EXPRIMENTAL ANALYSIS OF PERMEABLE CONCRETE AND ITS APPLICATION OVER CONVENTIONAL METHOD.

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Abstract— The purpose of this paper is to summarize literature on permeable pavements, highlight current trends in research and industry, and to recommend future areas of research and development. Permeable paving is a range of sustainable materials and techniques for permeable pavements with a base and sub base that allow the movement of storm water through the surface. In addition to reducing runoff, this effectively traps suspended solids and filters pollutants from the water. The goal is to 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, thus one way to harvest storm water. In Maharashtra, fly ash is generated in huge quantity in thermal power stations. The disposal of fly ash is also a major socio-economic problem. So the use of fly ash up to 10-30% as a replacement to cement can overcome this problem. The use of fly ash will reduces the construction cost and also solve disposal problem. Porous pavement is unique and effective means to meet growing environmental demands. By capturing rainwater and allowing it to seep into the ground, this pavement technology creates more efficient land use by eliminating the need for retention ponds, swell, and other costly storm water management devices.

Key words – Permeable pavement, Sustainable material, Storm water, Filter Pollutants, Economy, Retention ponds.

Retention ponds.

1. Introduction

India is a developing country and safety of roads is still a concern hence to overcome major issues like safety, economy, and sustainable use the method of pervious concreting has proved to be a boon. Pervious concrete pavement is a unique and effective means to address. Impervious surfaces have mostly used in the decline of watershed integrity in urban and urbanizing areas. These surfaces are mostly used to serve vehicular traffic, but the maximum part of these surfaces or pavements such as driveways, walk paths, etc. experiences minimal traffic, whereas on the other hand main roads and traffic lots are sized to accommodate heavy vehicular traffic. Hence the large impervious surfaces lead to higher peak stream flows which causes bank erosions and other similar water related problems.

Permeable pavement is the best solution for problem of increased storm water runoff and decreased stream water quality. This is an emerging technique constructed for low volume roads and parking lots and an alternate storm water management techniques hence serves both the purposes. Permeable pavement are also designed to achieve water quality and quality benefits by allowing movement of storm water through pavement surface. The water passes through voids in pavement materials and provides the structural support as conventional pavement. That's why permeable concrete can be served as an alternative to conventional methods of road and pavement construction.

These roads and pavement have ability to reduce urban runoff and trap pollutants. Also it provides opportunity to reduce the impact of urbanization on receiving water systems by providing at source treatment and management of storm water. Permeable pavement system have been shown to improve storm water quality by reducing the pollutants concentration and pollutants loading of suspended solids heavy metals and hydrocarbons.

1.1 PERMEABLE PAVEMENT SYSTEM

1.1.1 Applications

Permeable pavement systems are suitable for wide variety of applications like commercial, residential, industrial , yet for light duty and less usage, even though this systems can be used for much wider range of use. The areas where the polluted water is available in the excess i.e. ground contaminated water the permeable pavement is constructed and infiltrate water is allowed to discharge in to suitable drainage system the general application of permeable concrete pavements are as follows :

- For residential driveways, footpaths, gardens, parks, highway shoulders, access driveways.
- Parking lots
- Logging paths, bicycle paths
- Land irrigations

1.2 Pervious Concrete

Pervious concrete is a mixture of Portland cement, coarse aggregate or gravel, and water. Unlike conventional concrete, pervious concrete contains a void content of 15 to 35 percent (average of 20 percent) that is achieved by eliminating the finer particles such as sand from the concrete mixture. This empty space allows water to infiltrate the underlying soil instead of either pooling on the surface or being discharged as runoff. Sidewalks and parking lots are ideal applications for pervious concrete. The structural strength of pervious concrete, although typically less than standard concrete mix designs, can easily withstand the relatively light loads generated by pedestrian and bicycle traffic. The loads placed on pervious concrete in parking lots can be much more substantial and require consideration when selecting the concrete mix and pavement thickness. While the structural strength of porous concrete can be increased by adding larger amounts of cement, the porosity will decrease, thus decreasing infiltration rates.

