Roadway Geometric Design 5

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PDH: 3

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INTRODUCTION

This course is the **last** in a series of five volumes that summarizes and highlights the geometric design process for modern roads and highways. The course objective is to give engineers and designers an in-depth look at the principles to be considered when selecting and designing roads. Subjects covered include: *interchanges (types, warrants); and grade separated structures (overpasses, underpasses).* The contents of this document are intended to serve as guidance and not as an absolute standard or rule.

The *American Association of State Highway and Transportation Officials (AASHTO)* publishes and approves information on geometric roadway design for use by individual state transportation agencies. For this course, AASHTO's **A Policy on Geometric Design of Highways and Streets** (also known as the "Green Book") will be used primarily for fundamental geometric design principles. This text is considered to be the primary guidance for U.S. roadway geometric design.

The practice of geometric design will always be a dynamic process with a multitude of considerations: *driver age and abilities; vehicle fleet variety and types; construction costs; maintenance requirements; environmental sensitivity; land use; aesthetics; and most importantly, societal values.* Despite this dynamic character, the primary objective of good design will remain as it has always been – **to provide a safe, efficient and cost-effective roadway that addresses conflicting needs or concerns.**

INTERCHANGES

An interchange is a system of interconnecting roadways that uses grade separations and ramps to permit roadway traffic to pass through the junction without directly crossing any other traffic stream. The selection of the appropriate type of facility and its essential elements (freeway, cross streets, median, ramps and auxiliary lanes) are typically influenced by highway classification, traffic, design speed, and access control. Grade separation produces the greatest efficiency, safety, and capacity for intersecting traveled ways.

Interchange configurations can vary in shape or scope and range from single ramps to complex systems involving multiple highways. While the desired traffic operation should be the dominant design factor – aspects of topography, culture, and cost may also be major considerations.

Interchange Warrants

- Design designation
- Reduction of bottlenecks or spot congestion
- Reduction of crash frequency and severity
- Site topography
- Road-user benefits
- Traffic volume warrant

Grade separations may also be warranted where: local roads cannot be terminated outside the right-of-way; frontage roads or other access cannot be provided; a railroad-highway crossing may be eliminated; an unusual concentration of pedestrian traffic occurs; bikeways and pedestrian crossings are designated; access to mass transit stations is needed; and ramp free-flow operation is required.

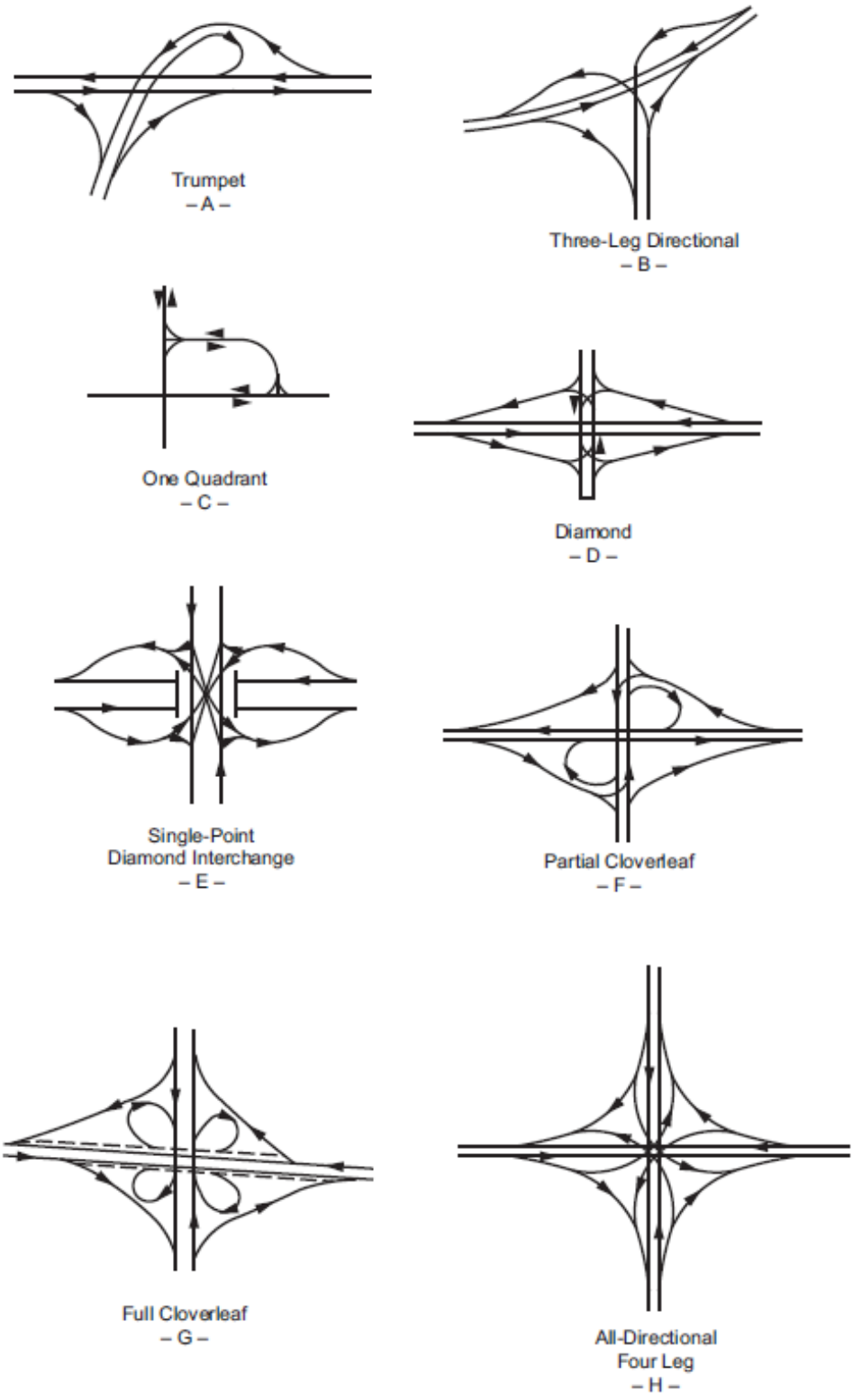

Figure 10-1. Interchange Configurations

Roadway interchanges are unique designs and are built to meet the specific needs at a certain location. Basic interchange configurations depend on: *topography; design controls; signage; culture; number of intersection legs; and expected traffic volumes*.

