

Geometric Design of Highways and Freeways

Code CE 864	Credit Hours 3-0
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Course Description

The geometric design of highways deals with the dimensions and layout of visible features of the highway. The emphasis of the geometric design is to address the requirement of the driver and the vehicle such as safety, comfort, efficiency, etc. The features normally considered are the cross-section elements, sight distance consideration, horizontal curvature, gradients, and intersection. The design of these features is to a great extent influenced by driver behavior and psychology, vehicle characteristics, traffic characteristics such as speed and volume. Proper geometric design will help in the reduction of accidents and their severity. Therefore, the objective of geometric design is to provide optimum efficiency in traffic operation and maximum safety at reasonable cost.

Text Book:

1. A Policy on Geometric Design of Highways and Streets, 2011, 5th ed. American Association of State Highway and Transportation Officials, Washington, D.C. (REQUIRED)
2. Class notes, presentations, and any additional material provided.

Reference Book:

1. Principles of Highway Engineering and Traffic Analysis by Fred L. Mannering, Walter P. Kilareski, Scott S. Washburn, 3rd Edition (2004).
2. Traffic and Highway Engineering by Nicholas J. Garber, Lester A. Hoel, 4th Edition, Cengage Learning
3. Highway Capacity Manual (HCM 2000).

Prerequisites

Nil

ASSESSMENT SYSTEM FOR THEORY

Quizzes	10-15%
Assignments	5-10%
Mid Terms	25%
ESE	40-50%
Term Project	10%

Teaching Plan

Week No	Topics	Learning Outcomes
1-2	Introduction to Geometric Design	Overview of geometric design principles Importance and objectives of geometric design Principles of highway location and design Introduction to geometric design and factors affecting geometric design Relationship between geometric design and road safety Highway alignment and road functional classes

3-4	Design Controls and Criteria	Design speed and its influence on road geometry Traffic volume considerations Vehicle dimensions and performance characteristics Human factors in geometric design
5-6	Horizontal Alignment	Elements of horizontal alignment: tangents, circular curves, and transition curves Design criteria for horizontal curves Superelevation and its calculation Horizontal sight distance
7	Vertical Alignment	Elements of vertical alignment: grades, crests, sags, and vertical curves Design criteria for vertical curves Grade line and its impact on vehicle operation Vertical sight distance
8	Cross-Section Elements	Typical cross-section components: lanes, shoulders, medians, and side slopes
9	MID SEMESTER EXAM	
10	Sight Distance	Types of sight distance: stopping sight distance, passing sight distance, and decision sight distance Factors affecting sight distance Design considerations for adequate sight distance Sight distance on horizontal and vertical curves
11	Intersection Design	Types of intersections: at-grade, grade-separated, and interchanges Design principles for at-grade intersections Roundabout design and operational considerations Signalized and unsignalized intersection design
12	Roadside Design and Safety	Roadside design principles Clear zone concepts and calculations Roadside barriers and safety features Landscaping and environmental considerations
13	Geometric Design of Interchanges	Types of interchanges: diamond, cloverleaf, and directional Design criteria for interchanges Ramp design and layout Interchange safety and operational considerations

14	Environmental and Aesthetic Considerations	Environmental impact assessment in geometric design Noise barriers and visual screening Integration of aesthetic elements into road design Sustainable design practices
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16-17	Software and Tools for Geometric Design Term Project and Presentations	Introduction to geometric design software (e.g., AutoCAD Civil 3D) Use of simulation tools for design validation Practical exercises and project work Group presentations and peer review Final assessment and feedback
18	END SEMESTER EXAM	