STORM WATER RUNOFF MANAGEMENT BY USING PERVIOUS PAVEMENT

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Abstract: In the present scenario, in India the storm water logging on the pavements is becoming the most concerned problem. At the same time in some cities ground water table is getting depleted. The main reason for this problem was not restoration of ground water level. The storm water is allowing to runoff due to the presence of concrete and bituminous pavements.Hence the most effective way of solving this problem is **Managing the Storm Water Runoff** as per our requirements. By this storm water can be stored in the monsoon seasons like a reservoir and then can be used in dry seasons. The storing of storm water can be done by various methods. Pervious pavements can be provided as the mosteffective method to rise of groundwater level. These pavements provide transportation, increases groundwater level, to reduce the runoff, to reduce the problem of water logging on the roads, increase the quality of water. This can be considered to be a green infrastructure practice and also offers many environmental benefits. It can be used in low traffic pathways, Sidewalks etc.

Keywords: Storm water, Runoff, Ground Water table, permeable pavement

1. Introduction

As urbanization increases, the urban drainage system becomes gradually overloaded, with frequent spills to receiving water bodies of polluted water and uncontrolled flood on critical areas. Upgrade or re-design the existing system is not an effective solution because it does not act on the causes. Instead, we can go for ‘upstream’ storm water control. This strategy is aimed to reduce storm water runoff mainly through water retention, detention and infiltration enhancement before in flow to the drainage system. This measure is commonly referred as Storm water Runoff Management Practice. Comparing to other solutions, Permeable pavements are highly effective and easily applicable. They do not need additional space to act on reduction of surface runoff volume and they may be used both for direct water infiltration into the ground and for water retention and detention.

Coarse aggregate: Aggregate is a collective term for the mineral materials such as sand, gravel and crushed stone that are used with a binding medium such as water, bitumen ,Portland cement, lime, etc. to form compound materials such as bituminous concrete and Portland cement concrete. By volume, aggregate generally accounts for 92 to 96 percent of bituminous concrete and about 70 to 80 percent of Portland cement concrete. Aggregate is also used for base and sub base courses for both flexible and rigid pavements Aggregates can either be natural or manufactured.

Bitumen: According to ASTM-Bitumen is a hydrocarbon material. Bitumen is a black or dark- colored (solid, semi-solid, viscous), amorphous, cementitious material that can be found in different forms, such us rock asphalt, natural bitumen, tar and bitumen derived from oil, which is referred to as petroleum bitumen. Currently most of the roads globally are paved with bitumen. Today the world's demand for bitumen accounts for more than 100 million tons per year which is approximately 700 million barrels of bitumen consumed annually. The adhesive property of bitumen binds together all the components without bringing about any positive or negative changes in their properties. Bitumen has the ability to adhere to a solid surface in a fluid state depending on the nature of the surface. The presence of water on the surface will prevent adhesion. Bitumen is insoluble in water and can serve as an effective sealant bitumen is water resistant. Under some conditions water may be absorbed by minute quantities of inorganic salts in the bitumen or filler in it.

Crushed stone: Crushed stone or angular rock is a form of construction aggregate, typically produced by mining a suitable rock deposit and breaking the stones. Crushed natural stone is also used similarly without a binder for riprap, railroad track ballast, and filter stone. It may be used with a binder in a composite material such as concrete, tarmac or asphalt concrete.

2. Materials and Methodology

The following are the materials used in the study

1. Coarse aggregate
2. Bitumen
3. Crushed stone
4. Under drain pipe

Pervious pavement design: Permeable pavements are which allow water to infiltrate through it. Therefore, they show a high porosity structure with open and interconnected spaces where water and air can pass through. Infiltration must be fast enough to avoid the possibility of significant ponding for most rainfall events. Although they are often referred as porous pavements in literature, it is important to notice that all pavements present some level of porosity. Thus, it is more accurate to use the terms permeable or pervious difference is the aggregate void rate, which must be such that it allows the base to perform as a water reservoir.

