DETAILED STUDY ON ROADS INTAMILNADU

M.S.PADMANABAN, LECTURER/CIVIL*

Abstract:

Transportation is the movement of people or goods from one place to another. Transport is important since it enables trade between people, which in turn augment economic growth and foster civilizations. The transport system comprises of highways or roadways, Railways, water ways and air ways.

Road ways include highways, city roads, village roads, feeder roads and Ghat roads. Roadways provide maximum service to one and all. It is possible to provide door to door services only by road.

INTRODUCTION ABOUT ROADS AND HIGHWAYS

DEVELOPMENT OF ROADS IN INDIA

Transportation is one of the infrastructures of a country. Transportation helps in economic, industrial, social and cultural development of a country. Transportation is very important for the economic development of any region since commodities produced, like food, clothing, industrial products, medicine need transport at all stages from production to distribution. It is also essential for strategic movement in emergency for defense of the country and to maintain better law and order. Transportation also helps in tourism development.

Road transport is one of the most common modes of transport. Roads in the form of track ways, human pathways etc. were used even from the pre-historic times. Since then many experiments were going on to make the riding safe and comfort. Thus road construction became an inseparable part of many civilizations and empires.

The history of highway engineering gives us an idea about the roads of ancient times.

Roads in Rome were constructed in a large scale and it radiated in many directions helping them in military operations. Thus they are considered to be pioneers in road construction.

In India the Mauryan dynasty rulers and Harsha Vardhana took much interest in the development of road system as they were able to appreciate the importance of road in terms of strategic and economical development of country. In the later period the Mughal emperors paid much importance in counstrucion of roads. Patna-Kabul, Delhi-Surat, Delhi-Golconda, Golconda-Bijapur, Bijapur-Ujjain and Surat-Maulipatanam are some of the notable highways developed by them.

* CENTRAL POLYTECHNIC COLLEGE, CHENNAI, TAMILNADU

BRITISH ROAD

The British government also gave importance to road construction. The British engineer John Macadam introduced what can be considered as the first scientific road construction method. Stone size is an important element of Macadam surface formation. By empirical observation of many roads, he came to realize that 250 mm layers of well compacted broken angular stone would provide the same strength and stiffness and a better running surface than an expensive pavement made on large stone blocks. Thus he introduced an economical method of road construction.

The mechanical interlock between the individual stone pieces provides strength and stiffness to the course. But the inter particle friction abraded the sharp interlocking faces and partly destroy the effectiveness of the course. This effect was overcome by introducing good quality interstitial finer material to produce a well-graded mix. Such mixes also proved less permeable and easier to compact. A typical cross section of British roads is given in Figure 1.

