2.1HIGHWAY CROSS SECTION ELEMENTS

The cross section elements involved in highway geometric design,

- Kerbs
- Camber
- Shoulders
- Guard rails
- Side walks
- Right of way
- Service roadsT
- Drainage andFootpath

Cross Slope or Camber

Cross slope or camber is the slope provided to the road surface in the transverse direction to drain off the rain water from the road surface. Drainage and quick disposal of water from the pavement surface by providing cross slope is considered important because of the following reasons:

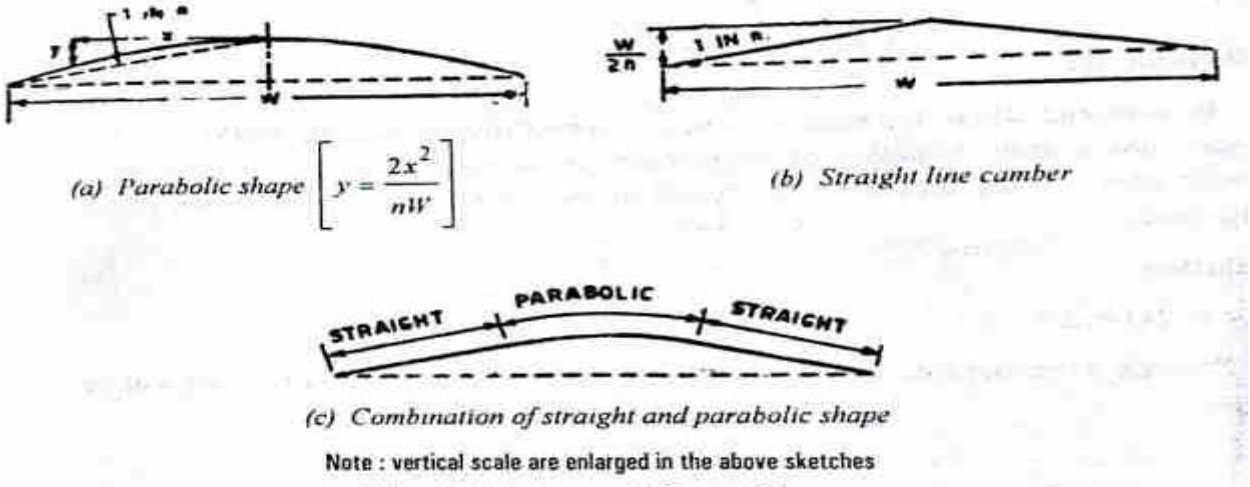
1) To prevent the entry of surface water into the pavement layers and the subgrade soil through pavement.
2) To prevent the entry of water into the bituminous pavement layers, as continued contact with water causes stripping of bitumen from the aggregates and results in deterioration of the pavement layer
3) To remove the rain water from the pavement surface as quickly as possible and to allow the pavement to get dry soon after the rain.

SHAPE OF CROSS SLOPE

In the field, camber of the pavement cross section is provided with a suitable shape.

Different shapes that are commonly adopted are

1) Parabolic
2) Straight Line
3) Straights with parabolic curve



(a) Parabolic shape $\left[y = \frac{2x^2}{nW} \right]$

(b) Straight line camber

(c) Combination of straight and parabolic shape

Note : vertical scale are enlarged in the above sketches

Figure 2.1.1 Shape of Cross Slope

[Source: "Highway Engineering" by S.K.Khanna,C.E.G.Justo, Page: 70]

WIDTH OF PAVEMENT OR CARRIAGEWAY

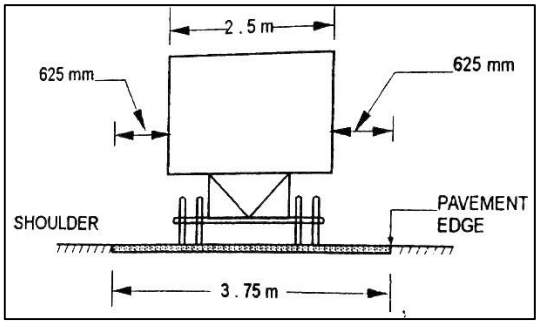
The width of pavement or carriageway depends on

1)Width of Traffic Lane 2) Number of Lanes.

