marking guidance, see the California MUTCD, Section 9C.

- (4) *Intersections with Highways.* Intersections are an important consideration in bike path design. Bicycle path intersection design should address both cross-traffic and turning movements. If alternate locations for a bike path are available, the one with the most beneficial intersection characteristics should be selected.

Where motor vehicle cross traffic and bicycle traffic is heavy, grade separations are desirable to eliminate intersection conflicts. Where grade separations are not feasible, assignment of right of way by traffic signals should be considered. Where traffic is not heavy, "STOP" or "YIELD" signs for either the path or the cross street (depending on volumes) may suffice.

Bicycle path intersections and their approaches should be on relatively flat grades. Stopping sight distances at intersections should be checked and adequate warning should be given to permit bicyclists to stop before reaching the intersection, especially on downgrades. When contemplating the placement of signs the designer is to discuss the proposed sign details with their Traffic Liaison so that conflicts may be minimized. Bicycle versus motor vehicle collisions may occur more often at intersections, where bicyclists misuse pedestrian crosswalks; thus, this should be avoided.

When crossing an arterial street, the crossing should either occur at the pedestrian crossing, where vehicles can be expected to stop, or at a location completely out of the influence of any intersection to permit adequate opportunity for bicyclists to see turning vehicles. When crossing at midblock locations, right of way should be assigned by devices such as "YIELD" signs, "STOP" signs, or traffic signals which can be activated by bicyclists. Even when crossing within or adjacent to the pedestrian crossing, "STOP" or "YIELD" signs for bicyclists should be placed to minimize potential for conflict resulting from turning autos. Where bike path "STOP" or "YIELD" signs are visible to approaching motor vehicle traffic, they should be shielded to avoid confusion. In some cases, Bike Xing signs may be placed in advance of the crossing to alert

motorists. Ramps should be installed in the curbs, to preserve the utility of the bike path. Ramps should be the same width as the bicycle paths. Curb cuts and ramps should provide a smooth transition between the bicycle paths and the roadway.

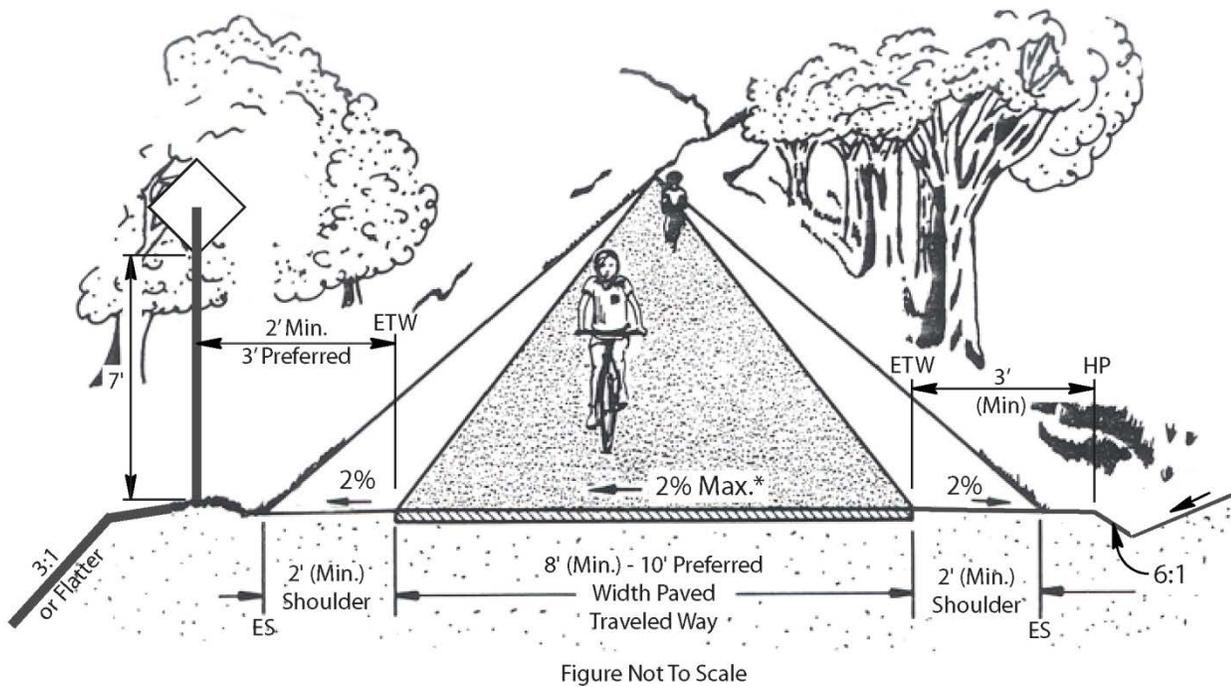
Assignment of rights of way is necessary where bicycle paths intersect roadways or other bicycle paths. See the California MUTCD, Section 9B.03 and Figure 9B-7 for guidance on signals and signs for rights of way assignment at bicycle path intersections.

- (5) *Paving at Crossings.* At unpaved roadway or driveway crossings, including bike paths or pedestrian walkways, the crossing roadway or driveway shall be paved a minimum of 15 feet to minimize or eliminate gravel intrusion on the path. The pavement structure at the crossing should be adequate to sustain the expected loading at that location

- (6) *Bike Paths Parallel and Adjacent to Streets and Highways.* A wide separation is recommended between bike paths and adjacent highways (see Figure 1003.1B). **The minimum separation between the edge of pavement of a one-way or a two-way bicycle path and the edge of traveled way of a parallel road or street shall be 5 feet plus the standard shoulder widths. Bike paths within the clear recovery zone of freeways shall include a physical barrier separation.** The separation is unpaved and does not include curbs or sidewalks. Separations less than 10 feet from the edge of the shoulder are to include landscaping or other features that provide a continuous barrier to prevent bicyclists from encroaching onto the highway. Suitable barriers may include fences or dense shrubs if design speeds are less than or equal to 45 miles per hour. Obstacles low to the ground or intermittent obstacles (e.g., curbs, dikes, raised traffic bars, posts connected by cable or wire, flexible channelizers, etc.) are not to be used because bicyclists could fall over these obstacles and into the roadway.

