Intersection Geometric Design II

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PDH: 3

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INTRODUCTION

This course is the second of two that summarizes and highlights the geometric design process for modern roadway intersections. The contents of this document are intended to serve as guidance and not as an absolute standard or rule.

When you complete this course, you should be familiar with the general guidelines for at-grade intersection design. The course objective is to give engineers and designers an in-depth look at the principles to be considered when selecting and designing intersections.

Subjects include:

General intersection design considerations

Roundabout design – elements, single-lane, multilane, mini-roundabouts

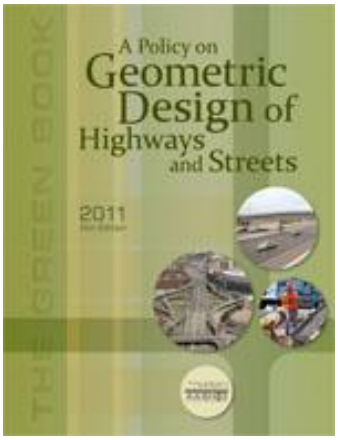
Frontage roads

Pedestrian facilities

Bicycle considerations

Railroad crossings – alignments, sight distance

For this course, Chapter 9 of **A Policy on Geometric Design of Highways and Streets** (also known as the "Green Book") published by the American Association of State Highway and Transportation Officials (AASHTO) will be used primarily for fundamental geometric design principles. This text is considered to be the primary guidance for U.S. roadway geometric design.



This document is intended to explain some principles of good roadway design and show the potential trade-offs that the designer may have to face in a variety of situations, including cost of construction, maintenance requirements, compatibility with adjacent land uses, operational and safety impacts, environmental sensitivity, and compatibility with infrastructure needs.

Geometric design is the assembly of the fundamental three-dimensional features of the highway that are related to its operational quality and safety. Its basic objective is to provide a smooth-flowing, crash-free facility. Geometric roadway design consists of three main parts: **cross section** (lanes and shoulders, curbs, medians, roadside slopes and ditches, sidewalks); **horizontal alignment** (tangents and curves); and **vertical alignment** (grades and vertical curves). Combined, these elements provide a three-dimensional layout for a roadway.

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.**

BASICS

Intersections are unique roadway elements where conflicting vehicle streams (and sometimes non-motorized users) share the same space. This area encompasses all modes of travel

- *pedestrian*
- *bicycle*
- *passenger vehicle*
- *truck*
- *transit*

as well as auxiliary lanes, medians, islands, sidewalks and pedestrian ramps. These may further heighten the accident potential and constrain the operational efficiency and network capacity of the urban street system. However, *the main objective of intersection design is to facilitate the roadway user and enhance efficient vehicle movement.* The need to provide extra time for drivers to perceive, decide, and navigate through the intersection is central to intersection design controls and practices.

Designing to accommodate the appropriate traffic control are critical to good intersection design. Warrants and guidelines for selection of appropriate intersection control (including stop, yield, all-stop, or signal control) may be found in the MUTCD.

Basic Elements of Intersection Design

Human Factors

Driver habits, decision ability, driver expectancy, decision/reaction time, paths of movement, pedestrian characteristics, bicyclists

Traffic Considerations

Roadway classifications, capacities, turning movements, vehicle characteristics, traffic movements, vehicle speeds, transit, crash history, bicycles, pedestrians

Physical Elements

Abutting properties, vertical alignments, sight distance, intersection angle, conflict area, speed-change lanes, geometric design, traffic control, lighting, roadside design, environmental factors, crosswalks, driveways, access management

Economic Factors

Improvement costs, energy consumption, right-of-way impacts

A range of design elements are available to achieve the functional objectives, including horizontal and vertical geometry, left- and right-turn lanes, channelization, etc.

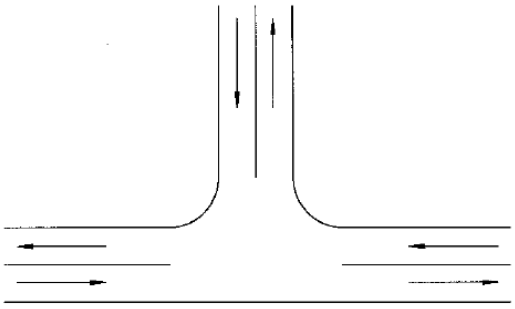
Level of service analysis and roadway capacity are critical considerations in intersection design. Capacity is determined by constraints at intersections. Vehicle turns at intersections interrupt traffic flow and reduce levels of service.

AASHTO defines intersection capacity as “the maximum hourly rate at which vehicles can reasonably be expected to pass through the intersection under prevailing traffic, roadway, and signalization conditions”. The Highway Capacity Manual (HCM) provides various analysis techniques for comparing different conditions at intersections.

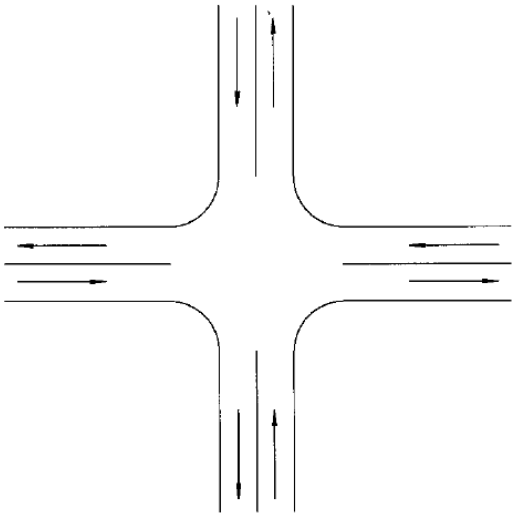
A well-designed intersection is clear to the driver with design dimensions supporting operational requirements, traffic control devices functioning as intended, and nonmotorized vehicle users operating safely through the intersection.

Basic Types of Intersections

- Three-leg (T)
- Four-leg
- Multi-leg
- Roundabout



THREE-LEG INTERSECTION



FOUR-LEG INTERSECTION

ROUNDABOUT DESIGN

The “modern roundabout” was a British solution to the problems associated with rotary intersections. The resulting design is a one-way, circular intersection with traffic flow around a central island. The U.K. adopted a mandatory “give-way” rule for entering traffic at all circular intersections to yield to circulating traffic. This rule greatly reduced the number and severity of vehicle crashes.

Basic Principles for Modern Roundabouts

1) **Yield control at all entry points** – All approaching traffic is required to yield to vehicles on the roundabout’s circulatory roadway before entering the circle. Yield signs are used primarily as entry control. Weaving maneuvers are not considered a design or capacity factor.
2) **Traffic deflection** – Entering vehicles are directed to the right (in the U.S.) by channelization or splitter islands onto the roundabout’s circulating roadway avoiding the central island. No entrance traffic is permitted to travel a straight route through the roundabout.
3) **Geometric curvature** – Entry design and the radius of the roundabout’s circulating roadway can be designed to slow the speeds for entering and circulating traffic.

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