



Nilachal Polytechnic

Bhubaneswar

Sem. :4th Subject : Highway Engg.

Branch: Civil Engineering

Name of the Faculty : Sweta Sarangi

Text Book to be followed by Student / Faculty

Book- : Khana & Justo

Chapter- 5 : Hill Roads

1.Learning Objectives

Student will learn –

- i) About the hill roads
- ii) About different types of curves.
- iii) About side ditches.
- iv) About the retaining wall and brest wall
- v) About side drains, cross-drainage works

2. Essential Questions

- i) What are the types of curves?
- ii) What are the various components of hill roads?
- iii) What are the difference between Retaining Wall & Brest Wall?
- iv) Draw the cross-sectional view of hill roads.

3. Hours Required

Theory	3 hrs
Problems	nil
Question & Answer Theory	1 hrs
Total	4 hrs

4. Question for Teaching / Assignment / Self Practice

Question sets	02 Marks	05 Marks	10Marks
Teaching	3	1	2
Assignment	2	1	1
Self Practice	2	1	1
Total	7 No.s	3 No.s	4 No.s

Lesson Description:-

- A hill road may be defined as the one which passes through a terrain with a cross slope of 25% or more.
- There may be sections along hill roads with the cross slope less than 25%, especially when the road follows a river route.
- Even then these sections are also referred to as hill roads. Hence, to establish a hill road overall terrain must be taken into account.
- The hilly regions generally have extremes of climatic conditions, difficult and hazardous terrains, topography and vast high altitude areas.
- The region is sparsely populated and basic infrastructural facilities available in plain terrain are absent. Hence, a strong stable and feasible road must be present in hilly areas for overall development of other sectors as well.

Course Material

CHAPTER - 5 **Hill Roads**

Introduction:

- Roads constructed in mountains region is called hill roads. 🌄
- 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.

Components parts of Hill Roads

1. Side Drain
2. Parapet Drain
3. Catch Water Drains
4. Brest Wall
5. Retaining Wall
6. Cross Drains Road Bed
7. Road bed 🏠

Road bed

The pavement potion of hill road is called road bed. 🏠

Function: To resist stresses developed due to moving traffic.

Side Drain 🏠

Drain provided on the sides of road is called side drain. 🏠

Side drains runs parallel to the length of road. 🏠

Function: To collect and drain off rain water collected from camber of road.

Parapet Wall 🏗️

Wall which is provided above the formation level in the down side slope is called parapet wall. 🏗️

Function: Protection to the traffic against falling down the hill slope.

Catch Water drain 🏗️

It is drain provided on higher slope running parallel to the length of road.

Function: To make intercept for runoff coming from top of hill and divert water in to nearby cross drains.

Brest Wall 🏗️

The wall constructed to upside slope is called retaining wall. 🏗️

Function: Protect road from sliding of upside slope.

Retaining Wall 🏗️

The wall constructed to down side slope of road is called retaining wall.

Function: To protect down slope from sliding.

Cross Drains 🏗️

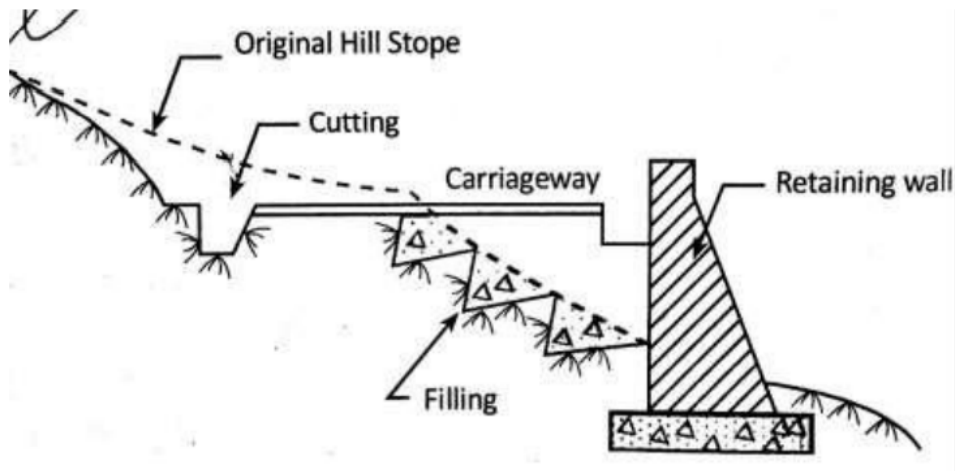
The drain which is laid along width of road is called cross drains. 🏗️