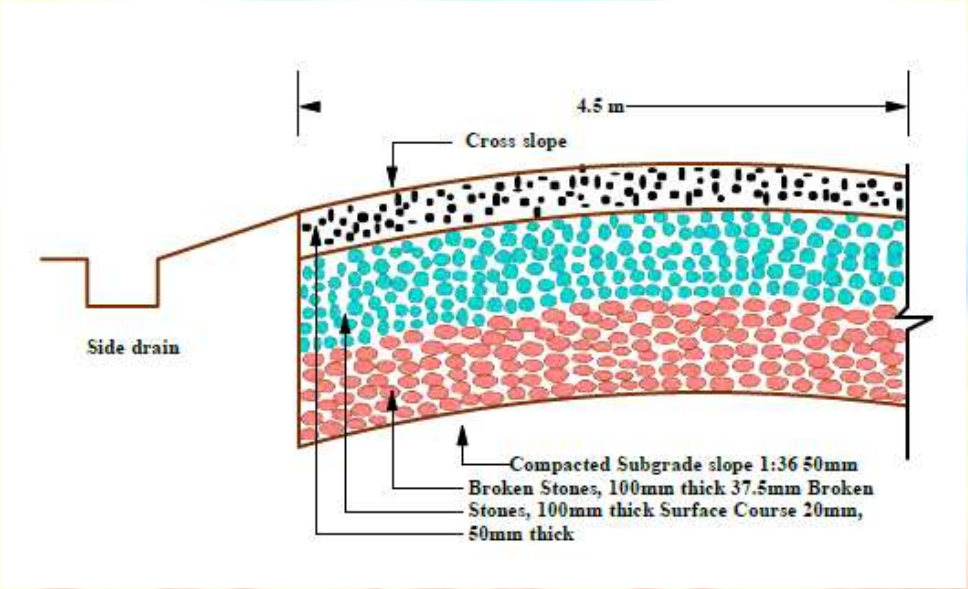


Fig.1 Typical cross section of British Road

MODERN ROADS

The modern roads by and large follow Macadam's construction method. Use of bituminous concrete and cement concrete are the later developments. Various advanced and cost-effective construction technologies are used. Development of new equipments helps in the faster construction of roads. Many easily and locally available materials are tested in the laboratories for their suitability and then used on roads for making economical and durable pavements.

CLASSIFICATION OF ROADS

Roads are also classified based on the following criteria. They are given in detail below.

1. BASED ON USAGE

This classification is based on whether the roads can be used during different seasons of the year.

i) All-weather roads: Those roads which are negotiable during all weathers, except at major river crossings where interruption of traffic is permissible up to a certain extent are called all weather roads.

ii)Fair-weather roads: Roads which are negotiable only during fair weather are called fair weather roads.

2. BASED ON CARRIAGE WAY

This classification is based on the type of the carriage way or the road pavement.

i) Paved roads with hard surface: If they are provided with a hard pavement course such roads are called as paved roads.(eg: stones, Water bound macadam (WBM), Bituminous macadam (BM), concrete roads.

ii) Unpaved roads: Roads which are not provided with a hard course of at least a WBM layer are called as unpaved roads. The earth and gravel roads come under this category.

3. CLASSIFICATION OF ROADS AS PER I.R.C (INDIAN ROAD CONGRESS)

Based on location and function, the Nagpur plan classifies the roads as

a) National Highways (NH)

b) State Highways (SH)

c) Major district Roads (MDR)

d) Other district roads (ODR) and

e) Village Roads

National Highways (NH)

The road network connecting State capitals, Major Cities, Major Ports, large industrial areas and important tourist centers are classified as the National Highways by Ministry of Road Transport and Highways (MORTH), Government of India (GOI). National Highways form the economic backbone to the country enhancing quick movement of men and materials to the requisite destinations in right time and facilitate rapid development along their routes.

Totally 4994 km length of National Highways runs through Tamil Nadu State. Out of this 1985 km are maintained by State National Highways Wing and balance 3009 km are maintained by the National Highways Authority of India (NHAI). National Highways are being developed by widening to two lane / four lane / six lane with paved shoulders and strengthening the existing riding surface with the funds from the MORTH, GoI and some of them are also taken up under Public Private Partnership mode.

State Highways (SH)

The State Highways connect District headquarters with National Highways and neighbouring States. These stretches get maximum importance owing to heavy traffic intensity. The total length of State Highways in Tamil Nadu is 12095 km.

Major District Roads (MDR)

The Major District Roads connect towns and municipal areas with District headquarters. These roads connect the production and marketing centres with National Highways and State Highways. In Tamil Nadu, the total length of Major District Roads is 11628 km.

Other District Roads (ODR)

The Other District Roads (ODR) are the backbone of the rural economy and day to day activities of general public which connect villages with marketing, educational and health care centers and Taluk headquarters and other nearby important roads. Based on the traffic intensity, the Other District Roads are maintained as Single Lane or Intermediate Lane.

Sugarcane Development Roads are also under the ODR category, which are connecting the sugarcane cultivating areas with Sugar mills and in turn with nearby marketing centres. There was 33751 km of Other District Roads including 1676 km of Sugarcane Development roads in the State of Tamil Nadu.

MODIFIED CLASSIFICATION OF ROAD SYSTEM BY THIRD ROAD DEVELOPMENT PLAN (1981 – 2001)

The roads in the country are now classified into three classes

1. Primary system

2. Secondary system

3. Tertiary system

1. Primary system consists of two categories of roads

• Expressways and

• National Highways (NH)

Express ways are separated class of highways with superior facilities and design standards meant for very high volume traffic. These permit only fast moving vehicles.

