

ROADS AND HIGHWAY ENGINEERING

•**Submitted By:-**

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Introduction

- Roads**:-Roads are general pathways or routes that connect different places within a city, town, or rural area. They can be small or large, and they serve to move people and goods over short or long distances. Examples include city streets or country roads.
- Highway**:-Highways are wider and faster roads designed to connect cities and regions over longer distances. They are typically built for higher-speed travel and have multiple lanes to handle more traffic. Highways often have features like overpasses, exits, and fewer stops, making them ideal for long-distance travel.
- Highway Engineering**:-It is the branch of science or engineering which deals with the art of design, construction and maintenance of roads of different kind.
- In other words, the network of roads in a country can be compared with that of **Arteries and Veins** in the human body. As arteries and veins are the carrier of blood, which conveys into different parts of the body, so important are the roads which conveys men, material and vital information to different parts of the country.

Importance of Highway **Transportation**

- a) Roads facilitate the traffic to go easily and conveniently from one place to another place.
- b) Roads are the symbol of a country's progress and well being.
- c) Roads help in establishing, cultural, social, religious and educational contacts between people.
- d) Roads help in the growth of trade and related economic activities by quickly marketing and distributing the produce of country side to the towns and cities.
- e) Good roads allow tourist inflow in the country and thus contribute largely towards economic growth of state.
- f) Development of road system provides direct employment in road construction, maintenance and other field. It has been estimated that every 1 crore rupee invested in road construction provides employment to 6500 people

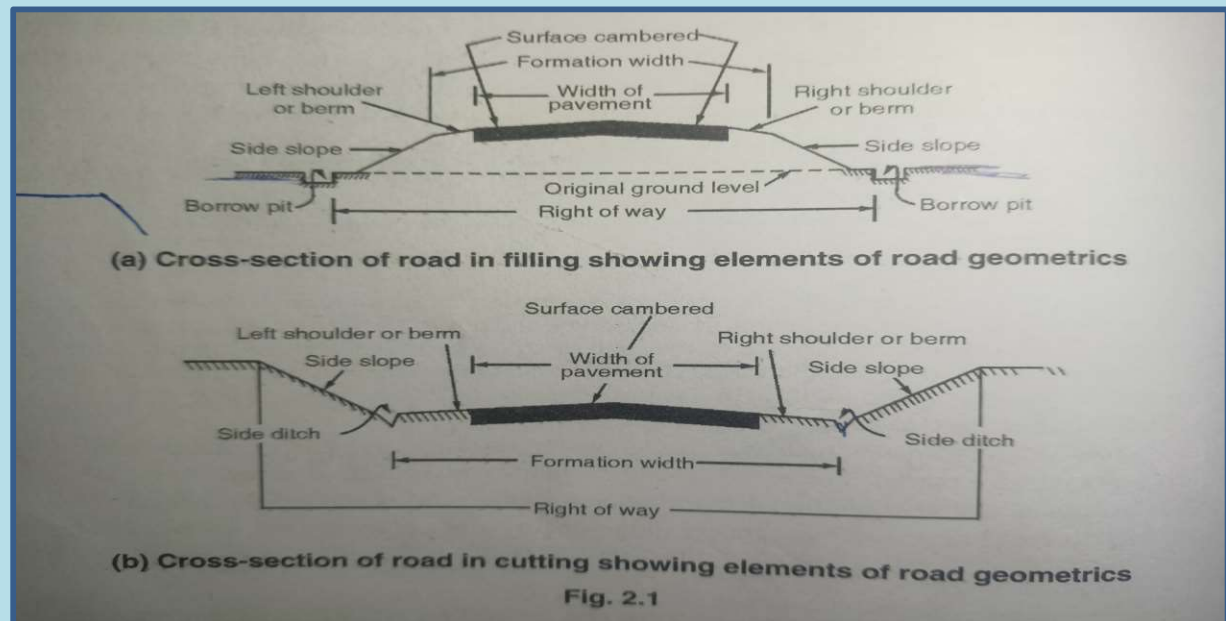
Important terms used in Highway Engineering

