

Chapter - 1Introduction

Highway :- The road of national or state importance, in a country, are known as highways.

Importance of Highway Transportation :-

The importance of highway transportation can be easily judged from the following advantages of roads.

1- Roads can be constructed to penetrate the interior of any region and to connect in remote villages specially in hilly region where provision of railway lines becomes uneconomical.

2- Roads can be constructed at comparatively lower initial cost than any other mode of transport. Motor vehicles are comparatively cheaper than other carriers like rail locomotive and aeroplanes.

3- Roads are used by various means of transport like private cars, two wheelers, cycles etc.

4- The cost of maintenance is also cheaper than railway track, airports and harbours.

(17)

Comparison betⁿ Macadam & Telford Method.

Macadam Method

1- The subgrade was given a cross slope of 1 in 36 to facilitate subgrade drainage.

2- The bottom layer of pavement or the sub-base course consisted of broken stones of less than 5 cm size to uniform thickness equal to 10 cm only.

3- Base and surface courses consisted of broken stones of smaller sizes to compacted thickness of 10 and 5 cm respectively and the top surface was given a cross slope of 1 in 36.

Telford Method

1- The subgrade was kept horizontal and hence subgrade drainage was not proper.

(2) Heavy foundation stones of varying sizes, about 17 cm towards the edges and 22 cm towards the centre were hand packed and prepared to serve as sub-base course.

(3) Two layers of broken stones were compacted over the foundation stones before laying the wearing course, 4 cm thick with a cross slope of 1 in 45.

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Road Geometrics :-

→ Road geometrics is the planning, design and fixing up of visible dimensions of a road for providing optimum speed, comfort and safety to the road users at a minimum operational cost.

→ Proper geometric design will help in the reduction of accidents and their severity.

→ Geometric design of highways deals with the following elements.

- 1- cross-section elements
- 2- sight distance considerations
- 3- Horizontal alignment details.
- 4- vertical alignment details
- 5- Intersection elements.