2. The secondary system consists

• State highways (SH) and

• Major District Roads

3. Tertiary system consists of

• Other District Roads (ODR) and

• Village Roads

CLASSIFICATION OF URBAN ROADS

The urban roads are classified as

• Arterial Roads

• Sub-arterial roads

• Collector streets and

• Local streets

Arterial and sub arterial roads are the streets primarily for through traffic.

FLEXIBLE ROAD PAVEMENTS AND RIGID ROAD PAVEMENTS

FLEXIBLE ROAD PAVEMENT

Flexible pavements will transmit wheel load stresses to the lower layers by grain-to-grain transfer through the points of contact in the granular structure (see Figure 2). The wheel load acting on the pavement will be distributed to a wider area, and the stress decreases with the depth. Taking advantage of this stress distribution characteristic, flexible pavement normally has many layers. Hence, the design of flexible pavement uses the concept of layered system. Based on this, flexible pavement may be constructed in a number of layers and the top layer has to be of best quality to sustain maximum compressive stress, in addition to wear and tear. The lower layers will experience lesser magnitude of stress and low quality material can be used. Flexible pavements are constructed using bituminous materials. These can be either in the form of surface treatments (such as bituminous surface treatments generally found on low volume roads) or, asphalt concrete surface courses (generally used on high volume roads such as national highways). Flexible pavement layers reflect the deformation of the lower layers on to the surface layer (e.g., if there is any undulation in sub-grade then it will be transferred to the surface layer). In the case of flexible pavement, the design is based on overall

performance of flexible pavement, and the stresses produced should be kept well below the allowable stresses of each pavement layer.

Pavement structure consists of the prepared sub-grade and the pavement component layers such as sub-base, base and surface course. The stability or the structural capacity of the pavement depends upon the pavement layer system including the sub-grade. However, the road users are concerned about the riding quality, safety and other performance aspects of the road pavement rather than the pavement structure, design life etc. Hence, it is important to ensure the above requirements also while designing a pavement. The flexible pavements are constructed as a multi-layer system consisting of typical component layers, namely sub-base, base course, and surface course.

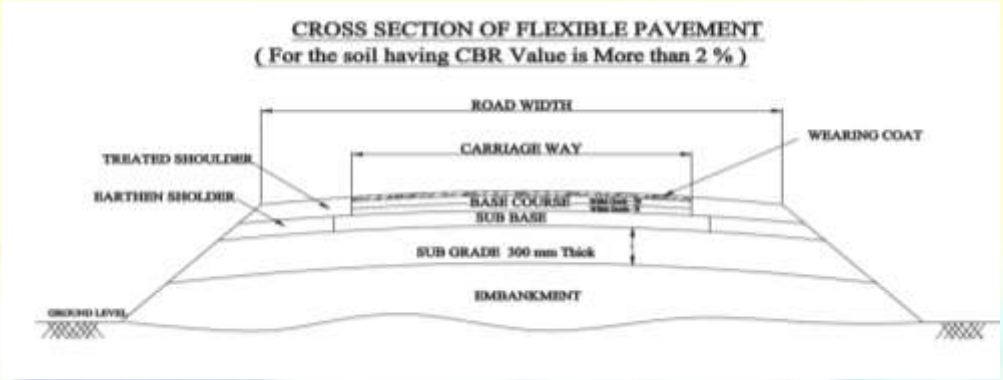


Fig. 2 Flexible pavements consist of a number of layers

RIGID PAVEMENTS

Rigid pavements have sufficient flexural strength to transmit the wheel load stresses to a wider area below. A typical cross section of the rigid pavement is shown in Figure 3. Compared to flexible pavement, rigid pavements are placed either directly on the prepared sub-grade or on a single layer of granular or stabilized material. Since there is only one layer of material between the concrete and the sub-grade, this layer can be called as base or sub-base course.