Bike paths immediately adjacent to streets and highways are not recommended. While they can provide separation between vehicles and non-motorized traffic, they typically introduce

Figure 1003.1A
Two-Way Class I Bikeway (Bike Path)

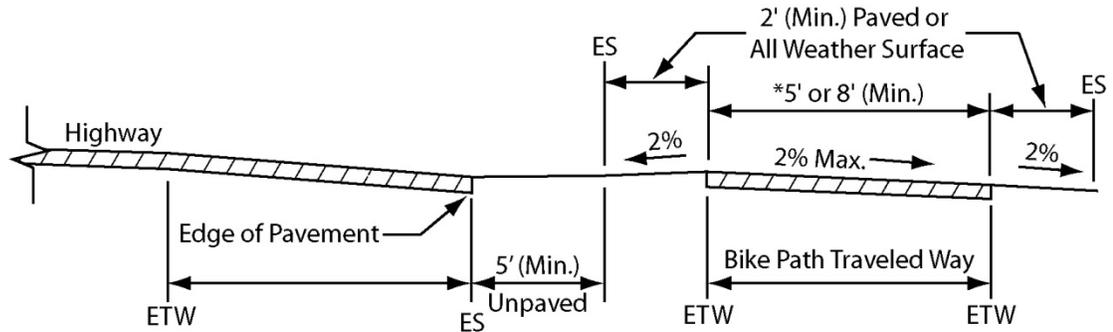


NOTES:

- (1) See Index 1003.1(13) for pavement structure guidance of bike path.
 - (2) For sign clearances, see California MUTCD, Figure 9B-1.
- * 1% cross-slope minimum.

Figure 1003.1B

Typical Cross Section of Class I Bikeway (Bike Path) Parallel to Highway



NOTE:

(1) See Index 1003.1(6) for guidance on separation between bike paths and highways.

* One-Way: 5' Minimum Width

Two-Way: 8' Minimum Width

significant conflicts at intersections. In addition, they can create conflicts with passengers at public transit facilities, and with vehicle occupants crossing the path. They are not a substitute for designing the road to meet bicyclist's mobility needs. Use of bicycle paths adjacent to roads is not mandatory in California, and many bicyclists will perceive these paths as offering a lower level of mobility compared with traveling on the road, particularly for utility trips. Careful consideration regarding how to address the above points needs to be weighed against the perceived benefits of providing a bike path adjacent to a street or highway. Factors such as urban density, the number of conflict points, the presence or absence of a sidewalk, speed and volume should be considered.

(7) *Bike Paths in the Median of Highway or Roadway.* Bike paths should not be placed in the median of a State highway or local road, and shall not be in the median of a freeway or expressway. Bike paths in the median are generally not recommended because they may require movements contrary to normal rules of the road. Specific problems with such facilities may include:

- (a) Right-turns from the center of roadways for bicyclists are unexpected by motorists.
- (b) Devoting separate phases to bicyclist movements to and from a median path at signalized intersections increases intersection delay.
- (c) Left-turning motorists must cross one direction of motor vehicle traffic and two directions of bicycle traffic, which may increase conflicts.
- (d) Where intersections are infrequent, bicyclists may choose to enter or exit bike paths at midblock.
- (e) Where medians are landscaped, visibility between bicyclists on the path and motorists at intersections may be diminished. See Chapter 900 for planting guidance.

(8) *Bicycle Path Design Speed.* The design speed of bicycle paths is established using the same principles as those applied to highway design

speeds. **The design speed given in Table 1003.1 shall be the minimum.**

**Table 1003.1
Bike Path Design Speeds**

Type of Facility	Design Speed (mph) ⁽¹⁾
Bike Paths with Mopeds Prohibited	20
Bike Paths with Mopeds Permitted	30
Bike Paths on Long Downgrades (steeper than 4%, and longer than 500')	30

NOTE:

- (1) On bike paths with mopeds prohibited, a lower design speed can be used for the crest vertical curve, equivalent to 1 mile per hour per percent grade for grades exceeding a vertical rise of 10 feet, when at a crest in path.

Installation of "speed bumps", gates, obstacles, posts, fences or other similar features intended to cause bicyclists to slow down are not to be used.

- (9) *Horizontal Alignment and Superelevation.* The minimum radius of curvature negotiable by a bicycle is a function of the superelevation of the bicycle path surface, the coefficient of friction between the bicycle tires and the bicycle path surface, and the speed of the bicycle.

For all bicycle path applications the maximum superelevation rate is 2 percent.

The minimum radius of curvature should be 90 feet for 20 miles per hour, 160 feet for 25 mile per hour and 260 feet for 30 miles per hour. No superelevation is needed for radius of curvature meeting or exceeding 100 feet for 20 miles per hour, 180 feet for 25 miles per hour, and 320 feet for 30 miles per hour. When curve radii smaller than those given because of right of way, topographical or other considerations, standard curve warning signs and supplemental pavement markings should be

installed. The negative effects of nonstandard curves can also be partially offset by widening the pavement through the curves.

- (10) *Stopping Sight Distance.* To provide bicyclists with an opportunity to see and react to the unexpected, a bicycle path should be designed with adequate stopping sight distances. **The minimum stopping sight distance based on design speed shall be 125 feet for 20 miles per hour, 175 feet for 25 miles per hour and 230 feet for 30 miles per hour.** The distance required to bring a bicycle to a full controlled stop is a function of the bicyclist's perception and brake reaction time, the initial speed of the bicycle, the coefficient of friction between the tires and the pavement, and the braking ability of the bicycle.

Stopping sight distance is measured from a bicyclist's eyes, which are assumed to be 4 ½ feet above the pavement surface to an object ½-foot high on the pavement surface.

- (11) *Length of Crest Vertical Curves.* Figure 1003.1C indicates the minimum lengths of crest vertical curves for varying design speeds.
- (12) *Lateral Clearance on Horizontal Curves.* Figure 1003.1D indicates the minimum clearances to line of sight obstructions, m , for horizontal curves. It is assumed that the bicyclist's eyes are 4 ½ feet above the pavement surface to an object ½-foot high on the pavement surface.