1.3 Pavers

Permeable interlocking concrete pavers (PICP) and clay brick pavers (PICBP) as well as concrete grid pavers (CGP) are similar in installation and function but are made from different materials. PICPs are solid concrete blocks that fit together to form a pattern with small aggregate-filled spaces in between the pavers that allow storm water to infiltrate. These spaces typically account for 5 to 15 percent of the surface area. PICBP as the same as PICPs except the material is brick instead of concrete. With CGPs, large openings or apertures are created by the CGPs lattice-style configuration. These openings, which can account for 20 to 50 percent of the surface area, usually contain soil or grass, though small aggregates can be used. While CGPs have larger openings than PICPs and PICBPs, they are not designed for use with a stone reservoir but instead can be placed directly on the soil or an aggregate base. As such, the infiltration rate of PICPs and PICBPs is much higher than that of CGPs. Plastic turf reinforcing grids (PTRG) are made of interlocking plastic units with large open spaces. PTRG are generally used to add structural strength to topsoil and reduce compaction.

1.4 Need of permeable concrete pavement

- To solve traffic jams problems arising due to water logging
- To neutralize the natural ecosystem.
- By using the technique of permeable concrete, we can collect the rainwater/stormwater and can be further stored.
- It is used to reduce the concentration of specific kind of pollutants either physically or chemically or biologically.

Life Span

Life span of porous concrete roads or pavement depends upon the size of air voids in the media. Due to more voids, there is more possibility of oxidation, so durability is less. It can be expected that the life span of permeable pavement is shorter than the impermeable pavement due to oxidation, deterioration by runoff and air filtration.

1.5 Future Research

Till date, the application of permeable pavement has been limited to some specific applications like parking lots, low volume roads. Future research may allow for new and innovative applications such as village roads, airport runways. Permeable pavements generally have low strength but by increasing its strength and improving the properties it can be used for construction heavy traffic roads like Urban roads, Highway Shoulders, etc. Generally in densely populated area less land space exists. So that roads are not properly arranged and also surface drainage facilities are not provided properly. So in rainy seasons the problems of water clogging arises. So For these areas permeable pavement can become a good option. In parks or gardens jogging tracks or walkways are mainly constructed of compacted soils. But in rainy seasons these roads becomes muddy which cannot be used for their intended purpose. This causes various problems to pedestrians. So for this type of situations permeable pavements can be proven advantageous.

Future research on effects of contaminants that remain in permeable pavement system should be taken under consideration. Also the impact of this system on environment after long time are unclear. Before all of this research has to be done to improve the lifespan of system as well as to reduce the cost of permeable pavement. If these problems were solved this system can be installed in more

1.5.1 *Related Works* A sustainable drainage system is designed to reduce the potential impact of new and existing developments with respect to surface water drainage discharges. The term sustainable urban drainage system is not the accepted name, the 'Urban' reference having been removed so as to accommodate rural sustainable water management practices. AASHTO Guide for Design of Pavement Structures[1] provides a comprehensive set of procedures which can be used for the design and rehabilitation of pavement; both rigid and flexible and aggregate surfaced for low volume roads. The guide has been developed to provide recommendation regarding the determination of the pavement structures. The procedure for design provide for the determination of alternate structure using a variety of material and construction procedures. Beeldens A et.al.

1.5.2 Stated that to ensure the combination of the bearing capacity and the water storage of the pavement, a special design is applied where both parameters are assigned respectively to the base and the sub base layer. In her paper describes various thickness to be adopted under different foundations. She also determined the thickness based under different loading conditions. Benjamin O.

1.5.3 Evaluated the performance of four permeable pavement systems with respect to durability, infiltration and water quality after 6 years of daily use. All four permeable pavement systems showed no major signs of wear. All rainwater infiltrated through these systems, with almost no surface runoff. Their study stated that water quality of infiltration is better than the surface runoff from the asphalt parking area. For all systems copper, zinc concentrations are below toxic level. Motor oil was detected in 89% of samples from asphalt runoff but was much lower in infiltration. E. Z. Bean et.al.

1.5.4 Studied the infiltration rate of permeable pavements. Asphalt surfaces have greatly increased the amount of pollutant carrying runoff entering surface waters. To overcome this, permeable pavement can be installed to allow water to infiltrate, thus reducing runoff and acting as filter. They conclude that maintenance using a vacuum sweeper should be performed once in a year for CGP sites filled with sand. Removing top 1.3 cm layer of material accumulated in void spaces improve the infiltration rates. Also PICP lots should be sited away from the areas with free fine particles

2. CONCLUSION

This paper describes about the permeable pavements, its types, needs and it's present applications. This paper also looks at various literature and studies conducted on permeable pavement systems. The water quality and life span aspects are outlined. This research or systems are changing the way of human development.

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