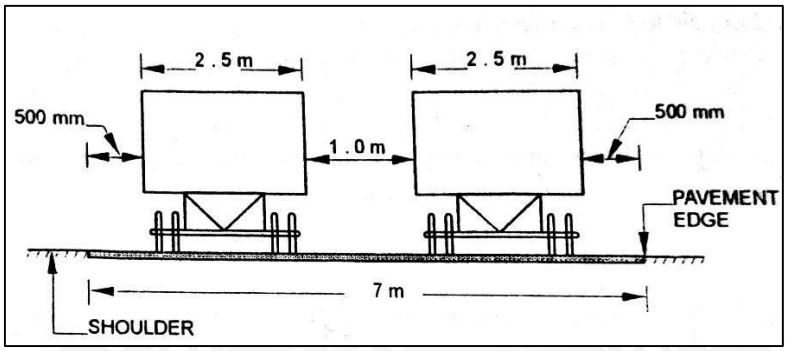
The portion of carriageway width that is intended for one line of traffic movement is called a traffic lane. As different classes of vehicles travel along the same roadway generally the lane width is decided based on a standard vehicle such as the passenger car. However, it is also necessary to consider the maximum width of the largest vehicle class such as the heavy commercial vehicle (HCV) which is legally permitted to use the roadway in the country.

Width of carriageway recommended by IRC

Class of Road	Width of Carriageway, m
Single Lane Road	3.75
Two Lane Road, without raised kerbs	7.0
Two Lane Road, with raised kerbs	7.5
Intermediate Carriageway	5.5
Multi Lane Pavements	3.5 per lane



Single Lane Pavement



Two Lane Pavement

Figure 2.1.2 Lateral Placement of Vehicle

[Source: "Highway Engineering" by S.K.Khanna,C.E.G.Justo, Page: 79]

MEDIANS/TRAFFIC SEPARATORS

In highways with divided carriageway, a median is provided between two sets of traffic lanes intended to divide the traffic moving in opposite directions. The main function of the median is to prevent head-on collision between vehicles moving in opposite directions on adjacent lanes. The median is also called or traffic separator. The traffic separators used may be in the form of pavement markings, physical dividers or area separators. Pavement marking is the simplest of all these, but this will not rule out head on collision. The mechanical separator may be suitably designed keeping in view safety considerations.

Kerbs: The boundaries between pavement and shoulders or footpath are known as kerbs.

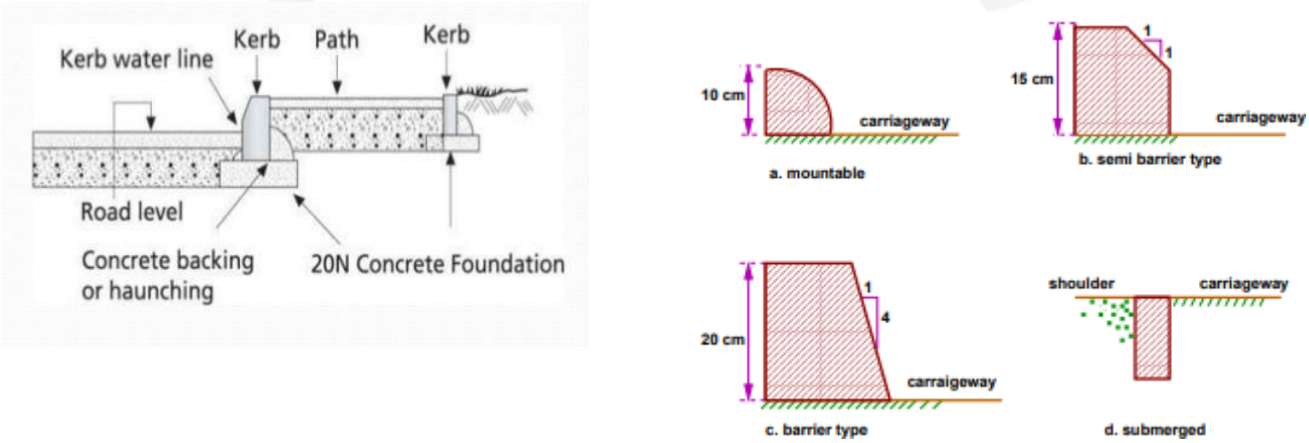


Figure 2.1.3 Kerbs

[Source: "Highway Engineering" by S.K.Khanna,C.E.G.Justo, Page: 80]