Objectives of permeable pavement:

- To provide an effective design of the pervious pavement by considering the both structural and hydrological considerations.
- To make installation process more convenient and economical.
- To make the pavement design more durable than present designs.
- To provide filtration of storm water along with the percolation.
- To solve traffic jam problems in highly developed areas due to problem of water logging.
- To reduce the imbalance in natural ecosystem.
- By using permeable paving system, we can collect the rainwater/ Storm water by this system and store to ground water table or by constructing a tank.
- Permeable pavement can reduce the concentration of some pollutants either physically (by trapping it in pavement or soil), chemically (bacteria and other micro-organisms can breakdown and utilize some pollutants), or biologically (plants that grow in some types of pavements).

Tests

The following are the tests conducted on the materials:

Tests on coarse aggregate:

1) Crushing test
2) Impact test
3) Abrasion test

Tests on Bitumen:

1) Ductility test
2) Softening point test
3) Penetration test

3. Methodology

Laying of permeable pavement :

Sub grade: It is the soil layer beneath the pavement which bears the design load, receives infiltration water, and is subject to ground water infusion due to seasonal fluctuationsor upward capillary migration. Sub grade bearing capacity, uniformity, and permeability are key factors in determining various pavement layers thickness.

Sub base: The base layer consists of a grades aggregate foundation that transfers the pavement load to the sub-grade in controlled radiating manner. Heavy- duty pavements or weak sub-grade, usually require an additional layer of base material, called a sub-base, which also consists of a clan but coarser-graded aggregate layer. Both aggregate base and sub-base typically extend beyond the pavement edge to provide lateral support and to prevent uneven sub-grade loading.

Base course: The base course in permeable pavements in a layer of material in an asphalt road way, race track or sporting field. It is located under the surface layer consisting of the wearing course and sometimes an extra binder course. If there is a sub base course, the base course is constructed directly above this layer. Other wise, it is built directly on top of the sub-grade. Typical base course thickness ranges from 100 to150 mm (4-6 in) and is governed by underlying layer properties.

Surface course: The surface course of a flexible pavement protects the underlying base course from traffic while providing adequate tire friction, generating minimal noise in urban areas. It also gives suitable light reflection for the night time driving. These surfaces are provided either by a bituminous film coated with stone or by thin asphalt layer.

4. Data Analysis:

4.1 Crushing Test Result:

S.NO	WEIGHT OF SAMPLE (W1) grams	SAMPLE PASSED IN 2.36 MM (W2) grams	SAMPLE RETAINED ON 2.36MM (W3) grams	CRUSHING VALUE
1.	3600	630	2970	17.6%

The crushing value obtained is **17.6%**

Impact Test Results:

S.NO	WEIGHT OF SAMPLE (W1) grams	SAMPLE PASSED (W2) grams	SAMPLE RETAINED (W3) grams	IMPACT VALUE
1.	650	70	580	10.76%

The impact value obtained is **10.76%.**

Abrasion Test Result:

The abrasion value of the aggregate is **27.6%**

Bitumen Tests Results:

Grades of Penetration test

S.NO	GRADE OF BITUMEN	PENETRATION VALUE
1.	S 20/30	Lies between 20 and 30
2.	S 40/60	Lies between 40 and 60
3.	S 50/70	Lies between 50 and 70
4.	S 60/80	Lies between 60 and 80
5.	S 100/150	Lies between 100 and 150
6.	S 150/220	Lies between 150 and 220

Penetration test results:

S.NO	SAMPLE	INTIAL READING	FINAL READING	PENETRATION VALUE
1	1	31	149	118
2	2	33	55	22

The penetration value is **55mm**
The Bitumen used is **S 50/70**

Ductility test results:

Source of paving bitumen and penetration grade	Min Ductility value (cm's)
Assam Petroleum A25	5
A35	10
A45	12
A65, A90 and 200	15
Bitumen from sources other than Assam petroleum S35	50
S45, S65 and S90	75

The ductility value obtained is **52cm.**

5. CONCLUSIONS

This is an Innovative project, describes about the laying of permeable pavement by using grid pattern.

The entire project describes about the tests to be conducted for laying a bituminous permeable pavement which can be economical and used at various application like sidewalks, parking lots, low traffic areas and gardening paths. This type of permeable pavements can increase the rate of penetration of runoff water. Comparing to other runoff management practise these pavements can be more effective as we consider the economic factors. As area considered these pavements provide more utilization area than the other practices.

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