Roadway Geometric Design 1

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PDH: 3

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INTRODUCTION

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.

This course is the **first** in a series of five volumes that summarizes and highlights the geometric design process for modern roads and highways. Subjects covered include: *highway functions (classification systems); design controls and criteria (design vehicles, highway capacity, traffic characteristics);* and *elements of design (sight distance, horizontal and vertical alignments).* 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 design guidelines for roadways. The course objective is to give engineers and designers an in-depth look at the principles to be considered when selecting and designing roads.

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. The majority of today's geometric design research is sponsored and directed by AASHTO and the Federal Highway Administration (FHWA) through the National Cooperative Highway Research Program (NCHRP).

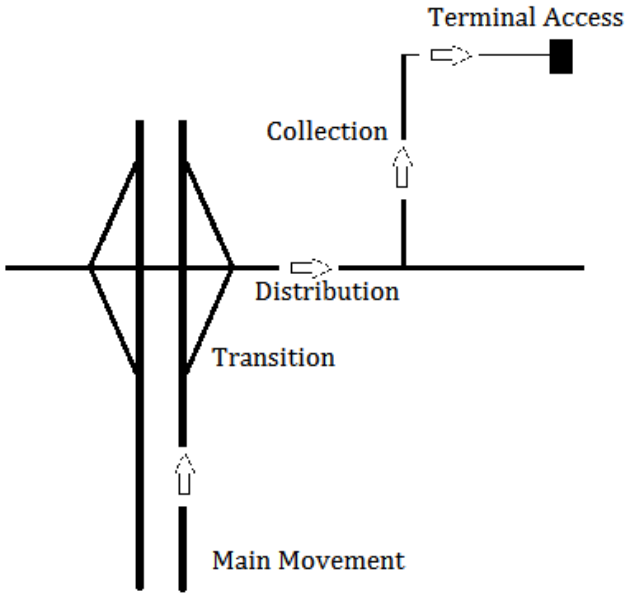
For this course, AASHTO's **A Policy on Geometric Design of Highways and Streets** (also known as the "Green Book") will be used primarily for fundamental geometric design principles. This text is considered to be the primary guidance for U.S. roadway geometric design.

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.

HIGHWAY FUNCTIONS

FUNCTIONAL CLASSIFICATION

Functional classification refers to different types of roadways that are classified by the service they provide. Distinct travel movements of most trips include: *main movement, transition, distribution, collection, access, and termination.* The figure below illustrates a typical highway trip – where the freeway is the main movement (uninterrupted, high-speed), speed is reduced for the freeway ramps which act as transitions, arterials distribute vehicles near residential areas, collector roads enter the neighborhoods, and local access roads provide direst approaches to terminal facilities.



Hierarchy of Movement

Movement hierarchy is based on traffic volume with *freeway* travel typically at the highest level – *arterial distributors* are next with collectors and *local access roads* at the lowest levels. Roadway obsolescence occurs when designs fail to recognize and accommodate the different trip levels within the movement hierarchy. Inadequate functional transitions result in congestion and conflict between roadways and traffic generating facilities (i.e. commercial driveways, freeway ramps).

The functional classification of streets and highways is dependent on their character of service (nature and types of trips, basic purpose of the road, and general traffic volume). This type of classification recognizes that most traffic moves through road networks and can be classified by travel category relationships.

