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ROAD DRAINAGE SYSTEM

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ABSTRACT

This study is carried out to review various research works carried out by researcher on effective drainage system of roads and highways. Poor drainage system of road can cause structure failures of road. But these failures can be avoided by carrying out some studies of physical factors and by following some structural guidelines of road drainage. This paper review and enlist these studies and design constraints and also discusses about factors affecting these systems and ways to resolve these.

I. INTRODUCTION

Drainage is the process of interception and elimination of water from over, and underneath the vicinity of the paved surface. Drainage is surface (where water is conveyed on the paved surface and drainage. channels), or subsurface (water flows underneath the pavement. structure). Surface and subsurface drainage of roads highly affects their structural integrity, life and safety of users, and is thus very important during highway design and construction. Road designs therefore must provide efficient means for removal of this water; hence the need of road drainage designs, drainage facilities are compulsory to guard the road against damage from surface and sub-surface water. Traffic safety is additionally crutial as poor drainage may end up in dangerous conditions like hydroplaning. Poor drainage may compromise the structural integrity and life of a. pavement. Drainage systems combine various natural and non-natural facilities e.g. ditches, pipes, culverts, curbs to clear away this water safely.

II. SURFACE DRAINAGE

Under the surface drainage, water is to be carried away in longitudinal drains and further disposed of at the closest stream, valley or water course. Surface water is drained from surface of road by providing camber or cross slope to the paved surface. The paved surface is also made impervious to confine the water entering the subgrade. The recommended ranges of camber for different kinds of pavement are as per Table-1.

Table-1: Recommended Camber/Cross-Fall

SURFACE TYPE	NON-KERBED ROAD	ROAD WITH KERB
Earthen, Gravelled or WBM Surface	3-5%	-
Thin open graded bituminous surfacing	2.5-3%	2.5-3%
High type bituminous surfacing	2.0-2.5%	2.5%
Cement concrete surfacing	2.0%-2.5% in case of transverse tine or brushtexturing	2.5%
	2.5%- in case of longitudinal Tine texturing	2.5%

In surface drainage we have to take into consideration the amount of frequency of flood, numerous drainage structure like culverts and gutters, road side channels, cross slope and side slope, catch drains, longitudinal gradients etc.

2.1 FACTORS AFFECTING THE SURFACE DRAINAGE OF PAVEMENTS:

For quick removal of water from surface of pavement the following features of pavement have to be detailed suitably:

- Geometric aspects of pavement such that longitudinal and transverse slopes
- Kerbs and gutters/outlets provided
- Median drains in divided carriageways

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- Texture of pavement
- Type of surface
- Lane width

2.2 COLLECTION OF SURFACE WATER:

The water collected is carried away into natural channels or artificial channels to prevent its interference with the correct functioning of any a part of the highway. Surface drainage must be provided to sort the precipitation removed from the pavement structure. Different kinds of road side drainage, categorised in keeping with the kind of construction, which is as given;

➢ Trapezoidal surface drainage

➢ V-shaped lined surface drainage

➢ Urban surface drainage

2.3 DESIGN OF SURFACE DRAINAGE:

Designing of surface drainage is done on the basis of results of analysis of average annual rainfall of that area and surface & hydrographic systems of that area. These are:

➢ Hydrological analysis

➢ Hydraulic analysis

III. SUB SURFACE WATER DRAINAGE SYSTEM

The change in water content of soil affects load bearing capacity of soil. The rise in moisture content of soil decreases its bearing capacity. Thus keeping now evident, there must not arise any change in moisture content of the subgrade of the road. The change in moisture content of the subgrade is due to variations within the capillary water, percolation of rain water, seepage flow and well water table. Thus the aim of the sub soil drainage is to forestall changes within the moisture content of the subgrade.

3.1 SOURCES FROM WHICH WATER/MOISTURE REACHES LOWER LAYERS OF PAVEMENT

- From low quality bituminous mixes which are permeable
- From the failed joint seals of cement concrete pavement
- From the cracks, potholes and joints
- Through the longitudinal joint amidst pavement and shoulder
- Seepage water from the adjacent high ground in the cut sections of hilly terrain or from impounded water level higher than the road level in the abutting agriculture fields (e.g. Paddy fields)
- From earth filled medians and shoulders
- From capillary rise of water when water-table is high.

3.2 CONTROL OF SUB SOIL FLOW:

If the seepage zone exists in the range of one meter depth from surface then it is essential to intercept the seepage flow by means of deep side drains or sub drains underneath the pavement .This should lower the water table and release the excessive hydrostatic pressure. Setting up of intercepting drains as shown in Fig-1.

