CHAPTER 8
FREEWAYS

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8.0 INTRODUCTION

The discussion in this chapter on freeways applies to both urban and rural freeways, except where noted. Supplemental requirements for the design of Interstate highways can be found in AASHTO's companion booklet, A Policy on Design Standards – Interstate System (1).

The highest type of arterial highway is the freeway, which is defined as an arterial highway with full control of access and no at grade crossings or connections. Full control of access is the condition where the right of owners or occupants of abutting land to access a freeway is fully controlled by public authority. Access connections to the freeway are with selected public roads only. Crossings at grade or direct private driveway connections are prohibited.

Essential freeway elements include: medians; grade separations; ramps; and in some cases, frontage roads. This chapter identifies the various types of freeways, emphasizes selected features, and discusses other design details unique to these freeway types.

Consult Chapters 3 and 4 for details on the basic design elements applicable to this classification of roadway.

8.1 GENERAL DESIGN CONSIDERATIONS

The following discussions are for both urban and rural freeways, except as noted.

8.1.1 Design Speed

Design speed should be consistent with the anticipated operating speed and driver expectations.

The design speed of urban freeways should not be less than 50 mph. On many urban freeways, particularly in developing areas, a design speed of 60 mph can be provided with little additional cost.

A design speed of at least 70 mph is typical on rural freeways; however, when practical, a design speed of 75 mph or higher should be considered on rural freeways where the speed limit is currently, or could become, 75 mph. Where terrain is mountainous, a design speed of 50 to 60 mph may be used.

8.1.2 Design Traffic Volumes

Both urban and rural freeways, especially in the case of new construction, are normally designed to accommodate traffic projections for a 20-year period. Some elements of freeway reconstruction may be based on a lesser design period. Specific capacity requirements should be determined from directional design hourly volumes (DDHV) for the appropriate design period.

8.1.3 Levels of Service

Freeways and their auxiliary facilities, i.e., ramps, mainline weaving sections, should generally be designed for level-of-service C. In heavily developed sections of metropolitan areas, conditions may necessitate the use of level-of-service D. In rural areas, level-of-service B is desirable for through and auxiliary lanes, although level-of-service C may be acceptable on auxiliary facilities carrying unusually high volumes of traffic. Designers should strive to provide the highest level of service practical and consistent with anticipated conditions. Procedures for traffic operational analyses for freeways are found in the *Highway Capacity Manual* **(2)**.

8.1.4 Pavement and Shoulders

Freeways have a minimum of two through-traffic lanes for each direction of travel. Through-traffic lanes should be 12 feet wide. Cross slopes should be 2 percent. There should be continuous paved shoulders on both the right and left sides of all freeway facilities. The usable paved width of the right shoulder should be at least 10 feet. On four-lane freeways, the median (left) shoulder is normally 4 feet wide. See section 4.3.

On freeways of six or more lanes, the usable paved width of the median shoulder should also be 10 feet. Where the DDHV for truck traffic exceeds 250 veh/h, a paved shoulder width of 12 feet should be considered.

8.1.5 Curbs

In general, neither vertical nor sloping type curbs are desirable for use on high-speed roadways. For more information, refer to the discussion on curb types and their placement in section 4.6 of this guide, the *PGDHS* **(3)** and the *AASHTO Roadside Design Guide* **(4)**.

8.1.6 Superelevation

See section 3.2.3.

8.1.7 Grades

Maximum grades as a function of design speed and type of terrain are given in Table 3-4. Where sustained upgrades are required, the need for climbing lanes should be investigated.

8.1.8 Structures

The design of bridges, culverts, walls, tunnels, and other structures shall be in accordance with the principals of the current AASHTO *Standard Specifications for Highway Bridges* **(5).** Structures carrying freeway traffic should provide an HS20-44 design loading.

The clear width on bridges carrying freeway traffic should be as wide as the approach pavement and paved shoulders (see Chapter 15 for shoulders less than 6 feet wide). Structures carrying ramps should provide a clear width equal to the ramp width and paved shoulders.

8.1.9 Vertical Clearance

See section 3.3 and Table 3-3.

8.1.10 Horizontal Clearance to Obstructions

Freeways should have clear zone widths consistent with their operating speed and side slopes as discussed in section 4.5 of this Guide, in Chapter 8 of the *PGDHS* **(3)**, and in the *AASHTO Roadside Design Guide* **(4)**.

8.1.11 Outer Separations, Borders, and Frontage Roads

See section 4.12.

8.2 RURAL FREEWAYS

8.2.1 Alignment and Profile

Rural freeways should have smooth-flowing horizontal and vertical alignments. Proper combinations of flat curvature, shorter tangents, gentle grades, variable median widths, and separate roadway elevation enhance the safety and aesthetic aspect of freeways. Changing median widths on tangent alignments should be avoided where practical to avoid a distorted appearance.

Rural freeways can usually be constructed near ground level with smooth and relatively flat profiles. The profile of a rural freeway is controlled more by drainage and earthwork considerations and less by the need for frequent grade separations and interchanges.