Types of kerbs:

1. Mountable
2. Semi-barrier
3. Barrier
4. submerged

a)Low or Mountable Kerbs

These types of kerbs are provided such that they encourage the traffic to remain in the through traffic lanes and also allow the driver to enter the shoulder area with little difficulty.

b)Semi-Barrier Type Kerbs

When the pedestrian traffic is high, these kerbs are provided. Their height is 15 cm above the pavement edge.

c)Barrier Type Kerbs

They are designed to discourage vehicles from leaving the pavement. They are provided when there is considerable amount of pedestrian traffic. They are placed at a height of 20 cm above The Pavement Edge with A Steep Batter.

d)Submerged Kerbs

They are used in rural roads. The kerbs are provided at pavement edges between pavement edge and shoulder

ROAD MARGINS

The portion of the road beyond the carriageway and on the roadway can be generally called road margin. Various elements that form the road margins are given below.

Shoulders

Shoulders are provided along the road edge and are intended for accommodation of stopped vehicles, serve as an emergency lane for vehicles and provide lateral support for base and surface courses. The shoulder should be strong enough to bear the weight of a fully loaded truck even in wet conditions. The shoulder width should be adequate for giving working space around a stopped vehicle. It is desirable to have a width of 4.6 m for the shoulders. A minimum width of 2.5 m is recommended for 2-lane highways in India.

The important functions of shoulders are:

(a) Shoulders provide structural stability and support to the edges of the flexible pavements.

(b) The capacity of the carriageway and the operating speeds of vehicles increase if the shoulders are laid and maintained in good condition.

(c) Shoulders serve as emergency lanes for vehicle compelled to be taken out of the main carriageway or roadway. Shoulders should have sufficient load bearing capacity to support loaded truck even in wet weather

(d) Shoulders also act as service lanes for vehicles that are disabled. The width of shoulder should be adequate to accommodate stationary vehicle fairly away from the edge of adjacent lane.

Guard rails

Guard rails are provided at the edge of the shoulder when the road is constructed on a fill so that vehicles are prevented from running off the embankment, especially when the height of the fill exceeds 3 m. Guard stones (painted with black and white strips) are installed at suitable intervals along the outer edge of the formation at horizontal curves of roads running on embankments along rural areas so as to provide better night visibility of the curves under head lights of vehicles

Footpath or side-walk

In order to provide safe facility to pedestrians to walk along the roadway, foot paths or side-walks are provided in urban areas where the pedestrian traffic is noteworthy and the vehicular traffic is also heavy. By providing good foot path facility, the pedestrians can keep off from the carriageway and they are segregated from the moving vehicular traffic. Thus, the operating speeds of the vehicular traffic increases and there will be marked reduction in accidents involving pedestrians.

Drive ways

Drive ways connect the highway with commercial establishment like fuel-stations, service-stations etc. Drive ways should be properly designed and located, fairly away from an intersection. The radius of the drive way curve should be kept as large as possible, but the width of the drive way should be minimised to reduce the crossing distance for the pedestrians.

Cycle tracks

Cycle tracks are provided in urban areas where the volume of cycle traffic on the road is very high. A minimum width of 2 m is provided for the cycle track and the width may be increased by 1.0 m for each additional cycle lane.

Parking lanes

Parking lanes are provided on urban roads to allow kerb parking. As far as possible only 'parallel parking' should be allowed as it is safer for moving vehicles. For parallel parking, the minimum lane width should be 3.0 m.

Bus bays

Bus bays may be provided by recessing the kerb to avoid conflict with moving traffic. Bus bays should be located at least 75 m away from the intersections.