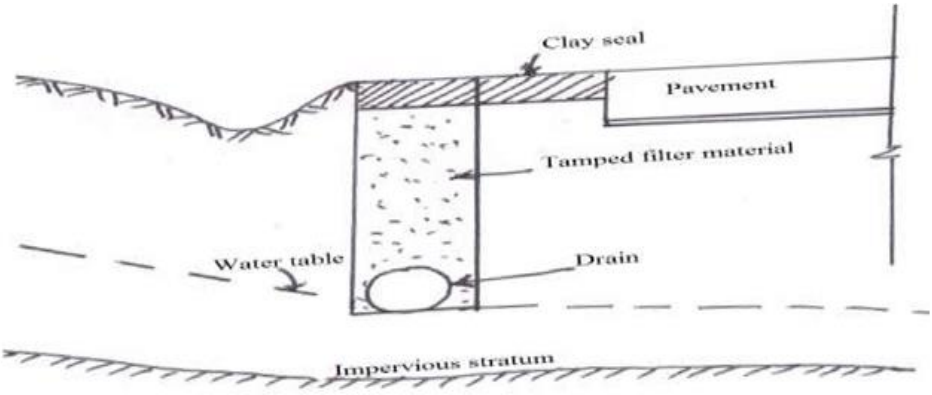

Fig 1: Intercepting Drains

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If the seepage zone is broad and impermeable strata are deep, the drain designed to keep the water table about 1.3 m below the establishment has been found satisfactory. In such condition it is cost-effective to take the trench to the impervious strata and intercept the seepage. (See Fig-2).

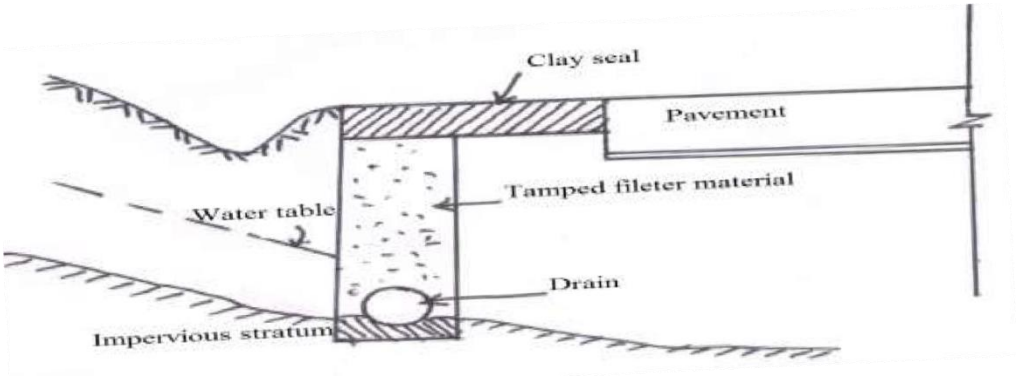

Fig 2: Deep drain

3.3 CONTROL OF HIGH WATER TABLE

In order to avoid excessive pressure on subgrade and pavement, it is essential that water table should be fairly below level of subgrade. It has been found that water table should be managed at least 1.2 m below the subgrade.

In region where the formation level is to be kept at or below the ground level, it crucial to lower the water table. The water table can be lowered in relatively permeable soil by construction of longitudinal drainage trenches with drain pipe and filter sand (See Fig-3)

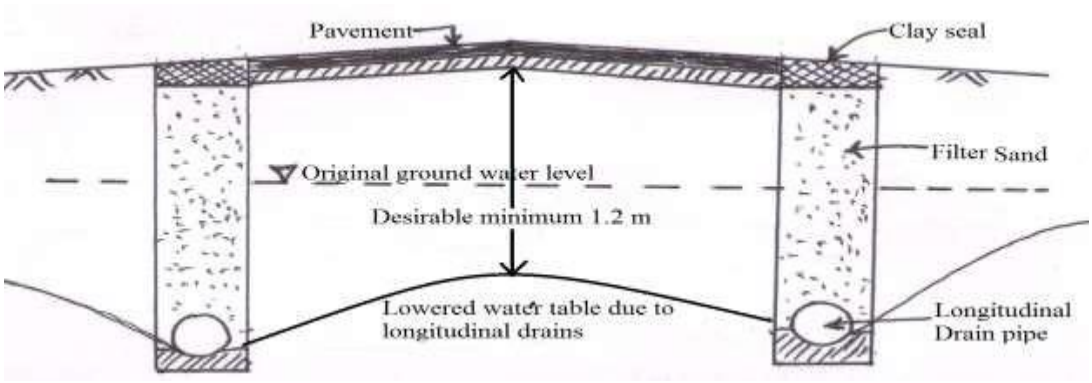

Fig 3: In permeable soils lowering high water table

The water table is lowered by providing additional transverse drains in case of relatively less permeable soil. (See fig-4)

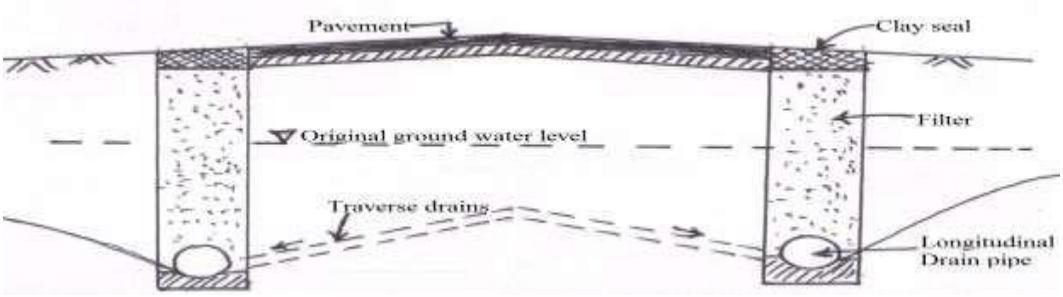

Fig 4: Sub-surface drainage system with Transverse drains

3.4 CONTROL OF CAPILARY RISE

In regions where capillary rise harmful to the subgrade, at there, then controlling capillary rise is more effective than lowering the water table by setting up a layer of granular material of suitable thickness between the subgrade and highest level of surface water table in the course of construction period of the embankment. The thickness of granular material should be of such extent that the capillary water cannot rise above the granular