Bicyclists frequently ride abreast of each other on bicycle paths, and on narrow bicycle paths, bicyclists have a tendency to ride near the middle of the path. For these reasons, lateral clearances on horizontal curves should be calculated based on the sum of the stopping sight distances for bicyclists traveling in opposite directions around the curve. Where this is not possible or feasible, the following or combination thereof should be provided: (a) the path through the curve should be widened to a minimum paved width of 14 feet; and (b) a yellow center line curve warning sign and advisory speed limit signs should be installed.

- (13) *Grades.* Bike path grades must meet DIB 82. The maximum grade rate recommended for bike

paths should be 5 percent. Sustained grades should be limited to 2 percent.

- (14) *Pavement Structure.* The pavement material and structure of a bike path should be designed in the same manner as a highway, with a recommendation from the District Materials Branch. It is important to construct and maintain a smooth, well drained, all-weather riding surface with skid resistant qualities, free of vegetation growth. Principal loads will normally be from maintenance and emergency vehicles.

- (15) *Drainage.* For proper drainage, the surface of a bike path should have a minimum cross slope of 1 percent to reduce ponding and maximum of 2 percent Per DIB 82. Sloping of the traveled way in one direction usually simplifies longitudinal drainage design and surface construction, and accordingly is the preferred practice. However, the unpaved shoulders slope away from the path at 2 percent. Ordinarily, surface drainage from the path will be adequately dissipated as it flows down the gently sloping shoulder. However, when a bike path is constructed on the side of a hill, a drainage ditch of suitable dimensions may be necessary on the uphill side to intercept the hillside drainage. Where necessary, catch basins with drains should be provided to carry intercepted water across the path. Such ditches should be designed in such a way that no undue obstacle is presented to bicyclists.

Culverts or bridges are necessary where a bike path crosses a drainage channel.

- (16) *Entry Control for Bicycle Paths.* Obstacle posts and gates are fixed objects and placement within the bicycle path traveled way can cause them to be an obstruction to bicyclists. Obstacles such as posts or gates may be considered only when other measures have failed to stop unauthorized motor vehicle entry. Also, these obstacles may be considered only where safety and other issues posed by actual unauthorized vehicle entry are more serious than the safety and access issues posed to bicyclists, pedestrians and other authorized path users by the obstacles.

The 3-step approach to prevent unauthorized vehicle entry is:

- (a) Post signs identifying the entry as a bicycle path with regulatory signs prohibiting motor vehicle entry where roads and bicycle paths cross and at other path entry points.
- (b) Design the path entry so it does not look like a vehicle access and makes intentional access by unauthorized users more difficult. Dividing a path into two one-way paths prior to the intersection, separated by low plantings or other features not conducive to motor vehicle use, can discourage motorist from entering and reduce driver error.
- (c) Assess whether signing and path entry design prevents or minimizes unauthorized entry to tolerable levels. If there are documented issues caused by unauthorized motor vehicle entry, and other methods have proven ineffective, assess whether the issues posed by unauthorized vehicle entry exceed the crash risks and access issues posed by obstacles.

If the decision is made to add bollards, plantings or similar obstacles, they should be:

- Yielding to minimize injury to bicyclists and pedestrians who may strike them.
- Removable or moveable (such as gates) for emergency and maintenance access must leave a flush surface when removed.
- Reflectorized for nighttime visibility and painted, coated, or manufactured of material in a bright color to enhanced daytime visibility.
- Illuminated when necessary.
- Spaced to leave a minimum of 5 feet of clearance of paved area between obstacles (measured from face of obstacle to face of adjacent obstacle). Symmetrically about the center line of the path.
- Positioned so an even number of bicycle travel lanes are created, with a minimum of two paths. Odd number of openings increases the risk of head-on collisions if

traffic in both directions tries to use the same opening.

- Placed so additional, non-centerline/lane line posts are located a minimum of 2 feet from the edge of pavement.
- Delineated as shown in California MUTCD Figure 9C-2.
- Provide special advance warning signs or painted pavement markings if sight distance is limited.
- Placed 10 to 30 feet back from an intersection, and 5 to 10 feet from a bridge, so bicyclists approach the obstacle straight-on and maintenance vehicles can pull off the road.
- Placed beyond the clear zone on the crossing highway, otherwise breakaway.

When physical obstacles are needed to control unauthorized vehicle access, a single non-removable, flexible, post on the path centerline with a separate gate for emergency/maintenance vehicle access next to the path, is preferred. The gate should swinging away from the path,

Fold-down obstacle posts or bollards shall not be used within the paved area of bicycle paths. They are often left in the folded down position, which presents a crash hazard to bicyclists and pedestrians. When vehicles drive across fold-down obstacles, they can be broken from their hinges, leaving twisted and jagged obstructions that project a few inches from the path surface.

Obstacle posts or gates must not be used to force bicyclists to slow down, stop or dismount. Treatments used to reduce vehicle speeds may be used where it is desirable to reduce bicycle speeds.

For obstacle post visibility marking, and pavement markings, see the California MUTCD, Section 9C.101(CA).

- (17) *Lighting.* Fixed-source lighting raises awareness of conflicts along paths and at intersections. In addition, lighting allows the bicyclist to see the bicycle path direction, surface conditions, and obstacles. Lighting for

Figure 1003.1C

**Minimum Length of Bicycle Path Crest Vertical Curve (L)
Based on Stopping Sight Distance (S)**

$$L = 2S - \frac{1600}{A} \quad \text{when } S > L$$

Double line represents $S = L$

L = Minimum length of vertical curve – feet

A = Algebraic grade difference - %

$$L = \frac{AS^2}{1600} \quad \text{when } S < L$$

S = Stopping sight distance – feet

Refer to Index 1003.1(10) to determine “S”, for a given design speed “V”