1- cross-section elements :-

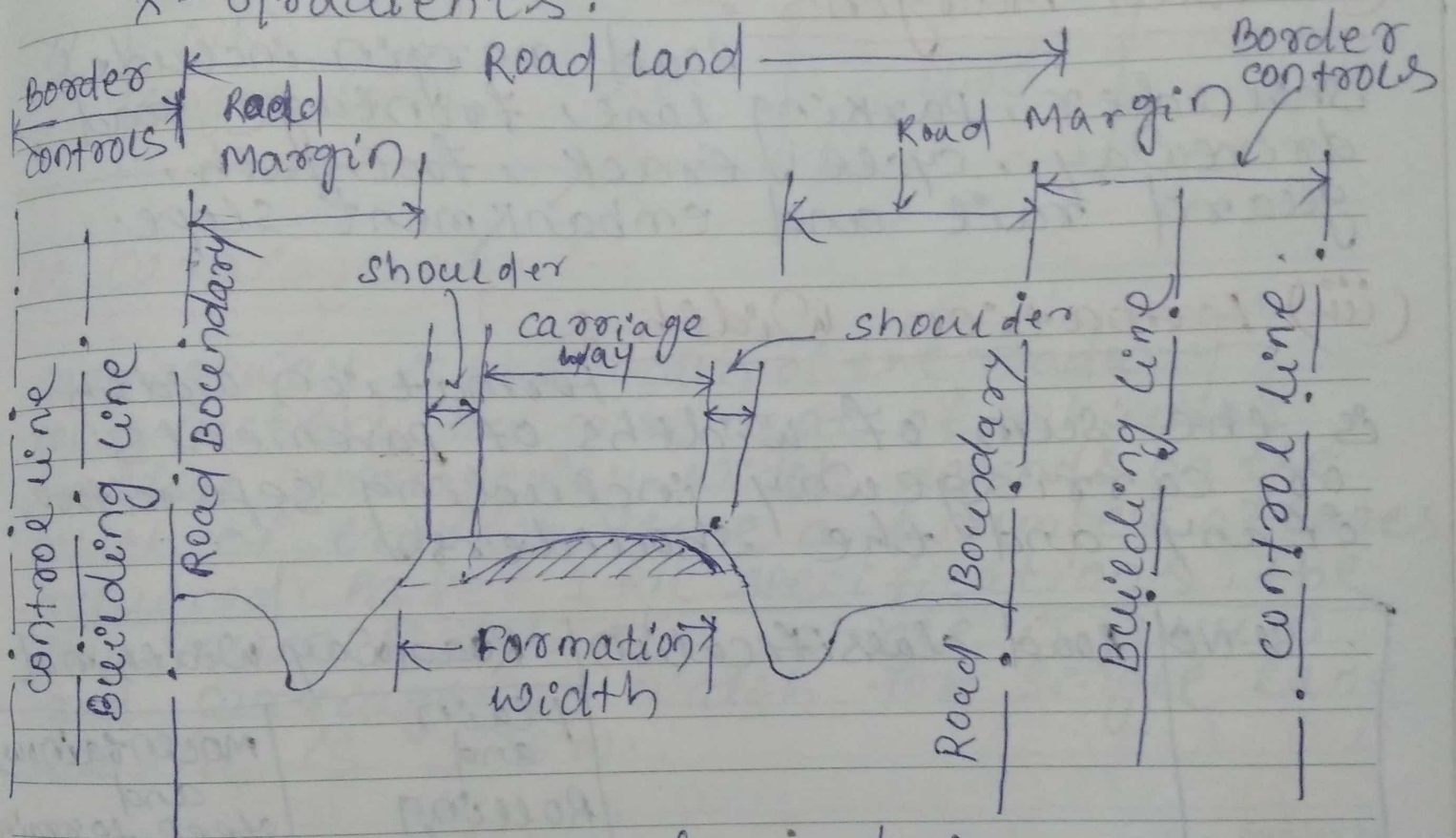
The cross-section elements are

- i- Right of way
- ii- Road margins
- iii- Formation width
- iv- carriage way

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(2) ~~(100)~~

- v - Shoulders
- vi - Side slopes
- vii - Kerbs
- viii - Formation level
- ix - Camber
- x - Gradients.



(cross section of a road in embankment)

Glossary of terms used in geometric and their importance

Notes

① Right of way :- Right of way is the area of land acquired for the road, along its alignment. The width

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Problem :- Design the rate of super-elevation for a horizontal curve of radius 450 m and speed 90 kmph.

Sol Given dat:

Radius, $R = 450 \text{ m}$.

Speed, $v = 90 \text{ kmph}$.

We know that for mixed traffic condition super-elevation is given by

$$e = \frac{v^2}{225R}$$

Putting the value of v and R in the above equation. we get

$$e = \frac{90^2}{225 \times 450} = 0.08$$

The value of e calculated is more than 0.07 hence provide $e = 0.07$.

(Ans)

check For co-efficient of friction developed for the maximum value of $e = 0.07$ by using the formula.

$$\begin{aligned}
 f &= \frac{v^2}{127R} - e & &= 0.142 - 0.07 \\
 & & &= 0.072
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{90^2}{127 \times 450} - 0.07
 \end{aligned}$$

Notes

ROAD MATERIALS

Road Materials :- The different types of materials used for constructing and supporting road pavement are known as road materials.

Different types of road materials.

Different types of road materials used for road construction are:

1- Soil

2- Aggregate

3- Binders.

(i) Soil :-

→ Soil is considered as the principal road material.

→ Soils with high plasticity have higher clay content and usually exhibit poor engineering behaviour.

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→ It has different types and so an adequate knowledge of the properties of soil is essential for proper design and construction of road pavement.

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Function of soil as Highway subgrade :-

