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A REVIEW PAPER ONWATER PERMEABLE ROAD PAVEMENTS

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ABSTRACT

Considerable research has been conducted on environmentally sustainable development. This has leads to the use of pervious concrete in place of conventional concrete. Pervious concrete has been used as an effective method for handling and reducing negative environmental impacts. The voids are creates in the concrete for passing the water from concrete, also reducing the problem of water logging and make a road surface skid resistance.

There is a analyzing the properties and characteristics of pervious concrete. The performance of pervious concrete was compared with the material used for the construction of concrete road pavements. The analysis was undertaken by comparing the characteristics of the pervious and normal concrete. The tests were conducted to determine the properties of concrete like compression strength, flexural strength and also permeability of concrete.

It was found that pervious concrete pavements possesses some positive features like increased skid resistance and high permeability but most importantly it requires the high strength for highly trafficked areas. Pervious concrete has proven to have properties suitable for use in low volume traffic areas. If pervious concrete pavements can be implemented, it will have various positive effects on the environment.

Keywords*: Pervious concrete, storm water, urban road, retention ponds, cost.*

I. INTRODUCTION

Considerable research has been conducted on environmentally sustainable development. This has leads to the use of pervious concrete in place of conventional concrete. Pervious concrete has been used as an effective method for handling and reducing negative environmental impacts. The voids are creates in the concrete for passing the water from concrete, also reducing the problem of water logging and make a road surface skid resistance.

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II. LITERATURE REVIEW

Javier Castro (Graduate Research Assistant),“ Portland cement concrete pavement permeability performance Nov 2010”**-**The above paper states an experimental study on transport proprieties of concrete are controlled by the characteristics of its pore network. Total porosity, pore size, pore connectivity, and pore saturation all influence the measured transport coefficients (Garboczi 1990; Bentz et al. 1999).Water absorbing concrete was first used in the 1800s in Europe as pavement surfacing and load bearing walls. Cost efficiency was the main motive due to a decreased amount of cement. It became popular again in the 1920s for two storey homes in Scotland and England. It became increasingly viable in Europe after WWII due to the scarcity of cement. It did not become as popular in the US until the 1970s.In India it became popular in 2000.The first Water absorbing placement in the IndianMetro Area

was in Sugar Creek, MO in November 2005. Since that time about 30+ pavements have been placed and many lessons learned about what makes Water absorbing concrete "good". Herein, are the current guidelines that have been learned and adjusted.[1]

JayeshkumarPitroda (Asst. Prof. B.V. M Engg College)"Evaluation Of Sorptivity And Water Absorption Of Concrete With Partial Replacement Of Cement By Thermal Industrial Waste (Fly Ash)"(8 Aug 2014),-The above paper states an experimental study on the properties of Water absorbing concrete by partial replacement of cement by thermal industrial waste. The mix design was carried out for M20 grade concrete as per IS 10262:2009[2]

Darshan S. Shah," Water absorbing Concrete: New Era For Rural Road Pavement"(Issued on 8th, August 2014)-The above paper states study on using pervious concrete as road construction material relatively new concept for rural road pavement, with increasing problem in rural areas related to low ground water level, agriculture problem. His report focus on pavement application of concrete which also has been referred on pervious concrete, permeable concrete , no fine concrete , gap graded concrete and enhanced porosity concrete. [3]

NavyaGundu" Water absorbing Concrete: New Era For Rural Road Pavement" [Sep. - Oct. 2015]-In this paper, an innovative model that can transport water pass into the pavement has been suggested in this direction. Different combinations of Cement, water and Course aggregate with different maximum size and gradation were adopted for mixing process to make approximately at M20 grade concrete.M20 grade concrete is achieved with a w/c ratio of 0.4 to 0.45 Course aggregate of nominal size 20 mm and with a cement to Course aggregate ratio of 1:4. Its density and flexural strength were observed to be 21 kN/m3and 35 kg/cm2respectively.A pavement slab suitable for low traffic volume roads is designed as per IRC SP62: 2004 which allows storage of water upto 125 lit./m3of concrete pavement giving time for infiltration thereby reducing the runoff and recharging the ground water or sufficient time for transport of it. A perforated pipe can be provided at center of the pavement above sub-base such that it collects the water stored in concrete and drains it to the required treatment plant or a fill pit. This however needs further investigation and trials before practical implementation.[4]

KoliNishikant"Manufacturing of Concrete Paving Block by Using Waste Glass Material"[June 2016]-The above paper statesan experimental work of using a different type of concrete for pavement work over conventional method of using cement concrete. He has added fine crush glass which leads to high strength of concrete in order produce concrete block. He has replaced the waste glass with the fine aggregate which provide pore in concrete to large extent and also increasing the strength of concrete in the porous form and the special concrete prepared by him he has used for making concrete pavement block.