Function: To drain off rain water collected in side drains and catch drains



Typical cross-sections hill road :-

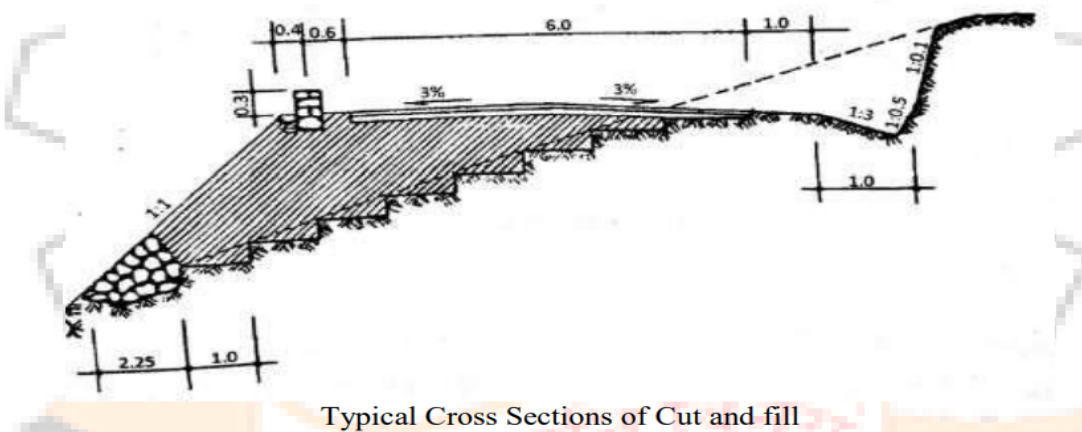
- ❑ The cross section of a road in a hilly terrain is determined by the original ground slope of the site, the slope of the road formation, width of roadway, side drain size, and shape and so on.
- ❑ **Various types of road Cross-section are:**
 1. Cut and fill
 2. Bench type
 3. Box cutting
 4. Embankment with retaining walls
 5. Semi bridge
 6. Semi tunnel
 7. Platforms



Typical Cross Sections of Hill Road

Cut and fill:-

- ☐ When roadbed slope has a gradient 2% or more a cut and fills road bed is cheaper and environmentally friendly as well.
- ☐ The fill mass is generally balanced by the cut mass. For adequate stability, benches are made on the surface of the hill side with a height of 0.5 m and length varying from 1.5 to 3.0m depending upon the slope.



Typical Cross Sections of Cut and fill

Breast Walls:-

- ☐ A breast wall is constructed to protect the natural sloping ground from the cutting action of natural agents.
- ☐ Breast walls also prevent slides of unreliable soils.