8.2.2 Medians

Median widths of about 50 to 100 feet are common on rural freeways. A 50-foot median provides for 6-foot graded shoulders and 6:1 foreslopes with a 3-foot median ditch depth and adequate space for vehicle recovery. A 100-foot median would permit the designer to use independent profiles in rolling terrain to blend the freeway more appropriately with the environment while maintaining flat slopes for vehicle recovery. In flat terrain, the 100-foot median is also suitable when stage construction includes the addition of two future 12-foot traffic lanes.

Where the terrain is extremely rolling or the land is not suitable for cultivation or grazing, a wide variable median having an average width of 150 feet or more may be attainable. This permits the use of independent roadway alignment, both horizontally and vertically, to the best advantage in blending the freeway into the natural topography. Foreslopes and backslopes used within the clear zone should provide for vehicle recovery. The remaining median width may be left in its natural state of vegetation, trees, and rock outcroppings.

In areas where right of way restrictions dictate or in mountainous terrain, median widths in the range of 10 to 30 feet may be necessary. In such instances, the median is usually paved. Due to the usual developing-area traffic volumes as well as operational characteristics in mountainous areas, a median barrier is usually warranted as a safety measure.

Emergency crossovers on rural freeways are normally provided where interchange spacing exceeds 5 miles. Between interchanges, emergency crossovers are spaced at 3 to 4-mile intervals. Maintenance crossovers may be required at one or both ends of interchange facilities for the purpose of snow removal and at other locations to facilitate maintenance operations. Crossovers should not be located closer than 1,500 feet to the end of a speed-change taper of a ramp or to any

structure. Crossovers should be located only where above-minimum stopping sight distance is provided and preferably should not be located within curves requiring superelevation.

The width of the crossover should be sufficient to provide safe turning movements and should have a surface capable of supporting the maintenance equipment used on it. Crossovers should not be placed in restricted-width medians unless the median width is sufficient to accommodate a vehicle length of 25 feet or more.

Where median barriers are employed, each end of the barrier at the opening requires a crashworthy terminal.

For further information on medians, refer to section 4.10 of this Guide, the *PGDHS* **(3)**, and the AASHTO *Roadside Design Guide* **(4)**.

8.2.3 Sideslopes

Flat, rounded sideslopes, fitting with the topography and consistent with available right of way, should be provided on rural freeways. Foreslopes of 6:1 or flatter are recommended in cut sections and for fills of moderate height. Where fill heights are intermediate, a combination of recoverable and non-recoverable slopes may be used to provide the acceptable vehicle recovery area. For high fills, steeper slopes protected by guardrail may be needed. In addition, backslopes of 3:1 or flatter permit landscaping and erosion control practices and ease of maintenance operations.

8.2.4 Frontage Roads

See section 4.11 of this Guide and the *PGDHS* **(3)**.

8.3 URBAN FREEWAYS

8.3.1 Medians

The median on urban freeways should be as wide and flat as feasible. Extra median width also can be used for transit or to provide additional lanes if more capacity is needed in the future. The minimum median width for a four-lane urban freeway is 10 feet, which provides for two 4-foot shoulders and a 2-foot median barrier. For freeways with six or more lanes, the minimum width is 22 feet, and preferably 26 feet, when truck traffic exceeds 250 DDHV, to accommodate the wider median shoulder. For these minimum median widths, a median barrier is always required. Additional horizontal clearance may be required to provide minimum stopping sight distance along the inside lane on sharper curves.

Median crossovers for emergency or maintenance purposes are generally not warranted on urban freeways due to the close spacing of interchange facilities and the extensive development of the abutting street network.

8.3.2 Depressed Freeways

Information for the following is found in Chapter 8 of the *PGDHS* **(3)**:

- Slopes and walls
- Typical cross section
- Restricted cross section
- Walled cross section

8.3.3 Elevated Freeways

Information for the following is found in Chapter 8 of the *PGDHS* **(3)**:

- Medians
- Ramps and terminals
- Frontage roads
- Clearance to building lines
- Typical cross section
- Viaduct freeways without ramps
- Two-way viaduct freeways with ramps
- Freeways on earth embankments

8.3.4 Ground-Level Freeways

Information for the following is found in Chapter 8 of the *PGDHS* **(3)**:

- Typical cross sections
- Restricted cross sections

8.3.5 Combination-Type Freeways

Information for the following is found in Chapter 8 of the *PGDHS* **(3)**:

- Profile control
- Cross-section control

8.3.6 Special Freeway Designs

Information for the following is found in Chapter 8 of the *PGDHS* **(3)**:

- Reverse-flow roadways
- Dual-divided freeways
- Freeways with collector-distributor roads

8.3.7 Accommodation of Transit and High-Occupancy Vehicle Facilities

Information for the following is found in Chapter 8 of the *PGDHS* **(3)**:

- Buses
- Rail transit

REFERENCES

1. AASHTO. *A Policy on Design Standards – Interstate System,* American Association of State Highway and Transportation Officials Washington, D.C.: 2016.
2. TRB. *Highway Capacity Manual*, Transportation Research Board, Washington, D.C.: 2010.
3. AASHTO. *A Policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials, Washington, D.C.: 2011.
4. AASHTO. *Roadside Design Guide*, American Association of State Highway and Transportation Officials, Washington, D.C.: 2011.
5. AASHTO. *AASHTO Standard Specifications for Highway Bridges*, American Association of State Highway and Transportation Officials, Washington, D.C.: 2002