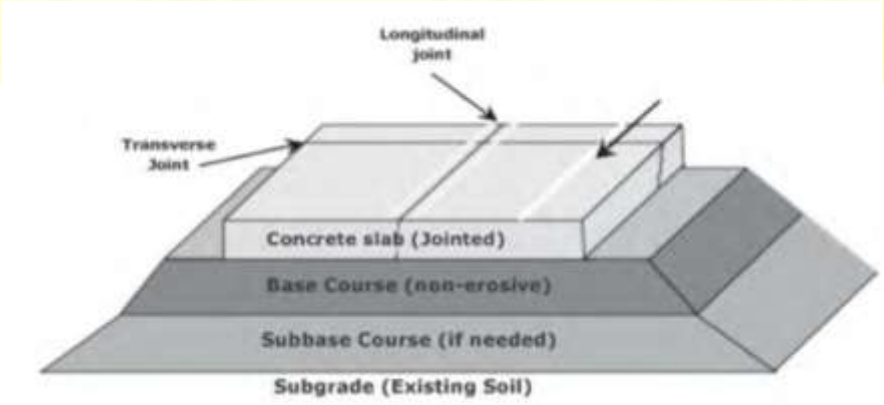


Fig. 3 Rigid pavements

In rigid pavement, load is distributed by the slab action, and the pavement behaves like an elastic plate resting on a viscous medium. Rigid pavements are constructed by Portland cement concrete (PCC) and should be analyzed by plate theory instead of layer theory, assuming an elastic plate resting on viscous foundation. Plate theory is a simplified version of layer theory that assumes the concrete slab as a medium thick plate which is plane before loading and to remain plane after loading.

SPECIFICATIONS OF ROAD

ROAD STRUCTURE

Road structure consists of the following components as shown in the following figure 4.

i. Sub soil

ii. Sub grade

iii. Base course

iv. Wearing course or Surface course

v. Berm

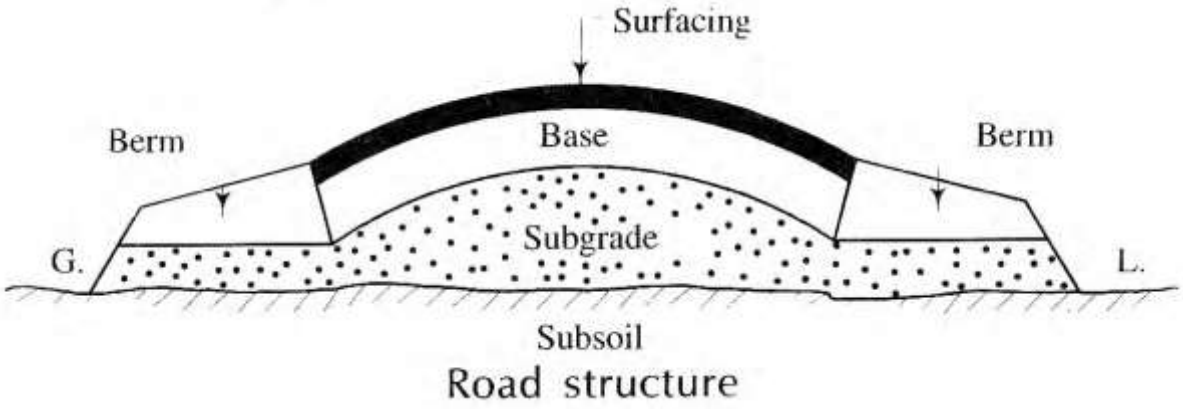


Fig. 4 Cross sections of road structures

i) SUB SOIL:

This is the natural or prepared soil on which a road has to be formed which should be strong and stable to carry the road traffic and weight of road construction.

ii) SUB GRADE:

The sub grade functions as a support to road surface and serves as a foundation. The life of road primarily depends on the stability and dryness of sub grade. Therefore considerable attention should be paid in the preparation of the sub grade.

iii) BASE COURSE:

Base course is a layer made of granular material such as broken granite stone, natural gravel, and boulder stone. It is a layer immediately under the weaning course. It is an important structural part of the road. It should be strong enough to bear the loads of the traffic. The material in a base course must be of extremely high quality. It must be well compacted.

iv) WEARING COURSE OR SURFACE COURSE:

Wearing course is the top most layer of a road which is in direct contact with the traffic. The purpose of the weaning course is to give a dense smooth riding surface with flexibility. It resists the pressure exerted by tyres and withstands wear and tear due to the traffic. It acts as a water tight layer and prevents percolation of water.