- a) **Road**:-A structure constructed of different materials(Earth, gravel, bitumen or cement concrete) to allow movement of vehicles, carts, cyclists, pedestrians etc from one place to another place.
- b) **Traffic**:-The motor vehicles of different kinds such as carts, cyclists and pedestrians moving together on a road is termed as “Traffic or Mixed Traffic”.
- c) **Right of way**:-The privilege to use road by the traffic is termed as Right of way.
- d) **Street**:-A road in a built up area or town is termed as street. In case of city streets, the traffic is heavy, so in order to avoid accidents, proper traffic control measures should be adopted.
- e) **Carriage way**: The part of road, which is used only by vehicular traffic i.e. bullock carts and motor vehicles etc. is known as carriage way. On important highways and major roads, the black metal part of the road is generally the carriage way.
- f) **Cycle track**:- The portion of the road used by pedal bicycles only is called cycle track. In village and district roads, cycle track is not provided.
- g) **Foot path**:- The part of road used by pedestrians or general people walking on foot is termed as foot path. It is slightly higher than the carriage way.
- h) **Express way**:- The carriage way reserved only for high speed power driven vehicles is called Express-way.) As all the vehicles entering on express way move at a high design speed, the entry to low speed vehicles is generally restricted.

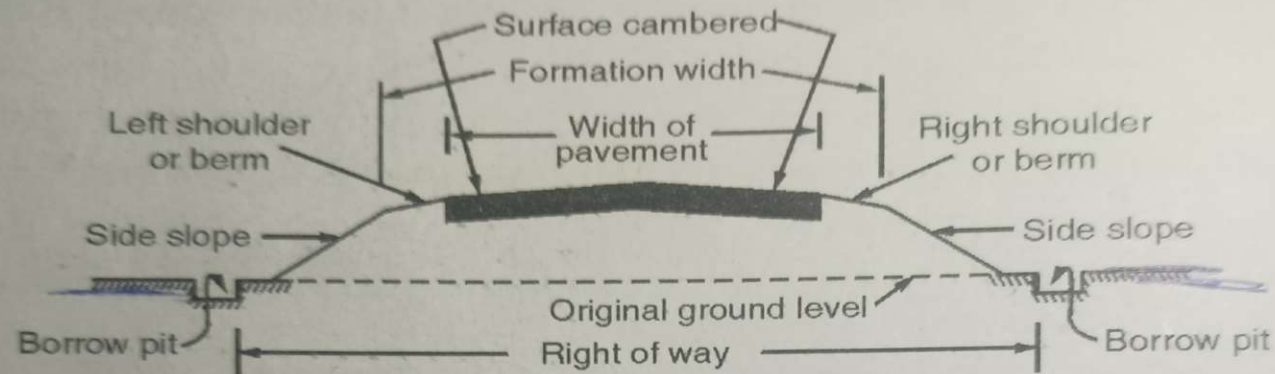
- i) **Express way**:- The carriage way reserved only for high speed power driven vehicles is called Express-way.) As all the vehicles entering on express way move at a high design speed, the entry to low speed vehicles is generally restricted.
- j) **Appian way**:- The major roads or highways constructed by Early Romans were called Appian way. These roads were mainly of strategic importance. 'Appian way' is an example of best road constructed during olden times.
- k) **Fair weather roads**:- The roads which can be used by traffic only in non monsoon season or fair weather are called Fair weather roads. During rainy season, these roads become unusable for traffic due to high accumulation of dirty water and mud on them. Village roads are generally fair weather roads.
- l) **All weather roads**:- The roads which can be used by traffic in all seasons are called All weather roads. National Highways and State Highways are all weather roads.
- m) **Ribbon Development**:- The settlement of population and growth of business centers & markets along side river shores, road side and near railway stations is referred to as "ribbon development. This justifies that progress and development follows the line of transportation. To avoid congestion alongside main transportation routes, ribbon development should be discouraged.
- n) **Roadside Arboriculture**:- The provision and maintenance of trees and shrubs along side roads for aesthetic beauty and providing shade, comfort and pleasing environment to road users is termed as roadside arboriculture.