The soil as highway subgrade has following

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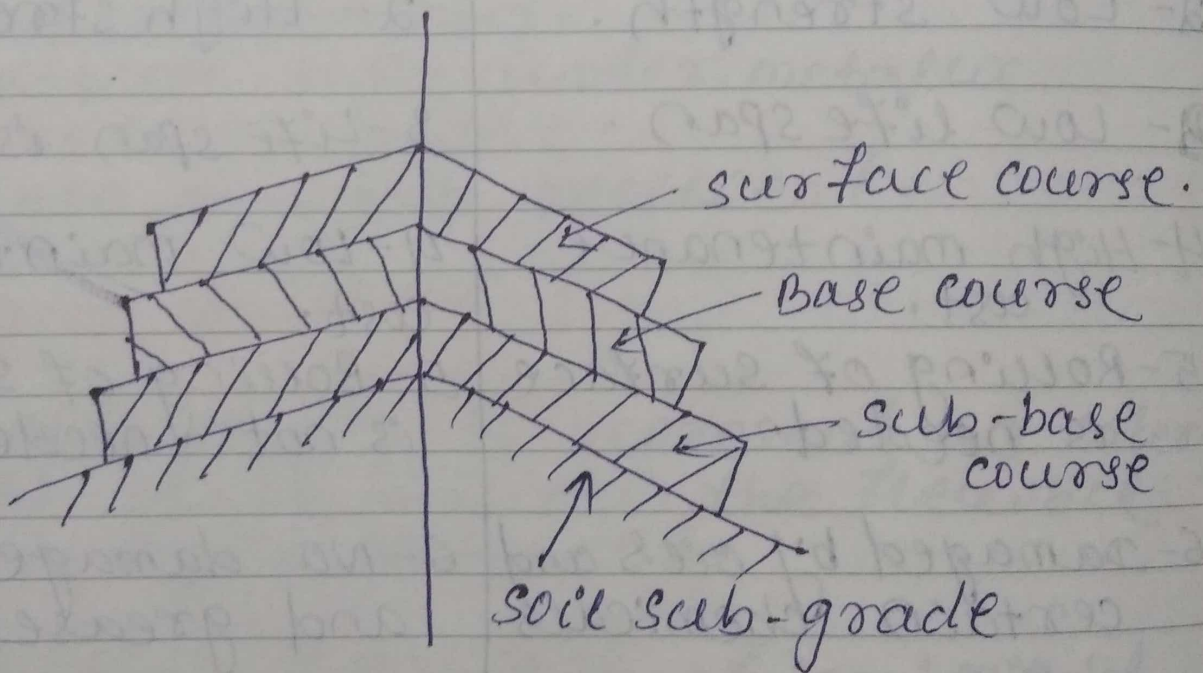
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Typical cross-sections of flexible Pavements.

A typical flexible pavement consists of four components.

- 1- sub-grade
- 2- sub-base course
- 3- Base course
- 4- surface course.



(structure of a flexible pavement)

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(iii) It takes up wear and tear due to the traffic.

(iv) It provides a water tight layer against infiltration of surface water.

Comparison of flexible and rigid pavements

Sl. No	Points of comparison	Flexible pavements	Rigid pavements.
1	Design precision	Design is less precise.	Design is more precise.
2	Life	It has less life	It has more life
3	Initial cost	Initial cost is less.	Initial cost is more.
4	Maintenance	It requires more maintenance.	It requires very little maintenance.
5	stage construction	Fit for stage construction.	Not fit for stage construction.
6	penetration of water.	It is less impervious.	It is more impervious.
7	sub-grade	A good sub-grade is essential.	A good sub-grade is not required.
8	opening of traffic after construction.	It can be opened to traffic immediately after construction.	It requires few days to open for traffic due to curing.

Notes

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35th	22	23	24	25	26	27	28
36th	29	30	31

CHAPTER - 5HILL ROADSHill Roads

→ The roads constructed in mountains regions of the country are called as hill roads.

→ It is also known as Ghat Roads.

→ These roads present more difficulties in their design, construction and maintenance etc.

→ There are different considerations while designing hill roads as compare to plain area roads.

→ Types of curve used in hill roads is of different than plain road.

→ All geometric parameters will gets changes while designing hill roads such as - curves, super elevation, SSD, OSD, Extra widening etc.

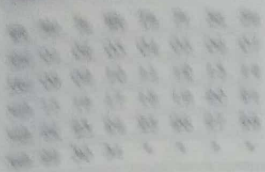
→ Special care should be taken in alignment, design and laying for hill roads as these are more dangerous and few times proves fatal to the traffic during accident.

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Classification of Hill Roads :-

Hill roads can be classified into three



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slope.

→ If these roads are to be used by jeeps the width is kept between 2.45 m to 3.65 m .

3- Village paths :-

→ The communication between villages and other working areas in hilly regions is established through village paths or tracks.

→ These are generally 1 m to 1.2 m wide and may have a slope of more than 45° .

→ The ruling and limiting gradient recommended for such type of paths are $1\text{ in }7.5$ and $1\text{ in }5$ respectively.

Component of a Hill Road :-

Following are the components of a hill road.

- 1- Retaining wall
- 2- Breast wall.
- 3- Parapet wall.
- 4- catch water drain
- 5- cross-drain.
- 6- Side drain

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CHAPTER-6

ROAD DRAINAGE

Road drainage :-

- Road drainage is the process of interception and removal of water from over, under and vicinity of the road surface.
- For safe and efficient design of road, road drainage is very important.
- The stability of road pavements can be maintained only if their surface and foundation bed remain in dry condition.
- During rains, part of the rain water flows on surface and part of it percolates in the sub-grade or any other layer of the pavement.