RIGHT OF WAY

Right of way is the area of land acquired and reserved along its alignment for construction and development of a highway is known as right of way.

LAND WIDTH

A minimum land width is prescribed for different categories of road. The below table 1 gives the minimum width of right of way for different categories of road.

Table 1 Requirement of right of way

NO.	Type of road	Plain and rolling terrain				Mountainous and steep terrain	
		Open areas		Built- up areas		Open areas	Built- up areas
		Normal m	Range m	Normal m	Range m	Normal m	Normal m
1	NH and SH	45	30-60	30	30-60	24	20
2	MDR	25	25-30	20	15-25	18	15
3	ODR	15	15-25	15	15-20	15	12
4	VR	12	12-18	10	10-15	9	9

There are chances of developments along its route and when it becomes necessary to have the widening of road in future; it proves to be difficult and costly to acquire such developed lands along the boundary of road. Hence the appropriate width of land has to be acquired in the initial stage so that the road can be widened without serious difficulties when the occasion demands in future. The rights of ownership of road land are vested with the highway authority.

As a further precaution, restrictions are put up on the construction activities along the road and for this purpose, building lines and control lines are decided at suitable distance from the road boundary.

The owner of land along highway route has to leave a certain set back or margin from road boundary and he can construct the building up to that line only in his plot. This line is known as building line.

A further set back in the form of control line has to be maintained by the private land owners along the highway route and the development between the portion covered by the building line and control line is restricted by the concerned highway authority.

The right of way mainly depends on the importance of road and it is decided in such a way that the following components of road are suitably accommodated:

(i) Availability of funds;

(ii) Cost of acquisition of lands;

(iii) Drainage systems;

(iv) Height of embankment or depth of cutting;

(v) Side slopes of embankment or cutting;

(vi) Visibility considerations on curves;

(vii) Width of formation;

(viii) Width of land required for future development;

WIDTH OF FORMATION:

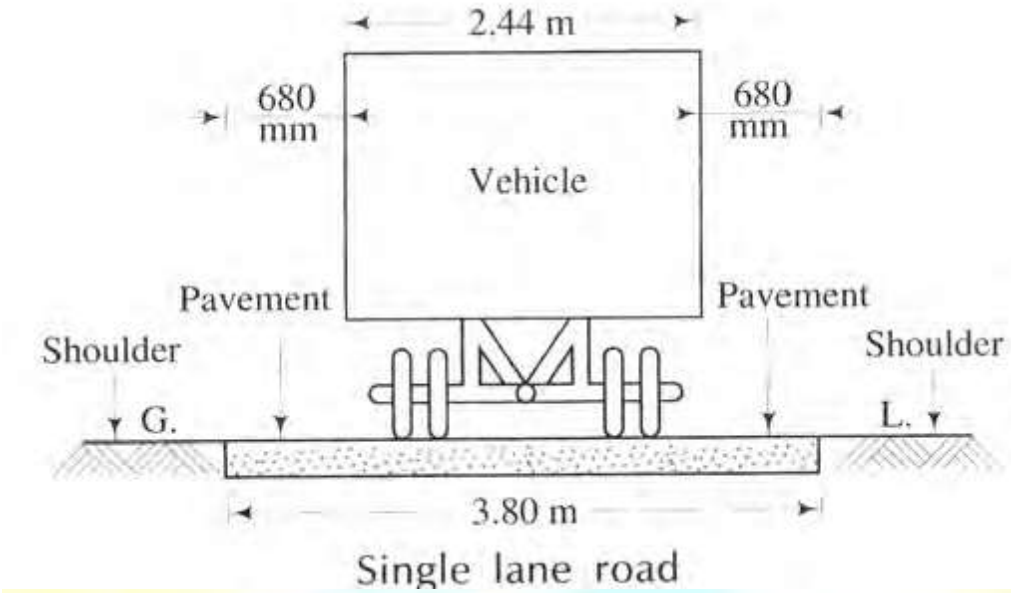
The width of pavement or carriage way depends on the width of traffic lane and number of lanes. The carriage way intended for one line of traffic movement may be called as a traffic lane. The lane width is determined on the basis of the width of vehicle and the minimum side clearance provided for the safety. When the side clearance is increased there is an increase in speed of the vehicles and hence in increase in the capacity of the pavement. A width of 3.75 m is considered desirable for a road having single lane for vehicles of maximum width 2.44 m. For pavement having two or more lanes, width of 3.5 m per lane is sufficient.