- The breast walls may be 0.6 m wide at the top. Weep holes should be provided at regular interval along the length of the wall to relieve the walls of saturated earth pressure.
- The breast wells are so designed that their line of pressure should be normal to the earth pressure or thrust

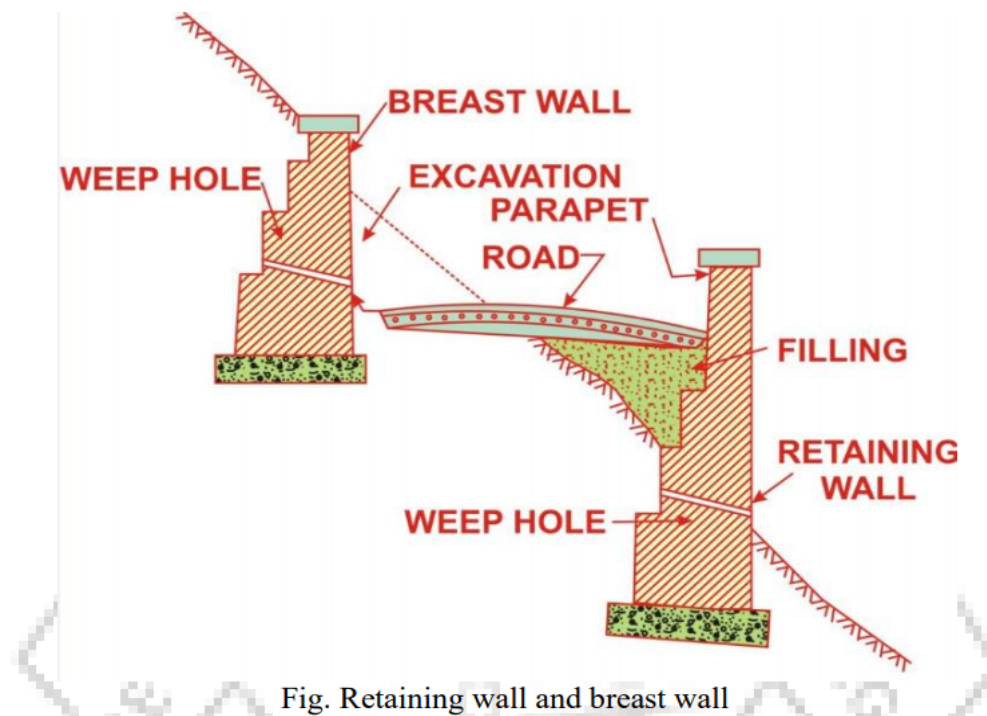


Fig. Retaining wall and breast wall

Retaining walls:-

- The walls constructed for retaining or supporting earth against their back are called retaining walls. Earth cannot remain vertical but would be in a state of equilibrium when it assumes a natural angle which is called angle of repose.
- If it is desired to be retain the earth vertically, that portion of the earth will have to be supported by a wall called retaining wall.
- The back of the wall is in the form of steps and the face of the retaining wall may be either vertical or battered.
- The width at the base will depend upon the height of earth to be retained as the more the height, the greater will be the pressure at the base and the top can be kept 2 bricks thick .

Difference between Breast walls and Retaining walls :

1. Breast wall and Retaining wall structure stand off to protect a freshly cut or old surface of a natural hill face.
2. Breast wall and Retaining wall structure prevent of hill slides under the action of weather and rain water flowing over hills slope. Retaining wall is provided to the downside of the road while breast wall uphill side of the road in hilly area.
3. Impact of snow, avalanches, landslides and surcharge are not considered in the design of Breast wall while in retaining wall all those factors are considered.
4. Height of breast wall shall not exceed 3 meter and for retaining wall we did not have such type of criteria.
5. Breast wall are not required to be constructed where back mass comprises of rocks or stable strata deposit of soil mass and for protecting the unstable soil mass we need retaining wall.
6. Retaining wall used for support artificial cutting or slope while breast wall used to support natural slope.
7. Design of retaining of wall capable to resist uplift pressure force and hydro static pressure for developed while breast wall is used to transfer the load.

