Water Absorbing Pavements by using Porous Concrete

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Abstract - *Water Absorbing pavement is a new technique in Pavement construction. Through this technique we can find a solution for the low ground water level, effective management of storm water runoff, Agricultural problems, etc. Pervious concrete can be introduced in low traffic volume areas, walk ways, sub base for concrete pavements, inter locking material etc. Pervious concrete as a paving material have the ability to allow water to flow through itself to recharge ground water level and minimize surface storm water runoff. This property of porous concrete reviews its applications and engineering properties, including environmental benefits, strength and durability. By replacing a part of cement with flash, then it results the safe disposal of waste material. Hence it acts as an eco-friendly paving material.*

***Key Words*: Pervious Concrete, Storm Water, Ground water Recharging, Light Weight, Waste Material Management, Strength, Durability…**

1. INTRODUCTION

Porous pavement is a storm water drainage system that allows rain water and runoff to move through the pavements surface to storage layer below, with the eventually seeping into the underlying soil. Permeable pavement is beneficial to the environment because it can reduce storm water volume, treat the storm water quality, and replenish the ground water supply and lower air temperatures on hot days. Due to increased void ratio, water conveyed through the surface and allowed to infiltrate and evaporate, whereas conventional surfaces will not do so. A porous pavement surface therefore becomes an active participant in hydrological cycle: rain fall and snow melt are conveyed back through soil into ground water. And also this pavement technology creates more efficient land use by eliminating the need for retention ponds, swales, and other storm water management devices. In doing so, pervious concrete has the Ability to lower overall project costs on a first-cost basis. In previous concrete, carefully controlled amounts of water and cementitious materials are used to create a paste that forms a thick coating around aggregate particles. A pervious concrete mixture contains little or no sand, creating a substantial void content. And that's why it is also known as No fines Concrete. Using sufficient paste to coat and bind the aggregate particles together creates a system of highly permeable, Interconnected voids that drain quickly. For porous concrete, water permeability is the main specification requirement instead of its strength and continuity of the open pores is the main concern in the production of porous concrete. The high water permeability of porous concrete makes it to be considered as an environmentally friendly concrete. When the component materials of porous concrete, environmentally unfriendly Portland cement is partially replaced by supplementary cementitious materials, such as fly ash, ground granulated blast furnace slag and coarse aggregates by recycled concrete aggregate, then the porous concrete could be considered as environmentally concrete for sustainable construction.

1.1 What is a no-fine concrete

Pervious concrete is a structural concrete pavement with a large volume (15 to 35percent) of interconnected voids. Like conventional concrete, its made from a mixture of cement, coarse aggregates, and water. However, it contains little or no sand, which results in a porous open-cell structure that water passes through readily.

1.2 Environmental Benefits

- Reduce the surface runoff of the storm water
- Pervious concrete pavement reduces or eliminates runoff and permits natural treatment of runoff water
- By collecting rainfall and allowing it to infiltrate, groundwater, aquifer recharge, water table level is increased
- Pervious concrete is a light weight pavement material
- Effective utilization of waste material such as flyash makes this technique more eco- friendly
- Pervious concrete pavement is ideal for protecting trees in a paved environment

•Although high-traffic pavements are not a typical use for pervious concrete, concrete surfaces also can improve safety during rainstorms by eliminating ponding

2. PREVIOUS RESEARCH

M. Admute, A. V. Gandhi, S. S. Adsul, A. A. Agarkar,(April-2017),"Permeable Pavements: New Technique For Construction Of Road Pavements in India"

In this paper they summarize literature on permeable pavements, highlight current trends in research and industry, and to recommend future areas of research and development. Permeable pavements have a base and sub base that allow the movement of storm water through the surface and hence reduce runoff, this effectively traps suspended solids and filters pollutants from the water. Permeable pavement control storm water at the source, reduce runoff, reduce cost and improve water quality by filtering pollutants in the substrata layers and increase subsurface water level. And also deals with make use of industrial waste fly ash in construction, by partial replacement of cement.

Jeet Yadu(2016)"Permeable Pavement & its Application-A Case Study"

He summarized literature on study of construction and application of such a pavement which is permeable in nature. The problem related to scarcity of water arriving due to increasing area of paved surfaces has been considered. A detailed study has been made in Raipur city and views are focused in the direction of water conservation through enhancing the ground water recharge. It also deals with the advantages and disadvantages of this pavement system. Permeable pavement are not so complex and are easy to install ,they have many advantages like ground water recharging, storm water management and applications of permeable pavement is depends on various aspects such as climate ,area of application, traffic volume and load.

Stephen.A.Arhin, Rezene, Wasi Khan,(December-2014),"Optimal Mix Design for Previous Concrete for Urban Area"

In this paper they developed and tested five design mixes of previous concrete to identify the appropriate mix which provided the maximum compressive strength with acceptable permeability rate and flexural strength for the district of Colombia. They conducted five designs mixes using three different types of compaction method such as self-consolidating, half ridding, and standard proctor hammer. They concluded that, the standard Proctor Hammer Compaction method appears to be Optimum procedure for preparing the previous concrete and having compressive strength 3500psi and permeability in between the range of 57.8. And 299.5 in/hr.

3. MATERIALS

3.1. Cement

53 Grade OPC provides high strength and durability to structure because of its optimum particle size distribution and superior crystalized structure. Being a high strength cement, it provides numerous advantages wherever concrete for special high strength application is required, such as in the construction of skyscrapers, bridges, flyovers, chimneys, runways, concrete roads and other heavy load bearing structures.