Necessity of Road drainage :-

Road drainage work is necessary because of the following reasons:

- 1- Variation in moisture content in expansive soils causes variation in the volume of sub-grade and contributes to the failure of pavement.
- 2- Excess moisture content in soil sub-grade causes considerable lowering

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30th	18	19	20	21	22	23	24
31st	25	26	27	28	29	30	31

WEDNESDAY of its stability.

- 3- The entrance of water causes reduction in bearing capacity of soil sub-grades like WBM and stabilized soil.
- 4- Due to poor drainage, waves and corrugations are formed in flexible pavements which causes failure of pavement.
- 5- In rigid pavements failure occurs by mud pumping due to the presence of water in fine sub-grade soil.
- 6- poor road drainage work causes erosion of soil from the top of unsurfaced road, slopes etc.
- 7- The shoulders and pavement edges get damaged due to excess water.

Requirements of a good road drainage work.

Requirements of a good road drainage

CHAPTER - 7ROAD MAINTENANCE

Introduction : When a constructed road is opened to traffic, its various components are subjected to wear and tear. Certain defects may also creep in due to the faulty design and improper quality of construction of road. If these defects, wear and tear are not rectified time-to-time, they get deteriorated and may lead to unsafe, uneconomical and inconvenient movements of traffic. Maintenance is intended to keep the pavement structure in serviceable condition as best as practicable and as long as possible. Poor maintenance of road is not only harmful to the traffic using it but is also harmful to the road itself. Poor maintenance may cause large number of accidents.

Types of Maintenance :-

Maintenance are of three types such as:

- 1- Routine
- 2- Recurrent
- 3- Periodic

Notes 1-Routine :- Routine maintenance does not depend on traffic level. It consists of grass cutting, drain clearing, maintenance of culverts and bridges etc.

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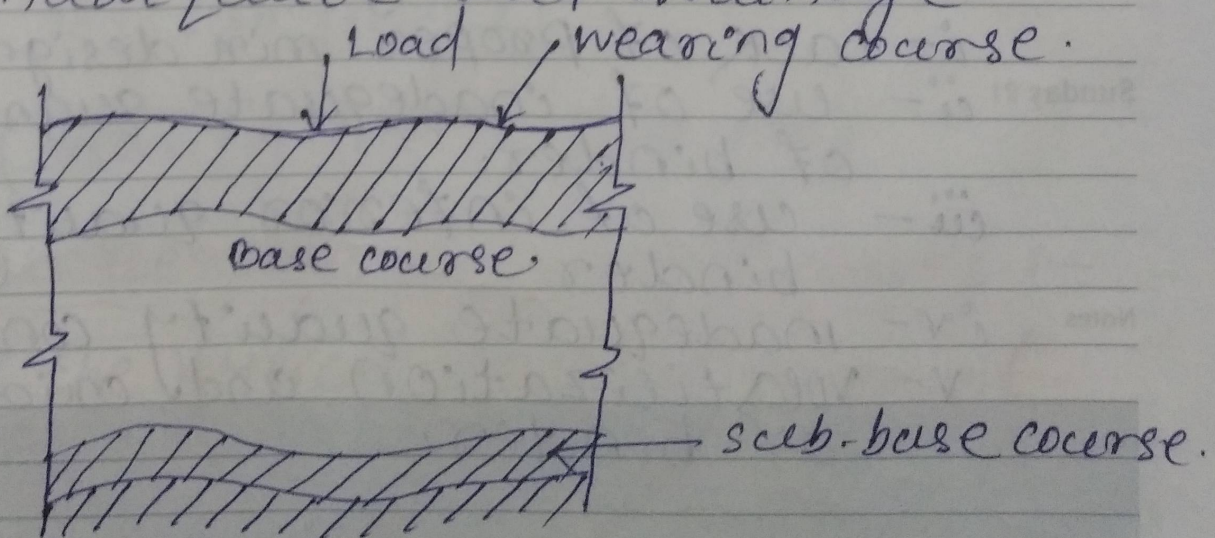
- 1-Sub-grade failure
- 2-Base course failure
- 3- Wearing course failure.

1-Sub-grade failure :-

The excessive deformation in sub-grade soil is one of the main cause of pavement failure. This type of failure causes excessive undulations of waves and corrugations in the pavement surface.

The basic reasons of sub-grade failure are :

- i- Inadequate stability due to improper compaction or presence of excessive moisture in the soil.
- ii- Excessive stress application.
- iii- Inadequate road drainage.



Notes

(sub-grade failure) (soil sub-grade)