
UNIT 6 ROAD UNDER SPECIAL CONDITIONS

Structure

- 6.1 Introduction
 - Objectives
- 6.2 Hill Roads
 - 6.2.1 Alignment Selection and Geometric Design Standards
 - 6.2.2 Landslides
 - 6.2.3 Special Structures in Hill Roads
- 6.3 Roads in Marshy Areas
 - 6.3.1 Problems Encountered
 - 6.3.2 Methods of Constructing Roads in Marshy Areas
- 6.4 Roads in Deserts
 - 6.4.1 Problems Encountered
 - 6.4.2 Road Location in Dune Areas
- 6.5 Low Cost Roads Connecting Villages
 - 6.5.1 Problem of Village Connectivity
 - 6.5.2 Principles Governing Rural Roads Design Standards
 - 6.5.3 Use of Labour-based and Appropriate Technology
- 6.6 Summary
- 6.7 Key Words
- 6.8 Answers to SAQs

6.1 INTRODUCTION

Roads passing through difficult terrain and environmental conditions require special attention in design, construction and maintenance. The following conditions are treated in this unit :

- (a) Hill Roads
- (b) Roads in marshy areas
- (c) Roads in deserts
- (d) Low cost roads connecting villages

Objectives

The objectives of this Unit are to cover the special problems of designing, constructing and maintaining roads in difficult area.

After studying this unit, you should be able to

- understand the design standards, construction practices and maintenance procedures in respect of hill roads and roads in marshy and desert areas,
- know the design of low cost Rural Roads serving villages, particularly unpaved roads,
- understand how low cost roads can be constructed with appropriate technology, and
- have an idea of how low cost roads can be maintained.

6.2 HILL ROADS

6.2.1 Alignment Selection and Geometric Design Standards

In section 2.5 of Unit 2, you have already learnt how an alignment of a hill road has to be selected. The selection of a good alignment results in economy in construction and subsequent maintenance. The geometric design standards have also been discussed in Unit 2. In this section, we shall discuss some special features of hill roads.

6.2.2 Landslides

Landslides are common in the Himalayan hill roads. The main causes contributing to landslides are :

- Removal of lateral support at the bottom of a hill due to erosion by rivers.
- Earthquakes.
- Clearing of vegetation by cutting trees and grazing by cattle.
- Increased surcharge caused by rain or snow.
- Lack of drainage.
- Presence of faults and joints in the strata.

The measures for the correction of landslides include :

- Improvement in the surface drainage by constructing catchwater drains, side drains, cross-drainage structures and French drains.
- Afforestation and growth of vegetation by providing jute fabric and turfing.
- Prevention of grazing of animals by fencing.
- Provision of check walls, breast walls and toe walls.

Special Structures in Hill Roads

The following structures are commonly needed in hill roads :

Retaining Walls

Needed to retain the fill portion, and generally constructed in dry stone masonry with pucca bunds (Figure 6.1).

