



## Introduction to geometric design

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.

### Factors affecting geometric design

A number of factors affect the geometric design and they are discussed in detail in the following sections.

#### 1-Design speed

Design speed is the single most important factor that affects the geometric design. It directly affects the sight distance, horizontal curve, and the length of vertical curves. Since the speed of vehicles varies with driver, terrain etc, a design speed is adopted for all the geometric design.

Design speed is defined as the highest continuous speed at which individual vehicles can travel with safety on the highway when weather conditions are conducive. Design speed is also different from the desired speed which is the maximum speed at which a driver would travel when unconstrained by either traffic or local geometry.

#### 2- Topography

The next important factor that affects the geometric design is the topography. It is easier to construct roads with required standards for a plain terrain. However, for a



given design speed, the construction cost increases multiform with the gradient and the terrain. Therefore, geometric design standards are different for different terrain to keep the cost of construction and time of construction under control. This is characterized by sharper curves and steeper gradients. The slope should be considered in the plain areas too considering the drainage conditions. Terrain can be classified as:

S. No.	Terrain Type	Percent Cross Slope
1	Plain	0 - 10
2	Rolling	11 - 25
3	Mountainous	26 - 60
4	Steep	> 60

For highway design, topography is generally classified into three groups:

- 1- Level terrain:** this is relatively flat. Horizontal and vertical alignments are generally long or can be achieved without much construction difficulty or major expense. In addition, these horizontal and vertical alignments permitting heavy vehicles to maintain approximately the same speed as passenger cars. Grades are generally limited to 1 or 2 percent.
- 2- Rolling terrain:** this type has natural slopes that often rise above and fall below the highway grade with occasional steep slopes that restrict the normal vertical and horizontal alignments. This terrain causing heavy vehicles to reduce their speeds substantially below those of passenger cars.
- 3- Mountainous (hilly) terrain:** it has sudden changes in ground elevation in both the longitudinal and transverse directions, thereby requiring frequent hillside excavations to achieve acceptable horizontal and vertical alignments.

### 3- Other factors

In addition to design speed and topography, there are various other factors that affect the geometric design and they are briefly discussed below:

**Vehicle:** The dimensions, weight of the axle and operating characteristics of a vehicle influence the design aspects such as width of the pavement, radii of the



curve, clearances, parking geometrics etc. A design vehicle which has standard weight, dimensions and operating characteristics are used to establish highway design controls to accommodate vehicles of a designated type. The vehicles which used roads are classified into category:

- 1- **Passenger cars:** these include all passenger cars, including minivans, vans, pick-up trucks, and Sport vehicles.
- 2- **Trucks:** these include all buses, single-unit trucks, combination trucks, and recreational vehicles

**Human:** The important human factors that influence geometric design are the physical, mental and psychological characteristics of the driver and pedestrians like the reaction time.

**Traffic:** It will be uneconomical to design the road for peak traffic flow. Therefore a reasonable value of traffic volume is selected as the design hourly volume which is determined from the various traffic data collected. The geometric design is thus based on this design volume, capacity etc.

**Environmental:** Factors like air pollution, noise pollution etc. should be given due consideration in the geometric design of roads.

**Economy:** The design adopted should be economical as far as possible. It should match with the funds allotted for capital cost and maintenance cost.