Road Geometrics

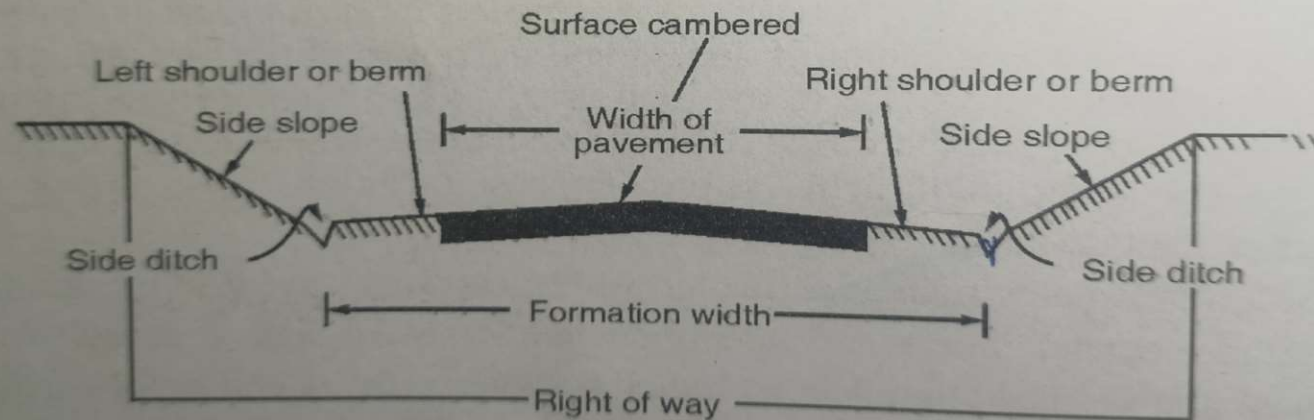
- **Definition:-**The proper planning, design and fixing up of visible dimensions of highway for providing optimum speed, comfort and maximum safety to road users at a minimum operational cost is 'Road Geometrics'.
- Various elements of road geometrics are:-
 - a) Right of way
 - b) Formation width
 - c) Road Margin
 - d) Road Shoulder
 - e) Carriage Way
 - f) Side Slopes
 - g) Kerbs
 - h) Formation Level
 - i) Camber
 - j) Gradient
 - k) Horizontal, vertical and transition curves



Road Geometrics



(a) Cross-section of road in filling showing elements of road geometrics



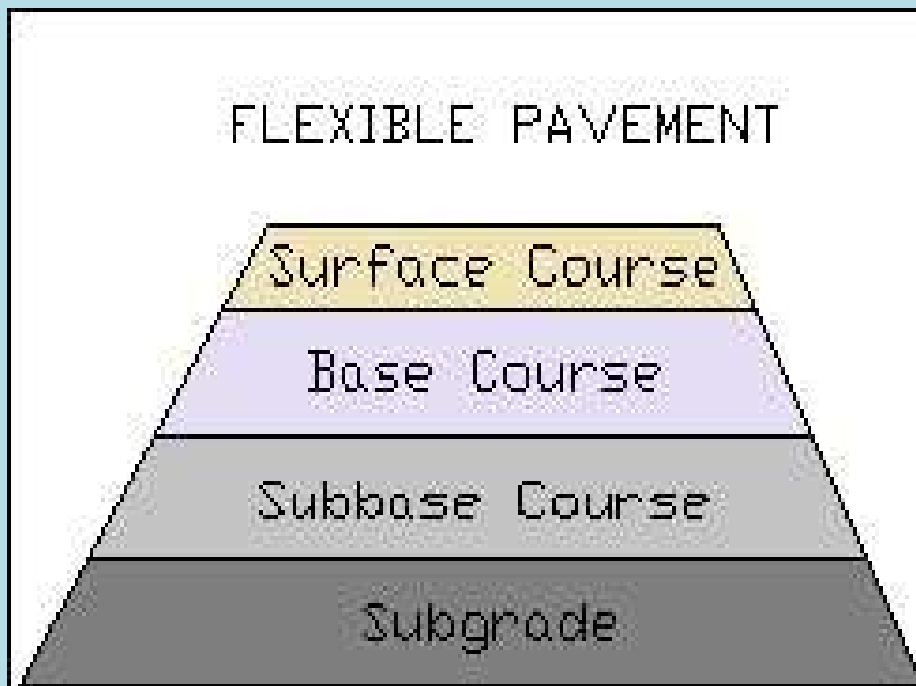
(b) Cross-section of road in cutting showing elements of road geometrics