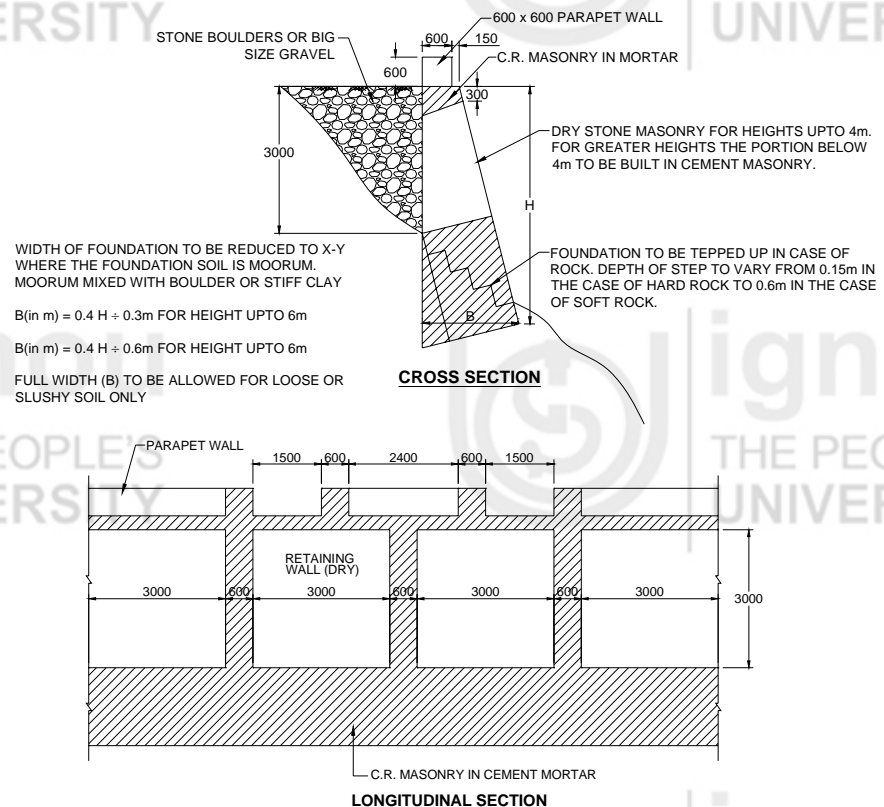


Figure 6.1 : Typical Design for a Retaining Wall

Note

- (1) All dimensions are in mm.
- (2) The gap in parapet may be reduced or closed entirely, at the discretion of engineer-in-charge. Suitable weep holes shall be provided if the parapet wall is built without gaps.
- (3) Top surface of parapet shall be given a slope of 25 mm.

Breast Walls

Needed to buttress uphill slopes (Figure 6.2).

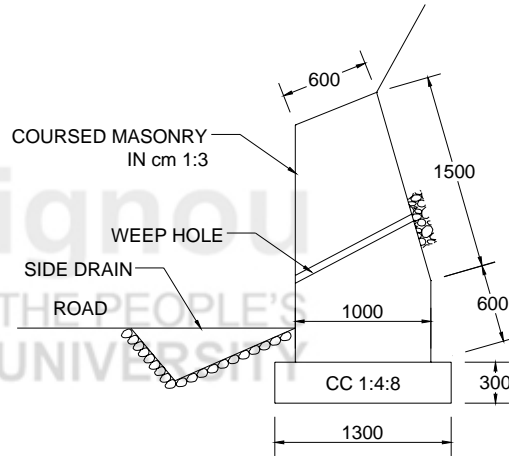


Figure 6.2 : Breast

Check Walls

Small retaining structures provided in series to arrest landslides.

Gabion Walls

Provided for retaining fill portion, and constructed with dry stones encased in wires mesh or geogrid cages.

Parapet Walls

Needed for protecting vehicles from falling into the valley (Figure 6.1).

6.3 ROADS IN MARSHY AREAS

6.3.1 The Problems Encountered

Roads passing through marshy and swampy ground and waterlogged areas have stable ground generally in a saturated condition. Road embankment can settle into the soft ground and damage the ground pavement. Special precautions are needed to avoid such failures.

6.3.2 Methods of Constructing Roads in Marshy Areas

The following methods are adopted for constructing roads in marshy areas :

- (a) Removal of soft soil and replacement with good soil.
- (b) Displacement of the soft soil by constructing the embankment and blasting the soft soil, such that the embankment displaces and occupies the space occupied by the soft soil.
- (c) By constructing the embankment in stages, allowing settlement to take place, and if necessary to construct the embankment to a level above the designed level, and removing the excess material after full settlement has taken place.
- (d) By providing vertical sand drains (0.4-0.6 m dia) which will facilitate the upward movement of water from the underlying saturated soil and drain it away. Figure 6.3 gives a typical layout of sand drains.

