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AN EXPERIMENTAL INVESTIGATION ON PERVIOUS CONCRETE

[1]Dr.B.PRASAD , [2]TAYYAB, [3]SRUTHI, [4]VINAY,[5] KALYANI
[1]PROFESSORDEPARTMENT OF CIVIL ENGINEERING CMR COLLEGE OF ENGINEERING & TECHNOLOGY
2,3,4,5 B-Tech, DEPARTMENT OF CIVIL ENGINEERING CMR COLLEGE OF ENGINEERING & TECHNOLOGY

Abstract:
Current climatic changes are occurring due to various human and industrial activities.In particular, the effects of urbanization and growing threat of global warming have likely caused increasing precipitation in many geographic regions. Pervious concreteis a unique sort of concrete with a high porosity used for concrete flatwork applications that permits water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and permitting groundwater recharge. In addition, Pervious Concrete can reduce the absorption of solar radiation and urban heat storage potential which can lead to temperate urban conditions, and thus protecting the environment and health and safety of living things. However, Pervious Concrete requires regular maintenance to prevent any clogging of the pores by sediments and vegetation. The design procedures are developed based on researchperformed by the collective pervious concrete community in the United States, andfrom across the world. The most common design is for parking areas and are aided by the included computer program, which optimizes mixtures for local materials. This type of concrete contains little or no fine aggregates such as sand, and is referred to as 'No fines' concrete. Proportion of cement, aggregate and water incorporated using the India Standard Code (IS: 10262: 2009). By using aggregates of a selected size and adjusting the concrete mix proportion, strength and abrasion resistance can be significantly improved. Keywords: Pervious concrete, Mix proportion, Permeability, Infiltration, Porosity.

INTRODUCTION:

History Of Pervious Concrete

The initial use of porous concrete was in the United Kingdom in 1852 with the construction of two residential houses. Cost efficiency seems to have been the primary reason for its earliest usage due to the limited amount of cement used and no or little amount of fine aggregates. It was not until 1923 when porous concrete re surfaced as a viable construction material. This time it was limited to the construction of 2-storey homes in areas such as Scotland, Liverpool, London and Manchester. Useof porous concrete in Europe increased steadily, especially in the World War II era. Since porous concrete use less cement than conventional concrete and cement was scare at that time. It seemed that porous concrete was the best material for that period. Porous concrete continued to gain popularity and its use spread to areas such as Venezuela, West Africa, Australia, Russia and the Middle East (2007). After World War II, porous concrete became wide spread for applications such as cast-in-place load-bearing walls of single and multistorey houses and, in some instances in high- rise buildings, prefabricated panels, and stem-

cured blocks (1995). Also applications include walls for two-story houses, load-bearing walls for high-rise buildings (up to10 stories) and infill panels for high-rise buildings (Tennis et al. 2004). Europeans have also used pervious concrete for paving. Stories have passed down through the years which tell us that soldiers didn't mind walking on pervious roads during World War II because their feet would remain dry. After World War II, Pervious concrete was brought to the United States. With population growth, continual urbanization hassled to an increase of impervious surface areas, which block the percolation of precipitation from rainfall and snowdown through the ground. This increases the potential for excess surface runoff, which can lead to downstream flooding, bank erosion and possibly transport of pollutants into potable water supplies. On the other hand, permeable pavements havethe ability to reduce runoff volume and improve water quality. Indeed, they can store stormwater runoff until infiltrating into soil or conveyed downstream in the stormwater management system by a drain. For this reason, many communities are now exploring their use as an alternative low impact development design for stormwater control measures. Such permeable pavement systems can contribute to solving drainage problems and reducing the risk of flash flooding, resulting from continuous urban developments. pervious concrete is a special type of concrete characterized by an 2 interconnected pore structure and high void content typically inthe range of 15 to 35% by volume. The use of pervious concrete may reduce flooding

FIG:-1

By the definition, pervious concrete is a mixture of gravel or granite stone, cement, water, little to no sand (fine aggregate). When pervious concrete is used for paving,the open cell structures allow stormwater to pass through the pavement, into the underlying soils. In other words, pervious concrete helps to protect the surface of the road and is eco-friendly Also, pervious concrete is light in weight, (1600 - 2000 kg/m3), due to presence of voids. Pervious concrete has an ample range of applications, even though its prime use is in pavements which are in residential roads, low water crossings, low volume pavements, sidewalks and pathways, parking areas, alleys, and driveways, slope stabilization, sub-base for conventional concrete pavements etc., Pervious concrete is also a unique and effective means to face important environmental issues and sustainable growth. When it rains, pervious concrete automatically acts as a drainage system, thereby putting water back to the groundwater table. Design mix is defined as the process of selecting the appropriate proportioning of ingredients that are decided after trial and error of various options in laboratory. Pervious concrete has a greater 3 advantage in many applications. But still, it has its own