Height of cyclist eye = 4½ feet

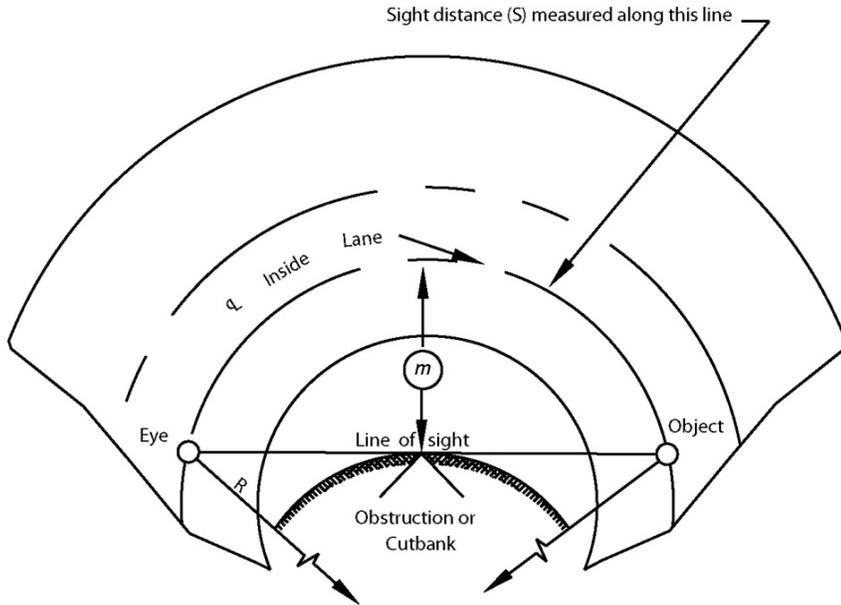
Height of object = ½-foot

A (%)	S = Stopping Sight Distance (ft)												
	70	90	110	125	130	150	170	175	190	210	230	250	270
3													7
4										20	60	100	140
5							20	30	60	100	140	180	220
6		S > L				33	73	83	113	153	193	233	270
7				21	31	71	111	121	151	191	231	273	319
8			20	50	60	100	140	150	180	221	265	313	365
9		2	42	72	82	122	162	172	203	248	298	352	410
10		20	60	90	100	140	181	191	226	276	331	391	456
11		35	75	105	115	155	199	211	248	303	364	430	501
12	7	47	87	117	127	169	217	230	271	331	397	469	547
13	17	57	97	127	137	183	235	249	293	358	430	508	592
14	26	66	106	137	148	197	253	268	316	386	463	547	638
15	33	73	113	146	158	211	271	287	338	413	496	586	683
16	40	80	121	156	169	225	289	306	361	441	529	625	729
17	46	86	129	166	180	239	307	325	384	469	562	664	775

S < L

Figure 1003.1D

Minimum Lateral Clearance (m) on Bicycle Path Horizontal Curves



S = Sight distance in feet.

R = Radius of \mathcal{C} of lane in feet.

m = Distance from \mathcal{C} of lane in feet.

Refer to Index 1003.1(10) to determine "S" for a given design speed "V".

Angle is expressed in degrees

$$m = R \left[1 - \cos \left(\frac{28.655}{R} \right) \right]$$

$$S = \frac{R}{28.655} \left[\cos^{-1} \left(\frac{R-m}{R} \right) \right]$$

Formula applies only when S is equal to or less than length of curve.

Line of sight is 28" above \mathcal{C} inside lane at point of obstruction.

Height of bicyclist's eye is 4 1/2 feet.

R (ft)	S = Stopping Sight Distance (ft)											
	60	80	100	120	140	160	180	200	220	240	260	
25	15.9											
50	8.7	15.2	23.0	31.9	41.5							
75	5.9	10.4	16.1	22.8	30.4	38.8	47.8	57.4	67.2			
95	4.7	8.3	12.9	18.3	24.7	31.8	39.5	48.0	56.9	66.3	75.9	
125		6.3	9.9	14.1	19.1	24.7	31.0	37.9	45.4	53.3	61.7	70.6
155		5.1	8.0	11.5	15.5	20.2	25.4	31.2	37.4	44.2	51.4	59.1
175		4.6	7.1	10.2	13.8	18.0	22.6	27.8	33.5	39.6	46.1	52.8
200		4.0	6.2	8.9	12.1	15.8	19.9	24.5	29.5	34.9	40.8	46.9
225			5.5	8.0	10.8	14.1	17.8	21.9	26.4	31.3	36.5	42.0
250			5.0	7.2	9.7	12.7	16.0	19.7	23.8	28.3	33.1	38.1
275			4.5	6.5	8.9	11.6	14.6	18.0	21.7	25.8	30.2	35.0
300			4.2	6.0	8.1	10.6	13.4	16.5	19.9	23.7	27.7	32.0
350				5.1	7.0	9.1	11.5	14.2	17.1	20.4	23.9	27.9
390				4.6	6.3	8.2	10.3	12.8	15.4	18.3	21.5	25.0
500					4.9	6.4	8.1	10.0	12.1	14.3	16.8	19.8
565					4.3	5.7	7.2	8.8	10.7	12.7	14.9	17.6
600					4.1	5.3	6.7	8.3	10.1	12.0	14.0	16.6
700						4.6	5.8	7.1	8.6	10.3	12.0	14.5
800						4.0	5.1	6.2	7.6	9.0	10.5	12.6
900							4.5	5.6	6.7	8.0	9.4	11.2
1000							4.0	5.0	6.0	7.2	8.4	10.0

bicycle paths is important and should be considered where nighttime use is not prohibited, in sag curves (see Index 201.5), at intersections, at locations where nighttime security could be a problem, and where obstacles deter unauthorized vehicle entry to bicycle paths. See Index 1003.1(16). Daytime lighting should also be considered through underpasses or tunnels.

Depending on the location, average maintained horizontal illumination levels of 5 lux to 22 lux should be considered. Where special security problems exist, higher illumination levels may be considered. Light standards (poles) should meet the recommended horizontal and vertical clearances. Luminaires and standards should be at a scale appropriate for a pedestrian or bicycle path. For additional guidance on lighting, consult with the District Traffic Electrical Unit.

1003.2 Class II Bikeways (Bike Lanes)

Design guidance that address the safety and mobility needs of bicyclists on Class II bikeways (bike lanes) is distributed throughout this manual where appropriate.

For Class II bikeway signing and lane markings, see the California MUTCD, Section 9C.04.

1003.3 Class III Bikeways (Bike Routes)

Class III bikeways (bike routes) are intended to provide continuity to the bikeway system. Bike routes are established along through routes not served by Class I or II bikeways, or to connect discontinuous segments of bikeway (normally bike lanes). Class III facilities are facilities shared with motor vehicles on the street, which are established by placing bike route signs along roadways. Additional enhancement of Class III facilities can be provided by adding shared roadway markings along the route. For application and placement of signs and pavement markings, see the California MUTCD Section 9C.