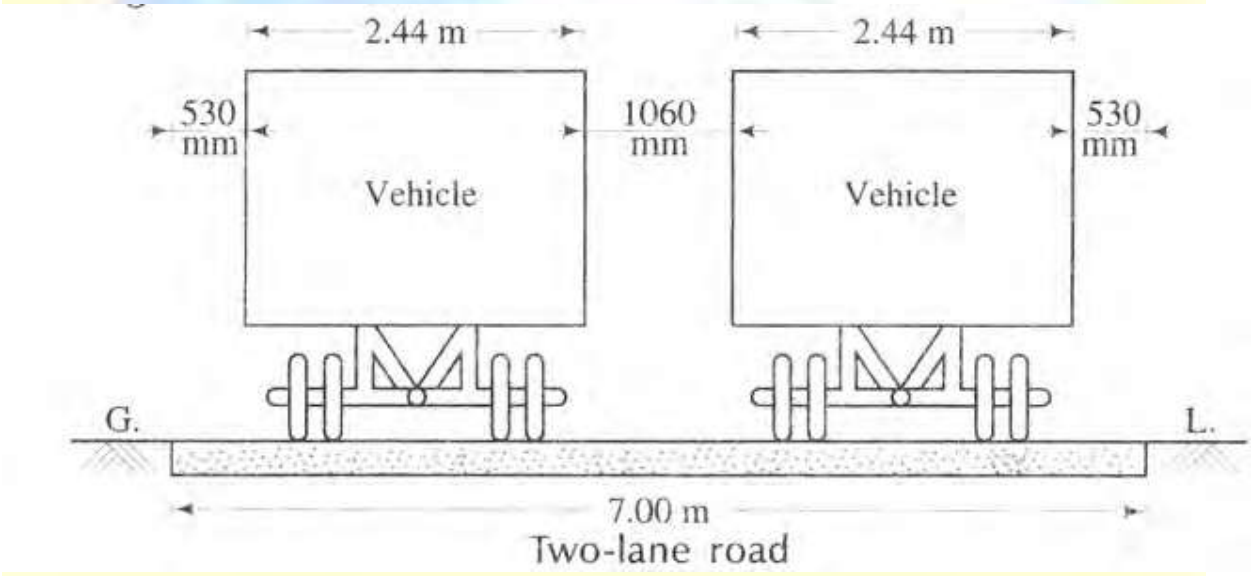
Table 2 Road Classification and dimensions

WIDTHS OF FORMATION

No.	Type of roadway	Formation width in m	
		Plain and rolling terrain	Mountainous and steep terrain
1	National and State Highways		
	Single lane	12.00	6.25
	Two lanes	12.00	8.80
2	Major district roads		
	Single lane	9.00	4.75
	Two lanes	9.00	-
3	Other district roads		
	Single lane	7.50	4.75
	Two lanes	9.00	-
4	Village roads		
	Single lane	7.50	4.00

Class of Road	**Width of the Carriage way**
(i) Single lane	3.75m
(ii) Two lanes, without raised kerbs	7.0m
(iii) Two lanes, with raised kerbs	7.5m
(iv) Intermediate carriage way	5.5m
(v) Multi lane pavement	3.5m per lane