3.2. Coarse Aggregate

Coarse aggregate was used as a primary ingredient in making the permeable concrete. Larger aggregates provide a rougher surface. Recent uses for pervious concrete have focused on parking lots, low-traffic pavements, and pedestrian walkways. For these applications, the smallest sized aggregate feasible is used for aesthetic reasons. Coarse Aggregates are those that are retained on the sieve of mesh size 4.75 mm. Their upper size is generally around 7.5 mm. Gravels from river bed are the best coarse aggregates in the making of Common Concrete.

3.3 Water

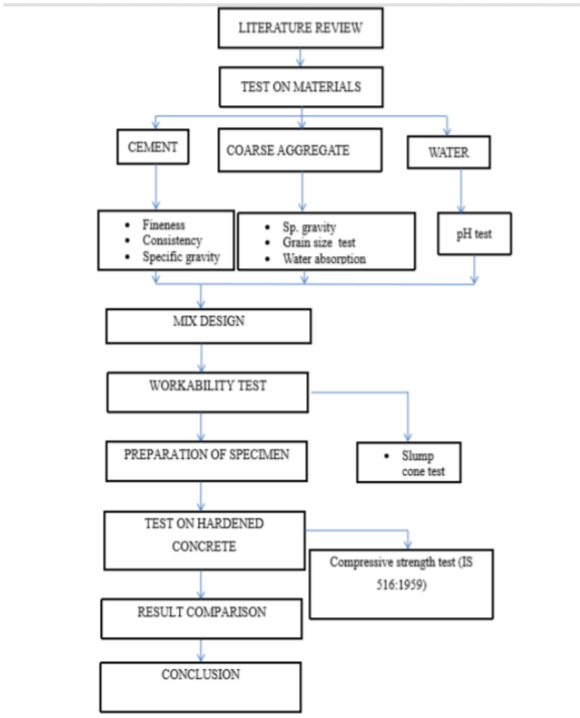
Water to cementitious materials ratios between 0.34 and 0.40 are used routinely with proper inclusion of chemical admixtures, and those as high as 0.45 and 0.52 have been used successfully. The relation between strength and water to cementitious materials ratio is not clear for pervious concrete because unlike conventional concrete, the total paste content is less than the voids content between the aggregates.

3.4 Admixture

Chemical admixtures are used in pervious concrete to obtain special properties, as in conventional concrete. Because of the rapid setting time associated with pervious concrete, retarders or hydration-stabilizing admixtures are used commonly. Here we used two different admixtures such as fly ash and conplast sp 500. Fly ash The burning of harder, older anthracite and bituminous coal typically produces Class F fly ash. This fly ash is pozzolonic in nature, and contains less than 20% lime (CaO). It is a fine powder which is byproduct from burning pulverized coal in electric generation power plants and It is a pozzolan, a substance containing aluminous and silicious materials that forms cement in the presence of water. Class F fly ash, with particles covered in a kind of melted glass, greatly reduces the risk of expansion due to sulphate attack as may occur in fertilized soils or near coastal areas.

Conplast sp 500 Conplast SP500 complies with IS: 9103:1999 and BS: 5075 Part 3 .Conplast SP500 conforms to ASTM-C-494 Type 'G. It is the high performance water reducing and super plasticizing admixture. Conplast SP500 is based on Sulphonated Naphthalene Polymers and is supplied as a brown liquid instantly dispersible in water. Conplast SP500 has been specially formulated to give high water reductions upto 25% without loss of workability or to produce high quality concrete. The main advantages of this admixture are improved workability, increased strength, improved quality, higher cohesion and chloride free.

4. METHODOLOGY



5. ADVANTAGES & DISADVANTAGES

5.1 Advantages

1.Effective surface Runoff Management

Permeable paving surface allows water to percolate though itself. They are effective in managing runoff from paved surfaces, thus providing local flood control.

2. Control over Pollutants

Permeable paving surfaces keep the pollutants in place in the soil or other material underlying the roadway, and allow water seepage to groundwater recharge while preventing the stream erosion problems

3. Ground Water Recharge

Permeable pavement contributes a lot in to ground water recharge.

4. Reduction in Cost

It reduces the need for traditional storm water infrastructure, which may reduce the overall.

5. Effective waste management Utilization of waste materials such flyash

5.2 Disadvantages

1. Traffic Loads and Volumes

Observations differ on whether low or medium traffic volumes and weights are appropriate for porous pavements.

2 Lack of Standard Test Method

This subject is a matter of research over the past time, and hence, it does not still have a standard method for testing.

6. MAINTENANCE

1. The overall maintenance goal for a permeable paving system is to prevent clogging of the void spaces within the surface material.

2. The surface must not be sealed or repaved with non-porous materials if it is to continue to function and to be counted towards meeting the maximum allowed parking requirement

3. Sand and salt must not be applied to areas with porous pavements

4. Depending on the system, occasional sweeping or vacuuming of debris will be required to ensure the void spaces do not clog

5.Educational signage should be used wherever porous pavement is installed as a teaching tool for the public and as a reminder of maintenance obligations

6. In preparing the site prior to construction, drainage of surrounding landscaping should be designed to prevent flow of materials onto pavement sur- faces

7. Soil, rock, leaves, and other debris may infiltrate the voids and hinder the flow of water, decreasing the utility of the pavement

8. Landscaping materials such as mulch, sand, and topsoil should not be loaded on pervious concrete, even temporarily

7. CONCLUSIONS

From the experimental results of investigation, the following conclusions can be made. Porous concrete allows water passes through it. It is not composed of fine aggregates. Aggregate having size more than 20mm cannot be used, because of larger voids cause settle down of cement slurry. And aggregates having size less than 10mm can give better results. Effective utilization of waste product (fly ash),and making it as a eco-friendly concrete. Lesser percentage of fly ash gives high strength than higher percentage. Higher percentage of fly ash weaker in cement bonding. Conplast Sp 500 is good admixture, and it increases the strength and bonding between cement and aggregates.

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