Minimum widths for Class III bikeways are represented, in the minimum standards for highway lanes and shoulder.

Since bicyclists are permitted on all highways (except prohibited freeways), the decision to designate the route as a bikeway should be based on

the advisability of encouraging bicycle travel on the route and other factors listed below.

(1) *On-street Bike Route Criteria.* To be of benefit to bicyclists, bike routes should offer a higher degree of service than alternative streets. Routes should be signed only if some of the following apply:

- (a) They provide for through and direct travel in bicycle-demand corridors.
- (b) Connect discontinuous segments of bike lanes.
- (c) They provide traffic actuated signals for bicycles and appropriate assignment of right of way at intersections to give greater priority to bicyclists, as compared with alternative streets.
- (d) Street parking has been removed or restricted in areas of critical width to provide improved safety.
- (e) Surface imperfections or irregularities have been corrected (e.g., utility covers adjusted to grade, potholes filled, etc.).
- (f) Maintenance of the route will be at a higher standard than that of other comparable streets (e.g., more frequent street sweeping).

(2) *Sidewalk as Bikeway.* Sidewalks are not to be designated for bicycle travel. Wide sidewalks that do not meet design standards for bicycle paths or bicycle routes also may not meet the safety and mobility needs of bicyclists. Wide sidewalks can encourage higher speed bicycle use and can increase the potential for conflicts with turning traffic at intersections as well as with pedestrians and fixed objects.

In residential areas, sidewalk riding by young children too inexperienced to ride in the street is common. It is inappropriate to sign these facilities as bikeways because it may lead bicyclists to think it is designed to meet their safety and mobility needs. Bicyclists should not be encouraged (through signing) to ride their bicycles on facilities that are not designed to accommodate bicycle travel.

(3) *Shared Transit and Bikeways.* Transit lanes and bicycles are generally not compatible, and present risks to bicyclists. Therefore sharing

exclusive use transit lanes for buses with bicycles is discouraged.

Bus and bicycle lane sharing should be considered only under special circumstances to provide bikeway continuity, such as:

- (a) If bus operating speed is 25 miles per hour or below.
- (b) If the grade of the facility is 5 percent or less.

1003.4 Trails

Trails are generally, unpaved multipurpose facilities suitable for recreational use by hikers, pedestrians, equestrians, and off-road bicyclists. While many Class I facilities are named as trails (e.g. Iron Horse Regional Trail, San Gabriel River Trail), trails as defined here do not meet Class I bikeways standards and should not be signed as bicycle paths. Where equestrians are expected, a separate equestrian trail should be provided. See DIB 82 for trail requirements for ADA. See Index 208.7 for equestrian undercrossing guidance.

- Pavement requirements for bicycle travel are not suitable for horses. Horses require softer surfaces to avoid leg injuries.
- Bicyclists may not be aware of the need to go slow or of the separation need when approaching or passing a horse. Horses reacting to perceived danger from predators may behave unpredictably; thus, if a bicyclist appears suddenly within their visual field, especially from behind they may bolt. To help horses not be surprised by a bicyclist, good visibility should be provided at all points on equestrian paths.
- When a corridor includes equestrian paths and Class I bikeways, the widest possible lateral separation should be provided between the two. A physical obstacle, such as an open rail fence, adjacent to the equestrian trail may be beneficial to induce horses to shy away from the bikeway, as long as the obstacle does not block visibility between the equestrian trail and bicycle path.

See FHWA-EP-01-027, Designing Sidewalks and Trails for Access and DIB 82 for additional design guidance.

1003.5 Miscellaneous Criteria

The following are miscellaneous bicycle treatment criteria. Specific application to Class I, and III bikeways are noted. Criteria that are not noted as applying only to bikeways apply to any highway, roadways and shoulders, except freeways where bicycles are prohibited), without regard to whether or not bikeways are established.

Bicycle Paths on Bridges – See Topic 208.

- (1) *Pavement Surface Quality.* The surface to be used by bicyclists should be smooth, free of potholes, and with uniform pavement edges.
- (2) *Drainage Grates, Manhole Covers, and Driveways.* Drainage inlet grates, manhole covers, etc., should be located out of the travel path of bicyclists whenever possible. When such items are in an area that may be used for bicycle travel, they shall be designed and installed in a manner that meets bicycle surface requirements. See Standard Plans. They shall be maintained flush with the surface when resurfacing.

If grate inlets are to be located in roadway or shoulder areas (except freeways where bicycles are prohibited) the inlet design guidance of Index 837.2(2) applies.

Future driveway construction should avoid construction of a vertical lip from the driveway to the gutter, as the lip may create a problem for bicyclists when entering from the edge of the roadway at a flat angle. If a lip is deemed necessary, the height should be limited to ½ inch.

- (3) *At-grade Railroad Crossings and Cattle Guards.* Whenever it is necessary for a Class I bikeway, highway or roadway to cross railroad tracks, special care must be taken to ensure that the safety of users is protected. The crossing must be at least as wide as the traveled way of the facility. Wherever possible, the crossing should be straight and at right angles to the rails. For bikeways or highways that cross tracks and where a skew is unavoidable, the shoulder or bikeway should be widened, to permit bicyclists to cross at right angles (see Figure 1003.5). If this is not possible, special construction and

materials should be considered to keep the flangeway depth and width to a minimum.

Pavement should be maintained so ridge buildup does not occur next to the rails. In some cases, timber plank crossings can be justified and can provide for a smoother crossing.