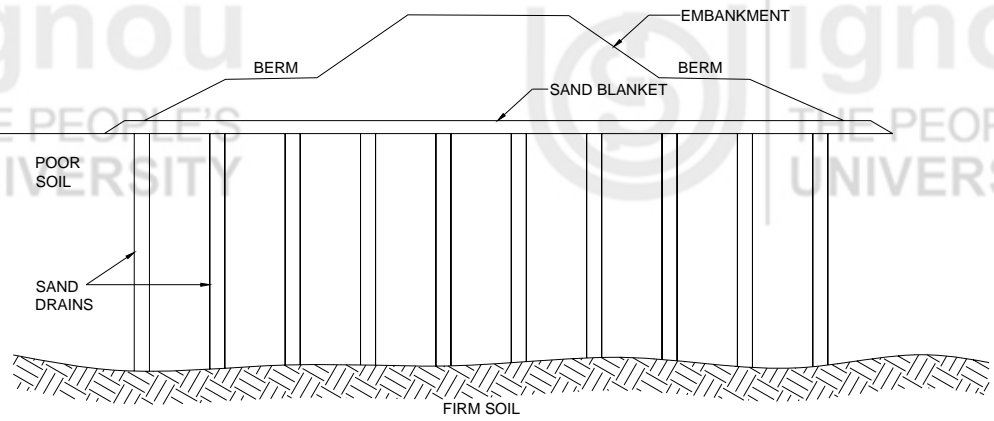


Figure 6.3 : Vertical Sand Drains

6.4 ROADS IN DESERTS

6.4.1 Problems Encountered

The western portion of Rajasthan is part of the Thar desert, where strong winds blow the fine desert sand particles leading to the formation of sand dunes. The sand dunes are mounds which can be as high as 100 m above the ground. Unless the roads are aligned properly, the embankment can be swept away by winds and sand can be deposited on the road rendering it unusable by traffic.

6.4.2 Road Location in Dune Areas

The following principle should be observed in locating a road in dune areas :

- (a) Align a road where sand is covered by vegetation.
- (b) Select a location where the sand is coarse and cannot be blown by wind.
- (c) If a road has to be aligned parallel to a sand ridge, avoid locating the road on the slopes. Locate the road either at the top of the ridge or in the inter-dunal space.
- (d) If possible locate the road away from the dune at a minimum distance of twice the dune height.

The details of the location of roads placed in dune areas are given in Figure 6.4.

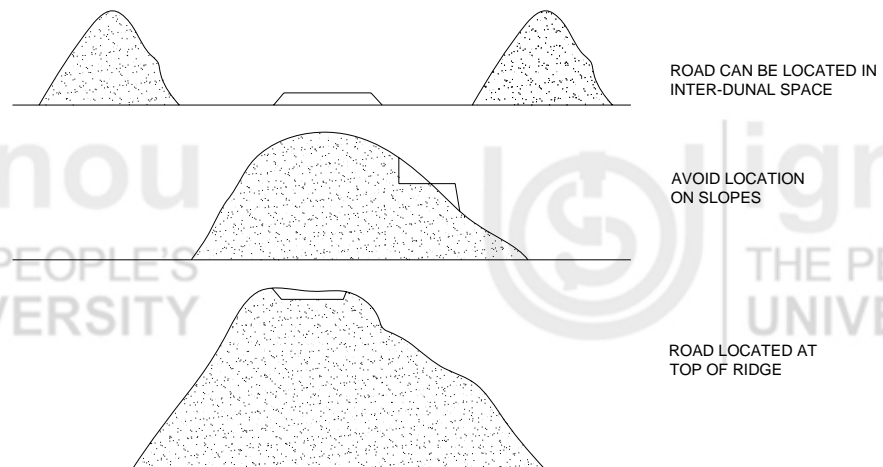


Figure 6.4 : Possible Locations of Road in Sand Ridge

The following guidelines may be observed in design :

- (a) Avoid sections with partial cut and partial fill.
- (b) Avoid cut sections as far as possible.

- (c) Avoid high road embankments.
- (d) When cutting is done in dunes, provide benchings 5-8 m wide.
- (e) It is preferable to black-top the road, since unsurfaced pavements can get dislodged when the sand deposit is cleared by a grader.
- (f) Precast concrete blocks are also be good surfacing specification since the cost of maintenance is minimised.