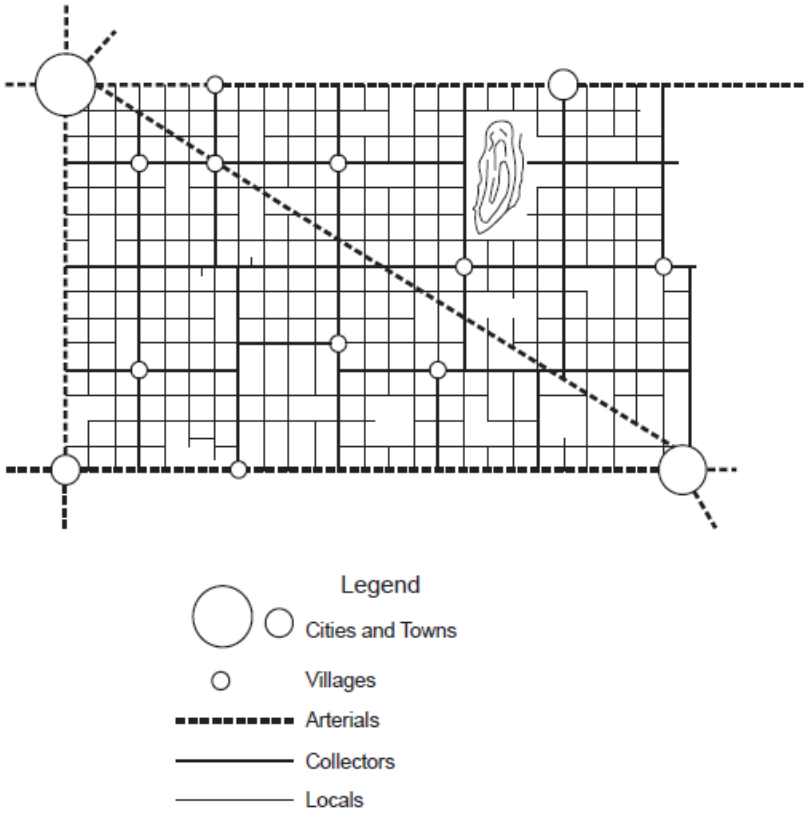


Figure 1-3. Schematic Illustration of a Functionally Classified Rural Highway Network

Access and mobility are crucial concerns for the functional classification of roadways. *Access-controlled roadways* (freeways, expressways, toll-ways) represent the top level of highway. Travel typically consists of longer distance trips with access limited to interchanges. These types of facilities utilize the most stringent design criteria to emphasize safety and mobility. *Arterial* roadways carry longer-distance traffic between cities and larger towns. They are usually designed with limits on driveways and interception spacing. *Collectors* connect and distribute traffic from local roads and small towns to the arterial networks. Although similar to local streets, collectors can handle substantially higher traffic volumes. *Local roads* serve as access to adjacent properties - intended for low traffic volumes at low speeds. Pedestrian safety is a high priority for these roadways.

FUNCTIONAL SYSTEM CHARACTERISTICS

Urban and rural roadway systems are classified separately due to their fundamentally different characteristics – *density, travel patterns, land use, and how these are related.* More arterials are generally used in urban areas with arterial subdivisions. Urban areas have set boundaries with a minimum population of 5000. Urbanized areas have populations of 50,000 or more while small urban area populations are between 5000 and 50,000.

Rural areas are those lands outside urban area boundaries. There are significantly more collectors and functional subdivisions of collector roads in rural areas.

Hierarchy of Functional Systems

Principal Arterials	*Main movement*
Minor Arterials	*Distributor*
Collectors	
Local Roads and Streets	

Rural Principal Arterial

- Suitable corridor movement for statewide and interstate travel
- Movements between urban areas with minimum 50,000 population and populations over 25,000
- Integrated movement without stub connections
- Interstate highways, freeways/expressways, and other principal arterials

Rural Minor Arterial

- Linkage of cities, larger towns, and other traffic generators
- Integrated interstate/inter-county systems
- Consistent internal spacing with population density
- Consistent corridor movements greater than rural collector or local systems
- High travel speeds and minimum interference to through movements

Rural collectors serve mainly intra-county traffic with shorter travel distances and more moderate speeds than arterials. These typically contain 20 to 25% of the total rural road length. *Major Collector Roads* serve important intra-county travel corridors, provides service to county seats larger towns (not on arterials), and links larger towns/cities with higher routes. *Minor Collector Roads* are reasonably spaced for population density to link important local traffic generators. They also provide service to smaller communities.

Rural local roads provide primarily short distance travel and land access adjacent to collectors. These roadways constitute all rural roads **not** in another classification and make up the majority (65 to 76%) of total rural roads.

Urban Principal Arterial

- For major urban areas, high traffic volumes, and largest trips
- Integrated internally and between major rural connections
- Carries important intra-urban and intercity bus routes
- Fully or partially access-controlled
- Spacing varies from 1 mile (central business districts) to 5 miles (less developed fringe areas)

Urban Minor Arterial

- For smaller areas, moderate length trips, and lower travel mobility
- Includes all arterials not classified as principal
- Places more emphasis on land access
- Does not typically penetrate neighborhoods
- Spacing ranges from 0.1 to 0.5 (central business areas) to 2 to 3 miles (suburban fringes) – normally 1 mile maximum in fully developed districts

Urban collectors provide service within residential, commercial, and industrial areas. These roadways penetrate neighborhoods and channel traffic to their ultimate destinations. Urban collectors may include total street grids in central business areas and carry local bus routes.

Urban local street systems contain all other roads not in a higher classification – 65 to 80% of total urban road length. These provide direct access to properties and connect to other facilities (arterials, collectors). Urban streets have the lowest mobility levels, no bus routes (if possible), and minimal service to through traffic.

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