Different types of curves :

The following types of curves are mostly found on hill Roads:-

Hair-Pin bend curves

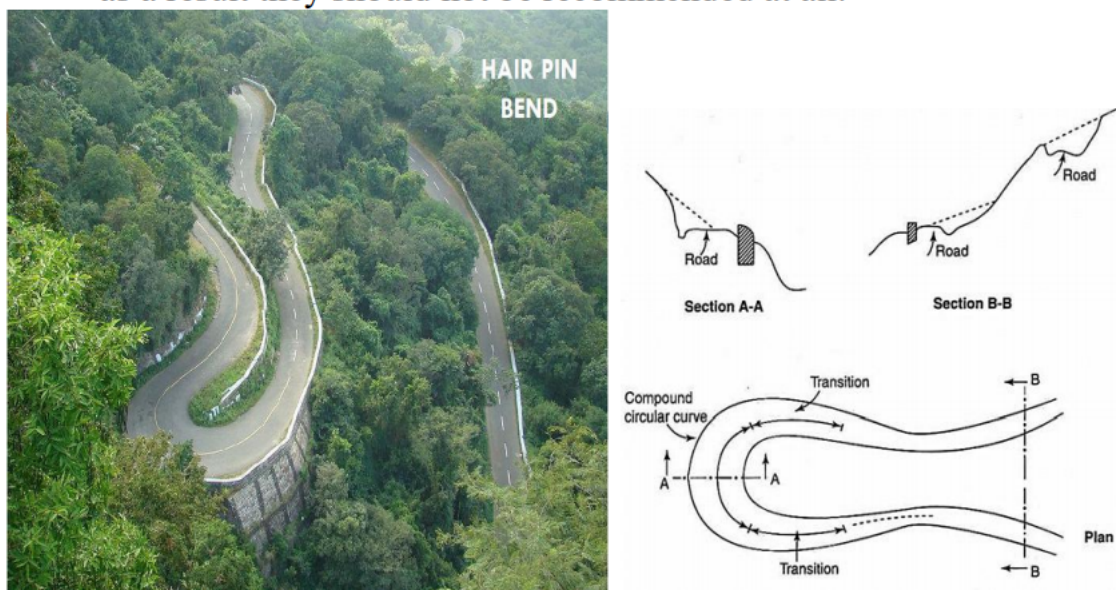
Salient Curves

Re-entrant Curves

Hair-pin curves: 🌧️

- ☐ This type of curve modifies its direction via an angle of 180 degree down the hill on the similar side is defined as hair-pin curve. 🌧️
- ☐ A Hair-Pin Bend: This curve is known as a hair-pin bend since it adheres to the shape of a hair-pin. If a bend is developed at the hair-pin curve in a hill road, it is called as hair-pin bend. 🌧️
- ☐ This type of curve should have been situated on a hill side containing the lowest slope and highest strength.

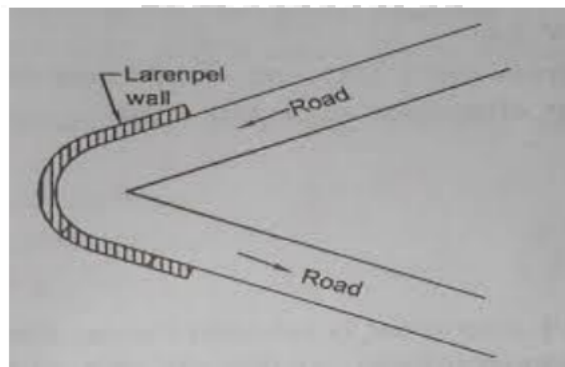
- It is considered as very secure from view point of landslides and ground water.
- The ideal Hair-pin bends should contain long arms and farther spacing. They minimize construction issues and high-priced protective works. ☔
- Hair-pin curves or bends with snakelike form are difficult to arrange and as a result they should not be recommended at all.