Single and double lane Roadway

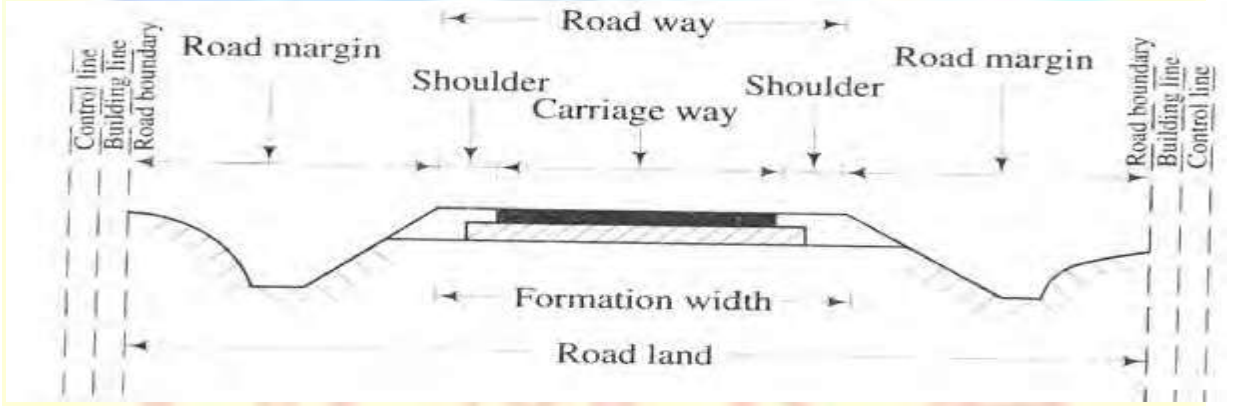
SHOULDERS:

Shoulders are provided along the road edge to serve as an emergency lane for vehicles to be taken out of the pavement. These also act as service lanes for vehicles that have broken down. The minimum shoulder width recommended by the IRC is 2.5 m. The shoulders should have sufficient strength to support loaded even in wet weather. The surface of the shoulder should be rougher than the traffic lanes so that the vehicles are discouraged to use the shoulder as a regular traffic lane.

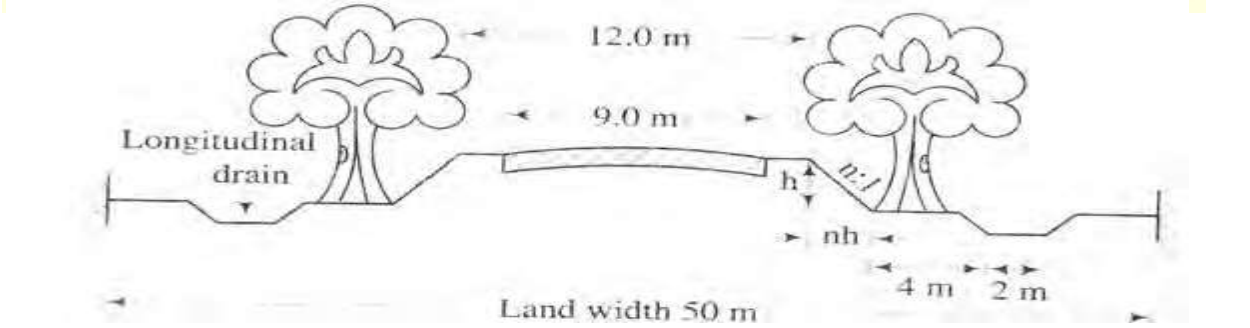
CROSS SECTIONS OF ROADS:

The following figures shows the cross-section of road in embankment, cross-section of road in cutting, the typical cross-section of two-lane NH or SH in rural area , the typical cross-section of two-lane city road in Built up area