SAQ 1

- (a) What are the causes contributing to landslides?
- (b) What are the measures to correct landslides?
- (c) Give sketches of :
 - (i) retaining wall
 - (ii) breast wall
 - (iii) parapet wall in hill roads
- (d) What are the problems encountered in roads in marshy areas?
- (e) What are the methods of constructing roads in marshy areas?

6.5 LOW COST ROADS CONNECTING VILLAGES

6.5.1 Problem of Village Connectivity

It is estimated that nearly 45 per cent of India's villages are not connected by an all-weather road. Thus, the people living in these villages are virtually cut off from the country's mainstream and lack schools, medical facilities, electricity and drinking water. Provision of an all-weather road to each village is thus an important task to be fulfilled soon. Since the task is enormous, it is necessary to explore low-cost solutions.

6.5.2 Principles Governing Rural Roads Design Standards

The following principles should govern in design of rural roads :

- (a) Rural Roads are low volume facility serving an access function. Hence the design speed and geometric design standards are kept the minimum (Unit 2).
- (b) Initial cost is an important consideration. Hence the pavement may be constructed to cater to low volume of traffic to start with, and later on strengthened as traffic intensity grows. A design period of 10 years is adequate.
- (c) Gravel roads, without black-topping, are adequate for most of the access roads to start with. The use of techniques like soil-stabilisation should be made. Maximum use of locally available materials must be made.
- (d) The alignment and grades should be selected at the initial stage itself because these are costly to be rectified later.
- (e) Drainage should be given adequate consideration.
- (f) Durable assets must be constructed and maintenance should receive good attention.
- (g) Low-cost cross-drainage structures like vented causeways, paved dips and submersible bridges should be adopted.

6.5.3 Use of Labour-based and Appropriate Technology

The construction and maintenance of rural roads can generate a good level of employment. Hence, the technology used should be labour-oriented. The use of agricultural tractor based technology, with implements such as disc harrows, tillers, rooters and rotavators should be favoured. The compaction of earthwork, with rollers and water sprinklers towed by an agricultural tractor should be adopted.

SAQ 2

- (a) What are vertical sands and what is their function?
- (b) What are the problems encountered in aligning roads in deserts?
- (c) What are the principles of locating roads in desert areas?
- (d) What are the principles governing Rural Road design standards?
- (e) What kind of technology is appropriate for low cost rural roads?

6.6 SUMMARY

In this unit, you have studied the problems of design and construction of roads in special areas such as hill roads, roads in marshy areas, roads in deserts and low cost roads linking villages. Each of these category of roads requires special attention which a civil engineer is required to know.

6.7 KEY WORDS

Hill Roads	: Roads in hilly and mountainous terrain.
Landslides	: The slippage of mass of hill face.
Retaining Walls	: Structures constructed to retain the fill portion in hill roads.
Breast Walls	: Structures constructed to buttress uphill slopes of hill roads.
Check Walls	: Small retaining structures provided in series to arrest landslides.
Gabion Walls	: Walls made up of stones encased in wire mesh or geogrid cages.
Parapet Walls	: Walls constructed for protecting vehicles from falling into the valley in hill roads.
Marshy Area	: Area which is water-logged and swampy.
Sand Drains	: Vertical drains constructed to facilitate upward movement of water from underlying saturated soil.
Dunes	: Mounds formed by deposit of wind-blown fine sand in deserts.
Gravel Roads	: Roads having a surfacing of naturally occurring or blended material.
Appropriate Technology	: Technology using equipment like tractors, disc harrows, tillers, rooters and rotavators.

6.8 ANSWERS TO SAQs

Road Under
Special Conditions

SAQ 1

- (a) Refer Section 6.2.2
- (b) Refer Section 6.2.2
- (c) Refer Figures 6.1, 6.2 and 6.3
- (d) Refer Section 6.3.1
- (e) Refer Section 6.3.2

SAQ 2

- (a) Refer Section 6.3.2
- (b) Refer section 6.4.1
- (c) Refer section 6.4.3
- (d) Refer section 6.5.2
- (e) Refer section 6.5.3