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material as shown in Fig-5.In place of granular layer, impermeable or bituminous layer may be provided.

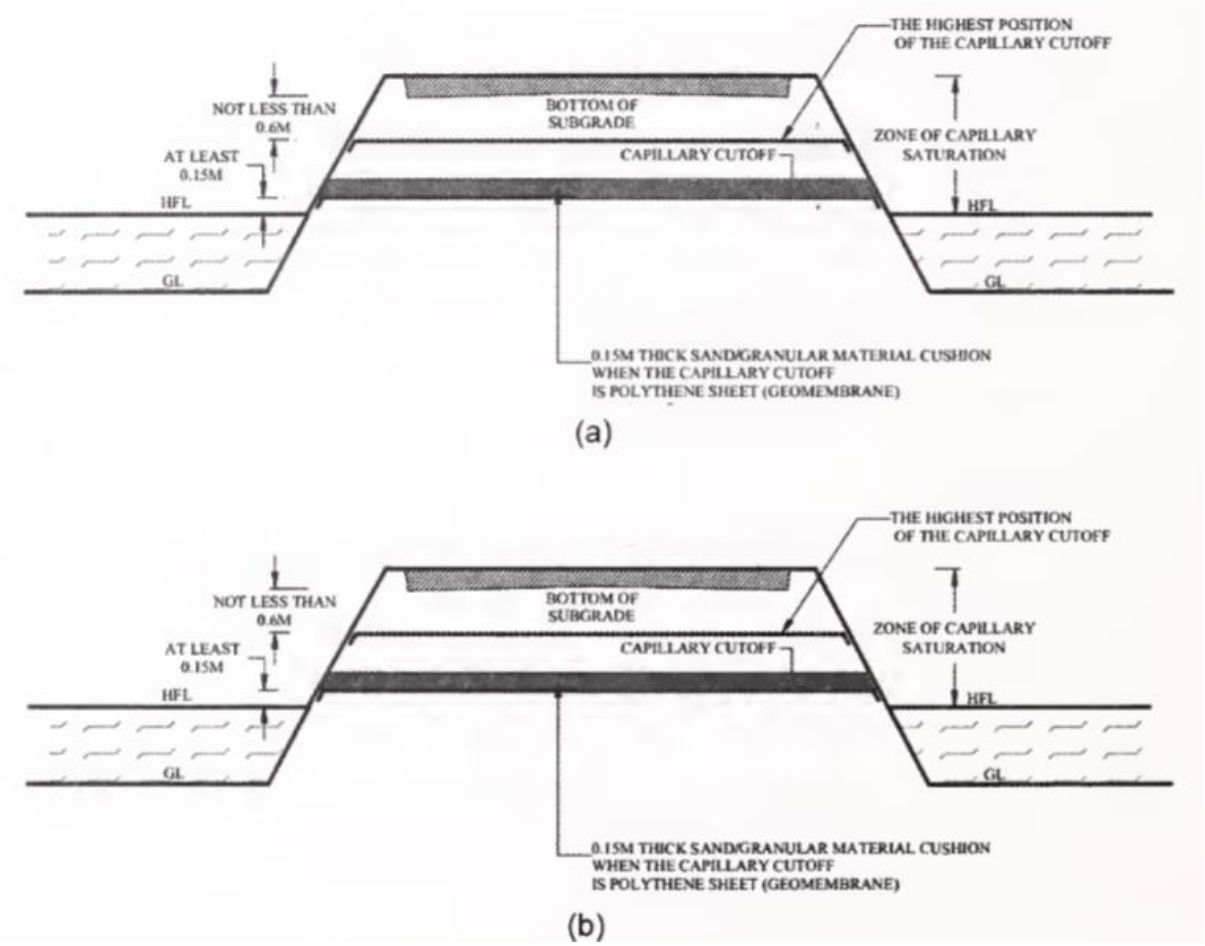

Fig 5: Control of capillary rise by granular layer

IV. CONCLUSION

Based on above study it can be concluded that water from vicinity of a road can affect road in many ways. Accumulation of water on surface can damage the pavement and sub-surface water can affect the subgrade and load bearing capacity of road. But it can be prevented by applying few preventive measures while construction of road or sometime after construction. It can also be prevented by doing some studies of physical factors of area where road is to be constructed and performing constructions accordingly. By these actions we can prevent lot of damages to the road pavement and enhance the life of roads.

V. REFERENCE

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