Schematic dig. of hair pin bend curve

Salient curves:

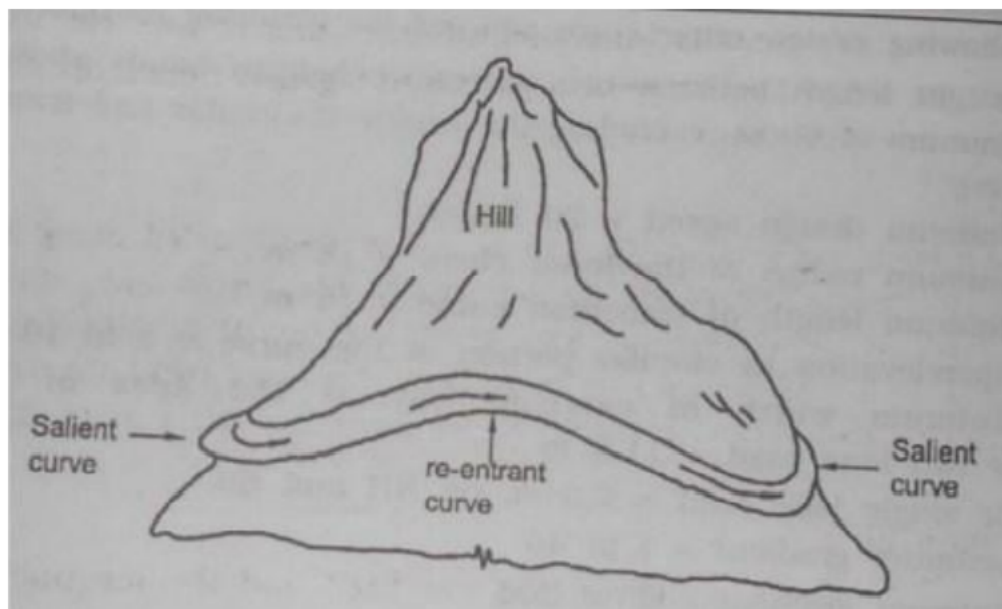
- The curves which contain their convexity on the exterior edges of a hill road are defined as salient curves.
- The centre of curvature of a salient curve is located towards the hill side. This type of curve appears in the road length that is built up on the ridge of a hill.
- The bend that is developed at the salient curve in a hill road is called corner bend. ☔
- Salient curves are very harmful for the traffic moving speedily. At such a curve or at corner bend, the segment of projected hill side is normally curtailed to make the perceptibility better. ☔
- It is demonstrated in the following figure (re-entrant curve). In the exterior perimeter of the road, the curve is basically arranged with a parapet wall for safeguarding the vehicles from falling down the hill slope.



Schematic dig. of Salient curve

Re-entrant curves: ☂

- The curves which contain their convexity on the inside edge of a hill road are known re-entrant curves. ☂
- The centre of curvature of re-entrant curves is located ahead of the hill side. This type of curve appears in the road length that is built up in the valley of a hill. ☂
- These curves are not harmful since they offer sufficient visibility to the traffic moving speedily. In such curves, the parapet wall is arranged only for protection for fast moving traffic.



Schematic dig. of Re-entrant curve

Question set

Classroom Teaching

Group A

1. What is the function of breast wall in hill roads? [2012S]
2. Define land sliding.
3. Define sub-surface drainage.?

Group-B

1. Write short notes on [2012S]
 - i) Hair pin bend
 - ii) Causes of landslides
 - iii) Retaining wall

Group-C

1. What are the types of hill road formation? Explain with appropriate sketch.
2. Explain briefly various problems in hill road construction and how they can be overcome

Assignment Questions

Group-A

1. What are the types of road drainage system?
2. What is side drains?

Group-B

1. Draw the typical cross-section of hill road in cutting and in partially cutting and partially filling.

Group-C

1. How side drains are provided in cutting and embankment? show with sketch.

Self Practice

Group-A

1. What do you mean by cross drainage work?
2. Define breast wall and retaining wall.

Group B

1. Draw the cross-section of a typical hill road showing its component parts.

Group C

1. Write the necessity of road drainage. Explain with sketch how the effectiveness of different drainage systems are achieved.

Faculty

HOD

Principal