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limitations which must be put in effective consideration when planning its use. Structurally when higher permeability and low strength are required, then pervious concrete can be used. The primary considerations when determining a mixture design are ⁾ Strength required for a particular pavement section design. ⁾ Porosity to produce the desired Infiltration

FIG:-2 **MATERIALS AND METHODOLOGY:**

cement shall conform to IS:8112-1989 and the designed strength of 28 days shall be minimum 43 MPa or 430 kg/sqcm. Even though 43 Grade cements' early strength is less as compared to that of 53 Grade, with time it will attain the same ultimate strength as that of 53 Grade cement. Unless a project requires very high strength cement, the use of 43 Grade OPC is generally recommended in general civil construction work such as residential, commercial and industrial structures. It is used in RCC works,

FIG:-3

preferably where the grade of concrete is up to M-30. It is also extensively used in the manufacture of pre-cast items such as blocks, pipes, tiles etc., and also in asbestos products such as sheets and pipes. Since OPC 33 has mostly been phased out in the country, OPC 43 is nowadays largely used in plastering, flooring and other non structural applications where OPC 33 was earlier being used. The physical and chemical characteristics of OPC 43 Grade Deccan Cement very comfortably meets BIS requirements. Particularly, the compressive strength of Deccan Cement OPC 43 is significantly higher than the standards specified by BIS. AGGREGATES-. The aggregates provide about 75percentage of the body of the concrete and hence its influence is extremely important. They should therefore meet certain requirements if the concrete is to be workable, strong, durable and economical. The aggregate must be proper shape, clean, hard, strong, and well graded. Coarse Aggregates: The aggregates which is retained over IS sieve 4.75mm is termedas coarse aggregate. The coarse aggregates 17 may be of following types Crushed graves or stone obtained by crushing of gravel or hard stone. Uncrushed gravel or stone resulting from the natural disintegration of rocks. Partially crushed gravel obtained as product of blending of above two types. The normal maximum size is gradually 10-20 mm; however, particle sizes up to 40mm or more have been used in self compacting concrete. Regarding the characteristics of different types of aggregate, crushed aggregates tend to improve the strength because of interlocking of angular particles, while

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rounded aggregates improved the flow because of lower internal friction. Locally available coarse aggregate having the maximum size of 20mm was used in this work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested as per IS: 383-1970. Locally available crushed stone coarse aggregates of nominal size 10mm and 20mm are used for the trial.

Properties of cement:

S.No	Properties	Values
1	Cement	OPC 43 grade used
2	Specific gravity	3.12
3	Fineness	9%
4	Normal consistency	32%
5	Initial setting time	30 mins
6	Final setting time	600 mins

Chemical composition of cement:

Silica-(SiO_2)	17%to 25%
Alumina (Al_2O_3)	3%to 8%
IronOxide-(Fe_2O_3)	0.5%to 6%
Lime-(CaO)	60%to 67%
Magnesia-(MgO)	1%to 3%
SulphurTrioxide-(SO_3)	1%to 3%
Miscellaneous	1%

IMPLEMENTATION:

This document is organized into six chapters. The Introduction of Pervious Concreteis described in Chapter 1 and the research findings in Chapter 2 are meant to support the design decisions in subsequent sections but only contain a brief summary of the available information. More comprehensive information can be obtained through reports, papers, and thesis listed in the selected reference section. The materials required and the methodology is described in Chapter 3 and Chapter 4 presents information and calculation to aid determining engineering properties with testing.Chapter 5 discusses the results and discussion. Conclusion is explained in Chapter 6. 3.2.2 EXISTING SYSTEM: The Greater Hyderabad Municipal Corporation (GHMC) launched a project called 'Pervious Concrete Road Pavement' at Katedan Sports Complex near Rajendranagar Circle. The pavement is designed to eliminate the possibility of water stagnation since there have been complaints of regular concrete not being ableto stop water flow and permeate, they have come up with this project. The entire parking area and pavement is covered with this kind of material, as well as inside the compound. The pavement was laid to a length of 20m and width of 6m

FIG:-4

The beautification of Durgam Cheruvu is on the top priority of the civic body in Hyderabad. Pervious concrete is used as footpath over a length of 233m at Durgam cheruvu cable bridge (Hyderabad). It is provided with a mesh at the top layer, uponmesh it is filled with Pervious concrete

PROPOSED SYSTEM:

Mix Proportion for M30 Grade of Pervious concrete and the type of cement used is OPC(Ordinary Portland Cement) 43 grade and the maximum nominal size of aggregate is 20mm and the water content which depends upon maximum