Interchange Configurations

System Interchange – connects 2 or more freeways

Service Interchange – connects freeways to lesser facilities

Rural interchange configurations are typically based on their service demand. Directional interchanges may be needed for intersecting freeways with high turning volumes.

Cloverleaf Interchange Minimum intersection design for 2 full-controlled access roads

Adaptable for rural locations with ample right-of-way and minimal weaving

Simple Diamond Interchange Most common for intersection of major road with minor facility

Capacity limited by at-grade ramp terminals at crossroads

Partial Cloverleaf Interchange Eliminates weaving of full cloverleaf design

Provides superior capacity

Appropriate where right-of-way is unavailable

Rural interchanges can be widely spaced and designed on an individual basis without impacting other interchanges. Final configurations may depend on available right-of-way, exit patterns, route continuity, advance exits, weaving, and signing. Sight distance should always be a major concern.

Urban interchanges should be considered as part of a system and not on an individual basis. Urban environments require considerable analysis of prevailing conditions. New interchange designs need to be both horizontally and vertically compatible with the urban corridor.

Interchange Design Principles

Weaving Single exits in advance of structure Potential for signing

Route continuity Availability of right-of-way Capacity Cost

Potential for stage construction Uniformity of exit patterns

Environmental compatibility

Design speeds, alignments, profiles and cross-sections for structure approaches should be consistent with the intersection. Grade separation geometry should exceed approaching roadway designs to reduce any sense of restriction. Interchange through highway alignments and profiles should be as flat and visible as practical.

Grade separation **sight distance** should meet or exceed stopping sight distance values. Decision sight distance is preferable where exits are involved, if practical. Above-minimum radii should be used for roadway horizontal curvature through interchanges.

The suggested **minimum interchange spacing** is 1 mile for urban areas and 2 miles for rural locations. Urban interchange spacing less than 1 mile may be used in conjunction with grade-separated ramps or collector-distributor roads.

Route continuity combines operational uniformity, proper lane balance, and maintaining a basic number of traffic lanes. This principle simplifies driving by providing a continuous through route – less lane changes, simpler signage, route delineation, and reduced driver distraction.

The **basic number of lanes** is the minimum number of lanes assigned to a freeway (regardless of changes in traffic volume or lane balance). The number of lanes is dependent on the traffic volume (DHV) over a significant length of roadway.

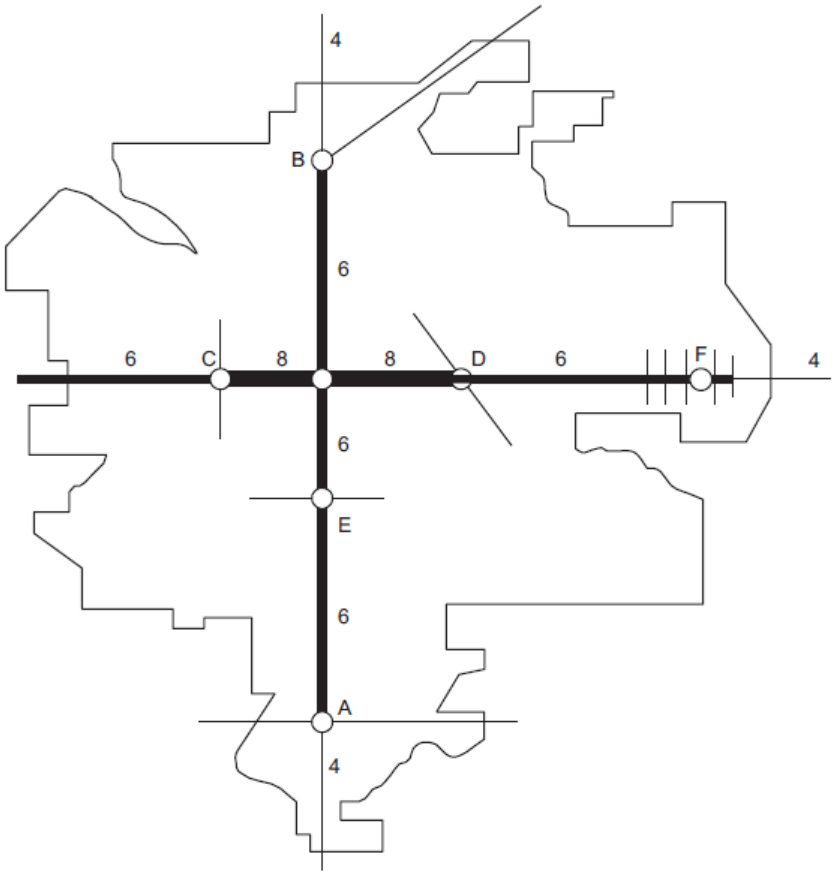

Figure 10-49. Schematic of Basic Number of Lanes

Purchase this course to see the remainder of the technical materials.