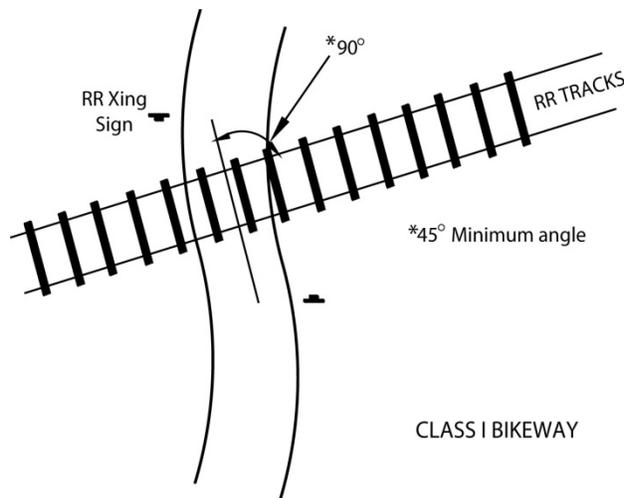
All railroad crossings are regulated by the California Public Utilities Commission (CPUC). All new bicycle path railroad crossings must be approved by the CPUC. Necessary railroad protection will be determined based on a joint field review involving the applicant, the railroad company, and the CPUC.

Cattle guards across any roadway are to be clearly marked with adequate advance warning. Cattle guards are only to be used where there is no other alternative to manage livestock.

The California MUTCD has specific guidance on Rail and Light Rail crossings. See Part 8 of the California MUTCD.

Figure 1003.5

**Railroad Crossing
Class I Bikeway**



NOTE:

See Index 403.3 Angle of Intersection for Class II and Class III facilities.

DIVERSION
Definition ----- 806.2

DIVIDED HIGHWAY
Definition ----- 62.3
Grade Line ----- 204.2

DIVIDED NONFREEWAY FACILITY
----- 108.1

DIVISION OF DESIGN
----- 10

DOWEL BAR
----- 622.4
Definition ----- 62.7

DOWNDRAINS
Definition ----- 806.2
Flume ----- 834.4
Pipe ----- 834.4

DRAIN
Edge System (See EDGE DRAIN)

DRAINAGE
Area, Definition ----- 806.2
Area ----- 819.2
Basic Policy ----- 803.1
Channels ----- 861
Computer Programs ----- 819.6
----- 825.3
Cooperative Projects Policy ----- 803.2
Course, Definition ----- 806.2
Definition ----- 806.2
Design Responsibility ----- 802.1
Detention Basins ----- 891.3
Divide, Definition ----- 806.2
Easement, Definition ----- 806.2
Economics of Design ----- 801.5
Galleries ----- 841.5
Glossary of Terms ----- 806.2
Median ----- 834.2
Objectives of Design ----- 801.4
Pavement ----- 650
by Pumping ----- 839
Roadway ----- 830
Section, Duties of ----- 802.1
Subsurface ----- 840
System, Definition ----- 806.2

DRAINS
Anchorage ----- 834.4
Benches ----- 834.4
Entrance Standards ----- 834.4
Geotextile ----- 841.5
Horizontal ----- 841.5
Outlet Treatment ----- 834.4
Overside, Spacing & Location ----- 834.4
Service Life ----- 857.1

----- 857.2
Slope ----- 834.4
Subsurface Types ----- 841.5

DRIVEWAYS
----- 205
Access Openings on Expressways ----- 205.1
Commercial ----- 205.3
Financial Responsibility ----- 205.5
Frontage Roads ----- 205.4
Local Standards ----- 205.3
Pedestrian Access ----- 205.3
Private, Definition ----- 62.3
Residential ----- 205.3
Rural Areas ----- 205.4
Urban ----- 205.3

DRY WEATHER FLOWS
Definition ----- 806.2

DUFF
Definition ----- 62.5

E

EARTH RETAINING SYSTEMS
Anchored Wall ----- 210.2
Cantilever Wall ----- 210.2
Concrete Gravity Wall ----- 210.2
Counterfort Wall ----- 210.2
Crib Wall; Concrete, Steel and Timber ----- 210.2
Drainage ----- 210.8
Electroliers and Signs ----- 210.8
Footings ----- 210.8
Gabion Basket Wall ----- 210.2
Gravity Wall ----- 210.2
L-Type Wall ----- 210.2
Masonry Wall ----- 210.2
Mechanically Stabilized Wall ----- 210.2
Non-Gravity Cantilevered Walls ----- 210.2
Proprietary ----- 210.2
Reinforced Embankments ----- 210.2
Rock Gravity Wall ----- 210.2
Rock/Soil Anchors ----- 210.2
Safety Railings ----- 210.6
Salvaged Material Retaining Wall ----- 210.2
Secant Soldier Pile Wall ----- 210.2
Sheet Pile Wall ----- 210.2
Slurry Diaphragm Wall ----- 210.2
Soil Mix Wall ----- 210.2
Soil Nail Wall ----- 210.2
Soil Reinforcement Systems ----- 210.2
Soldier Pile Wall with Lagging ----- 210.2
Tangent Soldier Pile Wall ----- 210.2
Tire Anchored Timber Wall ----- 210.2
Utilities ----- 210.8

EARTHQUAKE CONSIDERATIONS
----- 110.6

EASEMENT	
Definition -----	62.6
Definition -----	806.2
ECONOMIC ANALYSIS	
see LIFE-CYCLE COST ANALYSIS	
EDDY LOSS	
Definition -----	806.2
EDGE DRAIN	
-----	606.3
System, Definition -----	62.7
ELECTROLIERS AND SIGNS	
Walls -----	210.7
EMBANKMENT	
Definition -----	62.7
Side Slope Standards -----	304
Slopes at Structures -----	208.5
Structure Approach Embankment -----	208.11
EMINENT DOMAIN	
Definition -----	62.6
ENCROACHMENT	
Definition -----	62.6
END OF FREEWAY	
Connections with Local Roads -----	106.2
ENDWALL	
Definition -----	806.2
ENERGY	
Dissipator, Definition -----	806.2
Dissipator -----	827.2
Grade Line, Definition -----	806.2
Head, Definition -----	806.2
ENTRANCE	
Design (Hydraulic) -----	826
Freeway Interchange -----	504.2
Head, Definition -----	806.2
Loss, Definition -----	806.2
ENVIRONMENTAL REQUIREMENTS	
Transit Loading Facilities -----	108.2
Contractor's Yard and Plant Site -----	112
FHWA -----	108.3
Material Sites and Disposal Sites -----	111
Median Width -----	305.1
Project Development -----	81.1
Special Considerations -----	110
EQUALIZER	
Definition -----	806.2
-----	826.3
EQUESTRIAN TRAILS	
see TRAILS, MULTIPURPOSE	
EQUESTRIAN	
Definition -----	62.10
Undercrossing and Overcrossing -----	208.7
EQUIPMENT CROSSINGS	
-----	208.8
EQUIVALENT SINGLE AXLE LOADS	
Definition -----	62.7
Conversion ESAL to Traffic Index -----	613.3
ESAL Constants -----	613.3
Lane Distribution Factors -----	613.3
Projections, Truck Traffic -----	613.3
EROSION	
And Accretion, Definition -----	806.2
Control, Channel & Shore -----	871.1
Control, Planting -----	902
Control, Water Pollution -----	110.2
Definition -----	806.2
Vegetative Control -----	62.5
EVAPORATION	
Definition -----	806.2
-----	812.8
-----	814.4
-----	819.2
EXITS	
Freeway Interchange -----	504.2
EXPRESSWAY	
-----	62.3
F	
FAA	
Abbreviation -----	61.1
Notice Requirements -----	207.3
FACTORS AFFECTING INTERSECTION DESIGN	
see DESIGN, FACTORS AFFECTING	
FALSEWORK	
-----	204.8
Grade Line -----	204.8
Vertical Clearance -----	204.8
Width of Traffic Openings -----	204.8
Worker Safety -----	204.8
FAN	
Definition -----	806.2
FEDERAL-AID	
-----	40