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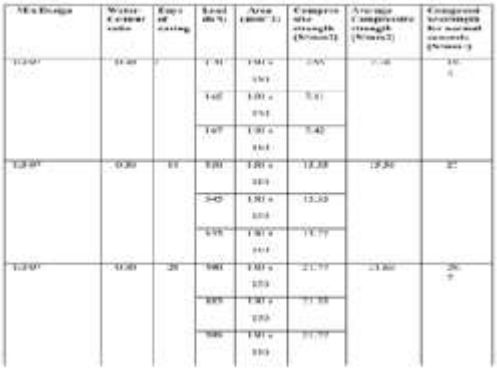
size of aggregate is obtained from Table-2 of IS 10262:2009.We will perform compressive strength test and based on the result obtained we can implement it in areas of low compressive strength

FIG:-5

RESULTS:



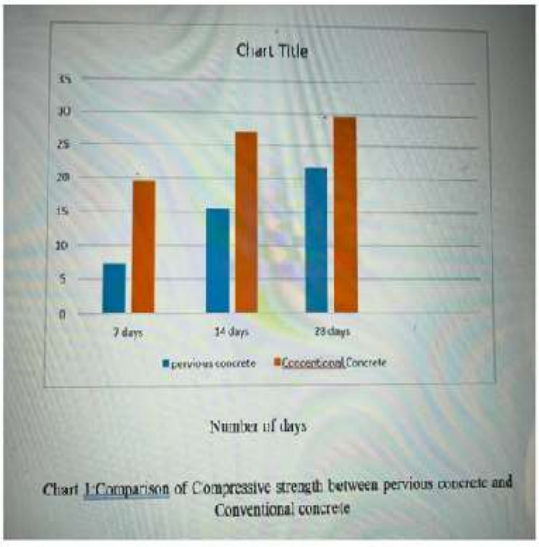
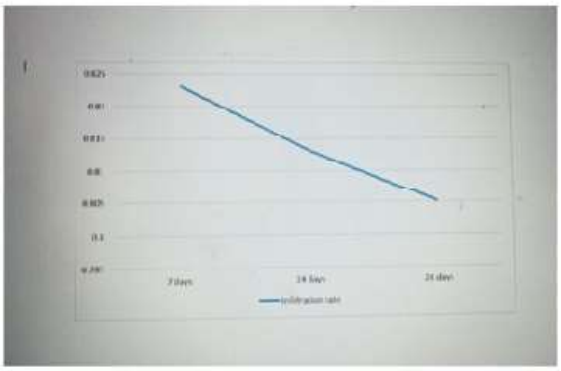


Chart 1:Comparison of Compressive strength between pervious concrete and Conventional concrete

INFILTRATION TEST RESULTS:::



Number of days

CONCLUSION:

Objective:To determine the effect of material proportion on the engineering properties of the pervious concrete. 1.To cast the concrete cubes the mix design is very essential. 2.The void ratio and unit weight are two important parameters of pervious concrete in the context of mix design. 3.Manual compaction with tamping rod is preferred if necessary. 4.The mechanical vibration shouldn't be provided since it leads to slurry settlement. 5.The porosity is directly proportional to the void ratio. As the void ratio increases porosity also increases. 6.The pervious concrete needs proper mix design. The proportion of cement, water, coarse aggregate and water-cement ratio have been calculated with the help of Indian standard code (IS: 10262: 2009). Objective: Investigate the performance characteristics of the pervious concrete such as compressive strength, and infiltration rate. 1.By reduction of fine aggregate compressive strength of the pervious concrete decrease. 2.40% compressive strength on 7 days and 38.13% compressive strength on 14 days and 27% of compressive strength decreased on 28 days by the reductionof 100% sand. 3.Comparing the compressive strength difference between both normal

concrete and pervious concrete, it can be concluded that regardless of any cement-aggregate ratio and curing days, the result still shows a lower compressivestrength parameter for pervious concrete in comparison to concrete. 4.The infiltration characteristics of pervious concrete were affected by the curing factor. 5.The infiltration rate during the 7th curing day is slightly higher than the infiltration rate at the 28th curing day. 6.Infiltration increases by reducing the fine aggregate in pervious concrete. 7.Compressive strength and permeability are inversely proportional to each other. As the porosity increases, compressive strength decreases. 8.Pervious concrete pavement is unsuitable for heavy-duty roads. 9.Currently, pervious concrete gives low compressive strength. Therefore, it is used for parking lots, sidewalks, and on highway shoulders and median. 10.Although the compressive strength may limit the applications of the pervious concrete but since high permeability is core purpose in the development of pervious concrete. It may applicable in the 41 area where lower compressive strength required like pathways or sidewalks etc.

FUTURE SCOPE: This project focused on mix design and compression test on pervious concrete, but it was noticed that there is no specific Mix Design for pervious concrete to be set as standard in any working conditions or any country. Although some tests like infiltration, compressive strength have been found in common in all of the applications. However there needs to be more research work to be done to examine that how this pervious concrete can be widely used to increase the ground water table by studying the soil nature, properties etc. which can help to meet the water demand and overcome water crisis which is troubling all over the world. Pervious concrete can be used for many numbers of applications, but its primary usage is in pavement industry. It has a wide scope for further, which will be a promising roadway materialin future to recharge ground water.

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