Concrete paving blocks has been mostly used in many countries for quite some time as a specialized problem-solving technique for providing pavement in areas where normal types of construction are less durable due to many operational and environmental suitability. This technology has been implemented in India in construction, a decade ago, for specific requirement works such as footpaths, parking areas etc. but now being adopted extensively in different uses where the normal construction of pavement using cement concrete technology is not feasible or desirable. Concrete blocks were first introduced in Holland in the fifties as replacement of paver bricks which had become limited due to the post-war building construction boom. These blocks were rectangular in shape and had more or less the same size as the bricks. During the past five decades, the block shape has steadily evolved from interlocking to non-interlocking to fully interlocking shapes.[5]

III. MATERIALS AND METHODS

Sieve Analysis

Sieve analysis is a method of determining the grading of a particular aggregate or a mixture of aggregates. The sieve analysis is carried out in a hand operating sieves to provide a more consistent result and achieve much greater accuracy. The sieves used vary in size but consecutive sieves used are smaller in aperture as you move down the stack. The aggregate was dry sieved due to the large particle size. Before sieving starts the aggregate particles were air dried to ensure that no small particles contaminated the larger sieves and to prevent the smaller sieves from becoming clogged. The aggregate was collected in boxes at the bottom of the pan. Half was discharged and the other

half was riffled again. This process was continued until the specifications for sampling were meet and an adequate quantity of material collected for the sieve analysis.

Concrete Tests
The tests that we have conducted to provide a complete picture of all the properties of the concrete in both the wet and hardened state.For this reason, it was proposed that the testing incorporate aggregate testing to determine the effect of the aggregate shape on the performance of the previous concrete. This was followed by conducting workability tests like the slump, VEBE and compaction factor tests on the wet concrete sample.

The hardened concrete tests proposed for the project were compressive strength and indirect tensile tests, modulus of rupture and elasticity and the skid resistance test. This testing includes determining the void ratio and calculating the permeability of the previous concrete.

Compressive Strength
The compressive strength tests are conducted to ensure a maximum strength is achieved by the concrete mix. Casted cylinder and cube testing are methods of determining the compressive strength of the prepared concrete. The cylinder testing is as per an Australian Standard for testing compressive strength, while cube testing is as per an British Standard. Both methods of determining compressive strength will be used as it may be easy to achieve a good result when using the cylinders and cubes.

The cube test, due to the method by which it is implemented, should give a more stable test specimen than the cylinders. This test will determine the strength of the concrete sample along the entire length of the sample and eliminate problems occurred with the edge aggregate dislodging or failing. The cube method usually determines a concrete strength increased by 10 and 40 percent in comparison to the equivalent cylinder test.

Compaction Factor Test
The compaction factor test is used to determine the extent with which the fresh concrete compacts itself when allowed to fall without the application of any external compaction. The compaction obtained from the free falling is compared with the same sample under standard compaction practices (that is 3 layers, each tamped by 25 times). The sample falls from the initial cone and is captured in a second cone. It is then allowed to fall into a test cylinder with a diameter of 150 mm and height of 300 mm.

Slump Test
The slump test is a method of testing the fresh concrete for calculating the workability of concrete which is prepared. It is a simple method of determining if different batches of concrete are the same. This is determined if the same constituents in the same proportions do not vary the characteristics of the concrete sample.

The slump is determined by filling concrete in a slump cone with fresh concrete in three layers. For each layer tamping is done 25 times by tamping rod. The slump cone is removed and the vertical subsidence of the fresh concrete sample is measured. Pervious concrete has very little cohesion due to its structure and may collapse on removal of the cone resulting in a poor result with little value.

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IV. NON-PAVEMENT APPLICATIONS OF PERVIOUS CONCRETE

Pervious concrete has been used by European countries in many different building situations. It has been utilized for cast-in-situ load-bearing walls in houses, multi-storey and high-rise buildings, as prefabricated panels and steam-cured blocks.

A prominent use of pervious concrete in Europe is in tennis court applications. The only variation from a normal mix is the slightly smaller aggregate used to provide a smoother playing surface. The permeability of the pervious concrete reduces the time taken for water to drain and the surface to be playable.

Water and Power Resources Services in America successfully tested the use of drains and draintiles constructed from pervious concrete under the hydraulic structures. This application made it possible to reduce the uplift pressure on the structures and to drain ground water from beneath infrastructure like sewer pipes.

V. PAVEMENT APPLICATIONS OF PERVIOUS CONCRETE

Pervious concrete pavements were developed after some success with open graded asphalt and their applications in parking lots and service roads. Open graded asphalt is a mix of even graded coursed aggregate, small amounts of fines and a bituminous material. This road surfacing has a relatively high void ratio or porosity normally ranging between 18 and 25 percent.

Parking lots are another application for pervious concrete, made using a pervious concrete wearing course and several underlying permeable layers. The underlying permeable layers consist of three layers varying from a sandy material to a 37 mm aggregate. The primary task of all the permeable layers is to act as a reservoir for retaining water until it permeates into the soil. This is an effective method of controlling water runoff in situations where flash flooding frequently occurs. To eliminates the problems of downstream flooding caused by traditional impervious concrete surfaces and to reduce the runoff.

VI. CONCLUSION

A major difference found was that the pervious concrete deformation is more than the normal sample of concrete before failure. This shows that a pervious pavement has the ability to deform under the loading of traffic. The deformation should not affect the performance of the pavement providing its capacity is not exceeded.

Pervious concrete is a viable material that has the potential to replace the use of normal concrete pavements in situations where heavy traffic is limited, such as car parks, residential streets and driveways. More applications may be possible if methods of reducing the raveling that occurs within the top aggregate are found.

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The compressive strengths obtained from the different aggregate samples test shows that the shape of the aggregate particles used can significantly affect the strength of the concrete.

The increases skid resistance that the pervious concrete possesses is an extremely valuable characteristic that increases the safety of all road users. Pervious concrete has many positive shows that make its use applicable to society. However, it is in its early stages of development that requires more research before it is readily available and used more widely.

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