STREETS			
Definitions -----	62.3		
STREET FURNITURE			
Definitions -----	62.5		
STRUCTURAL PLATE			
Arches -----	852.6		
Vehicular Underpasses -----	852.6		
STRUCTURAL SECTION			
see PAVEMENT STRUCTURE			
STRUCTURE APPROACH			
Design Responsibilities -----	601.3		
Foundation: Embankment Design -----	208.11		
Pavement Systems -----	672		
Slab-New Construction Projects -----	208.11		
Slab-Rehabilitation Projects -----	673		
STRUCTURE CLEARANCE			
-----	309		
Elevated Structures -----	309.4		
Horizontal -----	309.1		
Railroad -----	309.5		
Tunnel -----	309.3		
Vertical -----	309.2		
STRUCTURES, SLOPE TREATMENT UNDER			
See SLOPE TREATMENT			
STRUTTING			
Definition -----	806.2		
SUBBASE			
Definition -----	62.7		
Description -----	602.1		
Engineering Criteria -----	663		
Lime Treated -----	662.2		
Treated -----	662.2		
SUBCRITICAL FLOW			
Definition -----	806.2		
-----	864.3		
SUBDRAIN			
Definition -----	806.2		
-----	841.5		
SUBGRADE			
-----	614		
Definition -----	62.7		
Description -----	602.1		
Engineering Considerations -----	614.1		
Enhancement Fabrics -----	614.5		
SUBSEAL			
-----	607.6		
SUBSURFACE DRAINAGE			
-----	840		
SUBURBAN			
-----	81.3		
SUMP			
Definition -----	806.2		
-----	831.3		
SUPERCritical FLOW			
Definition -----	806.2		
-----	864.3		
SUPERELEVATION			
Axis of Rotation -----	202.4		
Basic Criteria -----	202.1		
Bridge -----	203.9		
Channels -----	866.2		
City Streets and County Roads -----	202.7		
Comfortable Speeds -----	202.2		
Compound Curves -----	202.6		
Ramps -----	504.3		
Relationship to Speed on Curves -----	203.2		
Reversing Curves -----	203.6		
Runoff -----	202.5		
Standards -----	202.2		
Transition -----	202.5		
SURFACE			
Course, Definition -----	62.7		
Course, Description -----	602.1		
Runoff, Definition -----	806.2		
Water, Definition -----	806.2		
Water -----	831.1		
SURFACE TRANSPORTATION PROGRAM			
-----	43.1		
SWALE			
Definition -----	806.2		
SWEPT WIDTH			
Definition -----	62.4		
-----	404.1		
Design Considerations -----	404.2		
T			
TAPERED INLET			
Definition -----	806.2		
-----	826.4		
TEXTURING			
Rigid Pavement -----	622.7		
THREE-CENTER CURVE			
Intersections -----	405.7		

THROUGHWAY

Definition ----- 62.3

TIME OF CONCENTRATION

Channel Flow ----- 816.6
 Combined Flow ----- 816.6
 Culvert Flow ----- 816.6
 Kinematic Wave Equation ----- 816.6
 Kirpich Equation ----- 816.6
 Overland Equation ----- 816.6
 Soil Conservation Service (SCS) Equation ----- 816.6
 Upland Method ----- 816.6

TOLL ROAD, BRIDGE OR TUNNEL

----- 62.3

TOPSOIL

Roadside Treatment ----- 706.3

TRACKING WIDTH

Definition ----- 62.4
 ----- 404.1
 Design Considerations ----- 404.2

TRAFFIC

Axle Load Spectra ----- 613.4
 Considerations ----- 401.3
 Considerations in Pavement Engineering ----- 613
 Control Devices ----- 62.8
 Control Devices ----- 403.10
 Control Plans, Special Problems ----- 110.7
 Definitions ----- 62.8
 Engineering ----- 82.7
 Index, TI ----- 613.3
 Interchanges ----- 500
 Islands ----- 405.4
 Lane ----- 62.1
 Markings ----- 62.8
 Noise Abatement ----- 1100
 Pedestrian Refuge ----- 405.4
 Ramp Intersection Flow ----- 406
 Sign ----- 62.8
 Signals ----- 62.8
 Specific Loading Considerations ----- 613.5
 Volume Projections ----- 613.2
 Volumes ----- 102.1

TRAILS

Multipurpose ----- 1003.5

TRANSIT

Bus Rapid Transit (BRT) ----- 62.10
 Definition ----- 62.10
 Design Vehicle ----- 404.3
 Factors Affecting Design ----- 401.6
 Loading Facilities ----- 108.2
 Turning Templates ----- 404.5

TRANSITIONS

General Standards, Pavement ----- 206.1

Lane Additions ----- 206.2
 Lane Drops ----- 206.3
 Pavement ----- 206
 Spiral ----- 203.8
 Superelevation ----- 202.5
 Temporary Freeway ----- 206.4