Fig. 2.1

Types of Roads

- **Road Pavement**:-It is defined as a structure constructed of one or more layers of different materials, properly treated and compacted to carry the traffic load smoothly and safely.
- **Types of Pavement**:- There are generally two types of pavements which are as follows:-

a) **Flexible Pavement**



b) **Rigid Pavement**



Materials used as Surface/Wearing course in Flexible Pavement

- **Bitumen**:- A non crystalline hydrocarbon compound in a solid or viscous state having adhesive properties and derived from crude petroleum either by natural or artificial distillation is termed as Bitumen.
- **Tar**:-Tar is a viscous liquid, jet black in colour obtained as a residual product after destructive distillation of coal or wood in the absence of air.
- **Asphalt**:-The term Bitumen and Asphalt are often confused. They actually refer to the same material. The word Bitumen cover both tar and asphalt, but conventionally, bitumen stands for asphalt. Asphalt is more used in road construction than the tar.

Difference between Bitumen and Tar

■ 4.5.4. Comparison between Bitumen and Tar

Bitumen	Tar
1. It is black or brown in colour obtained by distillation of crude petroleum.	1. It is also black or brown in colour but produced by destructive distillation of coal or wood.
2. It is soluble in carbon disulphide and in carbon tetrachloride.	2. It is soluble in only toluene.
3. It has good weather resisting property.	3. Its weather resisting ability is inferior to bitumen.
4. It is less temperature susceptible.	4. It is more temperature susceptible resulting in great variation in viscosity of product with temperature.
5. The free carbon content is less as compared to tar.	5. The free carbon content is more and is detected by solubility test.
6. Due to high viscosity, it cannot be tested in orifice viscometer.	6. Tars and cutbacks are generally tested in orifice viscometers for viscosity test.

Merits and Demerits of Flexible Pavement

- **Merits**:- Following are the merits of flexible pavements:-
 1. The initial cost of flexible pavement is low.
 2. These can resist tensile stresses to some extent.
 3. There is no effect of temperature variations on the flexible pavements.
 4. Construction of joints is not required in flexible pavements.
 5. Less or moderate skill and supervision is required.
 6. Due to flexibility and stress distribution characteristics of these pavements, inferior material can be used in lower layers by constructing the strongest top layer.
- **Demerits**:- Following are the demerits of flexible pavements:-
 1. These are inferior to concrete roads in terms of flexural strength.
 2. Under the action of excessive loading, these pavements fail showing pot holes, ruts and corrugations on the surface.
 3. Flexible pavements are less durable.
 4. Their maintenance cost is high.
 5. The life of flexible pavements is small as compared to cement concrete roads.
 6. The flexible pavements like WBM roads and village earth roads create dust nuisance.

Merits and Demerits of Rigid Pavement

- **Merits:-** Following are the merits of flexible pavements:-
 1. Concrete roads are superior. have high flexural strength and can take any amount of traffic load.
 2. Maintenance cost is low.
 3. Concrete pavements are more durable and have long life.
 4. Their initial cost is more but they prove economical in the long run.
 5. Old concrete pavement provides excellent base course for some resurfacing material, for example: bituminous concrete, sheet asphalt, brick pavement or block pavement.
- **Demerits:-** Following are the demerits of flexible pavements:-
 1. The initial cost of construction is high.
 2. Construction of joints and their proper functioning is essential in these pavements.
 3. Rigid pavement produce heavy stresses due to temperature variations.
 4. The construction of these roads require skilled labour and supervision.
 5. These pavements after construction cannot be opened to traffic in a short duration as they need curing period of 7 to 10 days to develop strength.

Maintenance of Flexible and Rigid Pavement

- **Maintenance of Bituminous Road:-**
 - i. Seal coat application
 - ii. Patch work
 - iii. Resurfacing
- **Maintenance of Concrete Road:-**
 - i. Crack Filling or Treatment of cracks
 - ii. Repair and maintenance of joints (Longitudinal & Transverse Crack)

List of References

1. **Singh, Jagroop. (n.d.).** *Highway Engineering* (Revised Edition).
2. **ChatGPT. (2024).** Responses and guidance on topics in road and highway engineering.

THANK YOU