Lay-byes

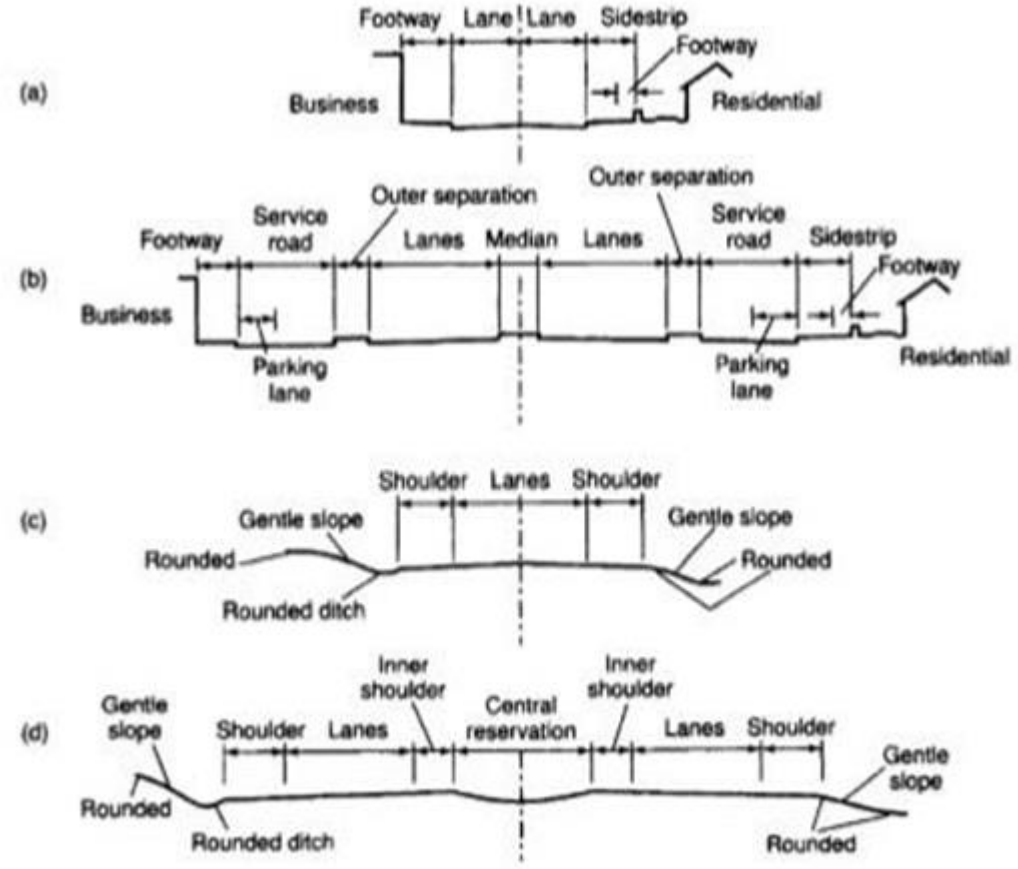
Lay-byes are provided near public conveniences with guide maps to enable drivers to stop clear off the carriageway. Lay-byes should normally be of 3.0 width and at least 30 m length with 15 m end tapers on both sides.

Width of Formation or Roadway

Width of formation or roadway is the sum of widths of pavement or carriageway including separators, if any and the shoulders. Formation or roadway width is the top width of the highway embankment or the bottom width of highway cutting excluding the side drains.

Right of Way and Land Width

Right of way is the area of land acquired for the road, along its alignment. The width of the acquired land for right of way is known as 'land width' and it depends on the importance of the road and possible future development. A minimum land width has been prescribed for each category of road. A desirable range of land width has also been suggested for each category of road. While acquiring land for a highway it is desirable to acquire more width of land as the cost of adjoining land invariably increases as soon as the new highway is constructed.



Simplified road cross-sections: (a) 2-lane street, (b) urban motorway, (c) 2- or 3-lane rural highway, and (d) rural motorway

Figure 2.1.2 Road Cross Section

[Source: "Highway Engineering" by S.K.Khanna,C.E.G.Justo, Page: 82]