DRAINAGE ON ROADS

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ABSTRACT:

It has been seen many times that water in pavements is one of the major causes of premature pavement failure. Water may enter the pavement due to various reasons which may be stagnation of water on the surface or faulty construction of the roads leading to seepage of water into the pavement and thus causing damage to the same. Water in the pavement system can lead to moisture damage, modulus reduction and loss of strength. In order to prevent such damages to the pavement, it is essential to provide proper drainage to the roads. The presence of water in a highway layer reduces the bearing capacity of the road, and in doing so it also reduces the structure's lifetime. Highway drainage is used to clear surface water from the highway. . Roads need to be well drained to stop flooding, even surface water can cause problems with ice in the winter. Water left standing on roads can also cause maintenance problems, as it can soften the ground under a road making the road surface break up.

1. INTRODUCTION:

Highway drainage is the process of removing and controlling excess surface and sub-surface water within the right way. This includes interception and diversion of water from the road surface and sub-grade. The installation of suitable surface and sub-surface drainage system is an essential part of highway design and construction.

During rain, part of the rain water flows on surface and part of it percolates through the soil mass as gravitational water until it reaches the ground water below the water table. Removal and diversion of surface water from the roadway and adjoining land is termed as surface drainage, while the removal of excess soil-water from the sub-grade is termed as sub-surface water.

2. NECESSITY OF HIGHWAY DRAINAGE

Highway drainage is important from various view points:

- Excess moisture in soil sub-grade causes instability under the road surface. The pavement may fail due to sub-grade failure. In some clayey soil variation in moisture content causes considerable variation in volume of sub-grade. This sometimes contributes to pavement failure.
- The waves and corrugations formed in case of flexible pavements also play an important role in pavement failure.
- Sustained contact of water with bituminous pavements causes failure due stripping bitumen from the aggregates like loosening of some of the bituminous pavement layer and formation of pot holes.
- The prime cause of failures in rigid pavements by mud pumping is due to the presence of water in fine sub-grade soil.
- Excess water on shoulders and pavement edge causes considerable damage.
- Excess moisture causes increase in weight and thus increase in stress and simultaneous reduction in strength in soil mass. This is one

of the main reasons of failure of earth slope and embankment foundations.

- In place where freezing temperatures are prevalent in winter, the presence of water in sub-grade and a continuous supply of water from the ground water can cause considerable damage to the pavement due to in frost action.
- Erosion of soil from top of un-surface roads and slopes of embankment, cut and hill side is also due to surface water.
- Failure due to hydraulic pressure and failure due to binder stripping can be avoided with the help of proper drainage on roads.

3. ROAD DRAINAGE

Well designed and well maintained road drainage is important in order to:

- Minimize the environmental impact of road runoff on the receiving water environment.
- Ensure the speedy removal of surface water to enhance safety and minimize disruption to road users.
- Maximize the longevity of the road surface and associated infrastructures.

There are many different types of drainage systems with different design features and attributes that can be used to manage flows and treat water quality. Drainage which is needed on the Highways Agency network depends not just on any flood risks and pollution risks identified but the characteristics of the natural water catchment area in which the network is based. The size, shape, gradient and geology of a catchment area are all factors which can influence the type of drainage methods used.

4. SURFACE DRAINAGE

The surface water is to be collected and then disposed off. The water on the surface is first collected in longitudinal drains, generally in side drains and then the water is disposed off at the nearest stream, valley or water course. For the preparation of surface drainage, we should keep in mind various things like

COLLECTION OF SURFACE WATER

Seeing the amount of rainfall and slope a suitable camber is to be provided for collection of surface water. The shoulders of rural roads are constructed with suitable cross slopes so that the water is drained across the shoulders to the side drains. These side drains of rural roads are generally Open (kutcha) drains of trapezoidal shape, cut to suitable cross-section and longitudinal slopes. These sides are provided parallel to the road alignment and hence these are also known as longitudinal drains. In embankments the longitudinal drains are provided on one or both sides beyond the toe; in cutting, drains are installed on either side of the formation.

In urban roads because of the limitation of land width and also due to the presence of footpath, diving island and other road facilities, it is necessary to provide underground longitudinal drains. Water drained from the pavement surface can be carried forward in the longitudinal direction between the kerb and the pavement for short distances which may be collected in catch pits at suitable intervals and lead through underground pipes.

Drainage of surface water is all the more important in hill roads. In hill roads disposal of water is also very important. Certain maintenance problems may arise due to faulty hill road construction.

5. CROSS DRAINAGE

For streams crossing the runways, drainage needs to be provided. Also often the water from the side drain is taken across by these cross drains in order to divert the water away from the road, to a water course or valley in the form of culverts or bridges. When a small stream crosses a road with linear water way less than amount six meter, the cross drainage structure provided is called culvert; for higher value of linear waterway, the structure is called bridge.

6. SUB-SURFACE DRAIN

Change in moisture content of sub-grade are caused by fluctuations in ground water table seepage flow, percolation of rain water and movement of capillary water and even water vapour. Although sub-surface drainage helps in removal of gravitational water, it is designed to keep minimum moisture in sub-grade.

LOWERING OF WATER TABLE

The highest level of water table should be fairly below the level of sub grade, in order that the sub grade and pavements layers are not subjected to excessive moisture. From practical considerations it is suggested that the water table

should be kept at least 1.0 to 1.2 meter below the sub grade. In place where water table is high (almost at ground level at times) the best remedy is to take the road formation on embankment of height not less than 1.0 to 1.2 meter. When the formation is to be at or below the general ground level, it would be necessary to lower the water table.

If the soil is relatively permeable, it may be possible to lower the high water table merely construction of longitudinal drainage trenches with drain pipe and filter sand. If the soil is relatively less permeable, the lowering of ground water level may not be adequate at the center of the pavement or in between the two longitudinal drainage trenches. Hence in addition, transverse drainage may have to provide in order to effectively drain off the water and thus lower the water table up to the level of transverse drains.

7. PREVENTIVE MEASURES

- **CONTROL OF SEEPAGE FLOW**

When the general ground and impervious strata below are slopping, seepage flow is likely to exist. If the seepage zone is at depth less than 0.6 to 0.9 meter from the sub grade level, longitudinal pipe drain in trench filled with filler material and clay seal may be constructed to intercept the seepage flow.

- **CONTROL OF CAPILLARY RISE**

If the water reaches the sub grade due to capillary rise is likely to be detrimental, it is possible to solve the problem by arresting the capillary rise instead of lowering the water table. The capillary rise may be checked either by capillary cut-off of any one of the following two types:-

a) A layer of granular material of suitable thickness is provided during the construction of embankment, between the sub grade and the highest level of sub surface water table.

The thickness of the granular capillary cut-off layer should be sufficiently higher than the anticipated capillary rise with in the granular layer so that the capillary water cannot rise above the cutoff layer.

b) Another method of providing capillary cut-off is by inserting an impermeable or

Bituminous layer in the place of granular blanket.

8. CONCLUSION

Seeing the above properties of drainage and keeping in view the necessity of drainage at surface as well as sub-surface level, drainage plays an important role in highway engineering. As drainage helps in avoiding various types of failures as may be caused by stagnant water on the road surface or its seepage beneath the pavement, it is important to provide drainage facility while construction of roads. Thus to increase the life of the road and to reduce the maintenance cost drainage of roads must be properly provided. Considering the above factors, this paper has been attempted in lieu of highway engineering.

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