TRANSPIRATION

----- 812.8
 ----- 819.2

TRANSPORTATION MANAGEMENT AREA

Definition ----- 81.3
 Interchange Spacing ----- 501.3

TRASH RACK

Definition ----- 806.2
 ----- 822.2

TRAVELED WAY

Definition ----- 62.1
 Design Considerations ----- 404.2
 Standards ----- 301

TREATED BASE AND SUBBASE

----- 662.2

TREATED PERMEABLE BASE AND SUBBASE

----- 662.3

TREES

Conventional Highways ----- 902.3
 Freeways and Expressways ----- 902.2

TRUCK

Critical Lengths of Grade ----- 204.5
 Design Vehicle ----- 404.3
 Escape Ramps ----- 702.1
 Turning Templates ----- 404.5
 Turns ----- 404.5
 Weighing Facilities ----- 703.1

TRUMPET INTERCHANGE

----- 502.2

TRUNK LINE

Definition ----- 806.2
 ----- 838.4

TUNNEL

Classification ----- 110.12
 Clearances ----- 309.3
 Liner Plate ----- 852.6
 Projects ----- 110.12
 Structural Repairs with Steel Tunnel Liner
 Plate ----- 853.7

TURBULENCE

Definition ----- 806.2

TURBULENT FLOW
 Definition ----- 806.2

TURNING LANES
 Left-turn Channelization ----- 405.2
 Right-turn Channelization ----- 405.3
 Separate ----- 62.1
 Traffic ----- 403.6
 Two-way Left-turn ----- 405.2

TURNING RADIUS
 Minimum ----- 62.4

TURNING TEMPLATES
 ----- 404.3
 Truck and Transit ----- 407

TURNOUTS
 ----- 204.5

URNS, PROHIBITED
 Intersections ----- 403.8

TWO-LANE CROSS SECTIONS
 New Construction ----- 307.2
 RRR Projects ----- 307.3

TWO-QUADRANT CLOVERLEAF INTERCHANGE
 ----- 502.2

TWO-WAY LEFT-TURN LANES
 ----- 405.2

U

UNDERCUT
 Definition ----- 806.2
 ----- 865.2

UNDERDRAINS
 Design Criteria ----- 842.4
 Installations ----- 842.2
 Open Joint ----- 842.5
 Perforated Pipe ----- 842.5
 Pipe ----- 842.5
 Selection of Type ----- 842.7
 Service Life ----- 842.6

UNDERFLOW
 Definition ----- 806.2

UNDERPASS
 Railroad, Grade Line ----- 204.8
 Railroad ----- 208.9

UNDIVIDED HIGHWAYS
 Axis of Rotation ----- 202.4

Grade Line ----- 204.2

UNTREATED GRANULAR BASE

see BASE

URBAN/URBANIZED

Access Control ----- 504.8
 Corner Radii ----- 405.8
 Definition ----- 81.3
 Design Speed ----- 101.2
 Drive way ----- 205.3
 Horizontal Clearance ----- 309.1
 Interchange Spacing ----- 501.3
 Median Standards ----- 305.1
 Outer Separation ----- 310.2
 Position of Curbs and Dikes ----- 303.5
 Weaving Section ----- 504.7

UTILITIES

at Walls ----- 210.8

V

VACATION

Definition ----- 110.9

VALUE ANALYSIS

----- 110.9

VEGETATIVE EROSION CONTROL

----- 62.5

VELOCITY HEAD

Definition ----- 806.2
 ----- 864.3

VERTICAL CLEARANCE

see CLEARANCES

VERTICAL CURVES

----- 204.4

also see SIGHT DISTANCE

VISTA POINTS

Definition ----- 62.5
 Aesthetic Factors ----- 109.3
 Design Standards ----- 904
 Features and Facilities ----- 904.3
 General ----- 904.1
 Minimum Standards ----- 904.1
 Site Selection ----- 904.2
 Water Supply ----- 706.6

VOLUME

----- 62.8
 Design Hourly Volume ----- 103.1
 Design Volume ----- 62.8

W

WALKWAYS

see PEDESTRIAN FACILITIES

WALLS

Head ----- 826.3

WALLS, RETAINING

see EARTH RETAINING SYSTEMS

WATER

Course, Definition ----- 806.2
 Pollution, Control of ----- 110.2
 Quality Control Boards ----- 110.2
 Shed ----- 819.2
 Table, Definition ----- 806.2
 Way, Definition ----- 806.2
 Wells, Abandonment ----- 110.2

WATER SUPPLY

Roadside Rests ----- 903.5
 Roadside Rests and Landscaping ----- 706.6
 Vista Points ----- 706.6

WAVE

Height ----- 873.2
 Run-up ----- 873.2

WEAVING

----- 62.8
 Sections ----- 62.4
 Sections, Interchange ----- 504.7

WEED CONTROL

Noxious, Control of ----- 110.5

WEEPHOLES

Definition ----- 806.2
 ----- 872.2

WEIGHING FACILITIES

Truck ----- 703.1

WEIR

Definition ----- 806.2

WELLS

----- 841.5
 Water, Abandonment ----- 110.2

WETLANDS PROTECTION

----- 110.4

WHEELBASE

Definition ----- 62.4

WHEELCHAIR RAMPS

see CURB RAMPS

WIDENING

Pavement ----- 206.2
 Ramps, for Trucks ----- 504.3
 Pavement Design Life ----- 612.3
 Pavement, Project Type ----- 603.2
 Signalized Intersections ----- 405.9
 Slope Benches and Cut Widening ----- 304.3

WIDTH

Driveway, Access Openings on Expressways --- 205.1
 Driveway, Urban ----- 205.3
 Lane ----- 301.1
 Lane, on Curves ----- 504.3
 Left Turn Lanes ----- 405.2
 Median ----- 305.1
 Opening for Falsework ----- 204.8
 Pavement ----- 301.1
 Right of Way ----- 306
 Shoulder ----- 302.1
 Structures ----- 208.1
 Swept, Definition ----- 62.4
 Swept, Design Considerations ----- 404.2
 Tracking, Definition ----- 62.4
 Tracking, Design Considerations ----- 404.2

Y

YARDS

Maintenance ----- 107.2
 Plant Sites, Contractors ----- 112