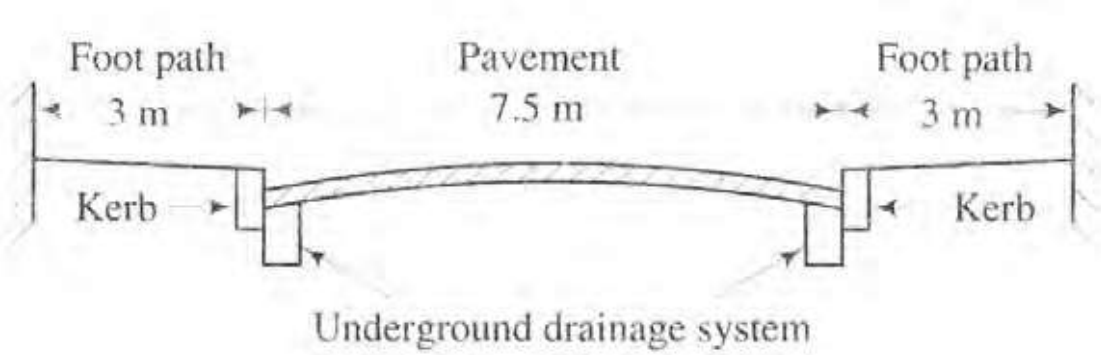
Cross section of road in cutting



Cross section of road in embankment



Cross section of two lane national highway

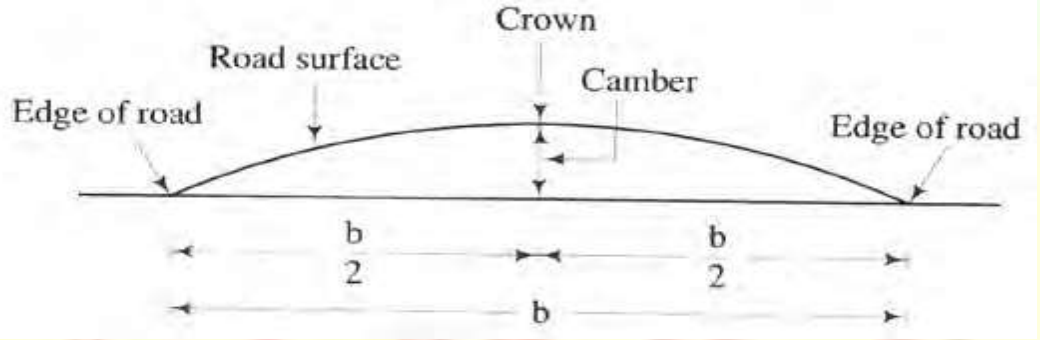


Cross sections of two lane road in built-up area

The carriage way intended for one line of traffic movement may be called a traffic lane. The pavement may be of single lane, two-lane or multi-lane.

ROAD CAMBER:

Camber is the cross slope provided across the road to raise middle of the road surface to drain off rain water from road surface. The camber given is either a parabolic, elliptic or straight line shape in the cross section.



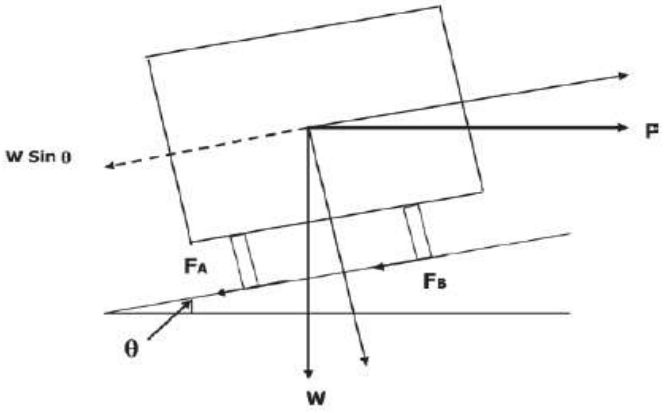
Camber or cross fall of road surface

Camber is measured in 1 in n or n % (e.g. 1 in 50 or 2%) and the value depends on the type of the pavement and the amount of rainfall.

Surface type	Heavy rain	Light rain
Concrete/Bituminous	2%	1.7%
Gravel / WBM	3%	2.5%
Earthen	4%	3.0%

SUPER ELEVATION

In order to counter act the effect of centrifugal force and to reduce the tendency of the vehicle to overturn or skid, the outer edge of the pavement is raised with respect to inner edge, by providing a transverse slope throughout the length of the horizontal curve. This transverse inclination to the pavement surface is known as super elevation or cant or banking. The super elevation "e" is expressed as the ratio of the height of outer edge with respect to the horizontal width.



Super elevation is provided to counteract centrifugal force on moving vehicles at horizontal curves. Super elevation obtained from the above expression should, however be kept within limit mentioned below:

Plain terrain - 7 %

Snow bound area - 7 %

Hilly area but not snow bound - 10 %

REFERENCES:

1. Indian Roads Congress (IRC) SPECIFICATIONS, STANDARDS, DESIGN CODES