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Study on Porous Concrete

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Abstract – Pervious concrete or enhanced porosity concrete has a strictly gap graded coarse aggregate phase and little or no fine aggregates so as to facilitate the formation of an interconnected network of pores in the material. The material is designed with cementitious material content just enough to coat the coarse aggregate particles so that a configuration that allows the passage of water at a much higher rate than conventional concrete. The pervious concrete has many advantages that improves city environment, recharges the ground by rain water and could be used as pavement for light vehicles, pedestrian pathways, parking lots, also it reduces the tire pavement interaction noise etc. the effectiveness of a pervious concrete pavement depends as the intrinsic permeability of the mass, and normally this is defined by the porosity. It has been observed that porosity alone is an inadequate indicator of the permeability of pervious concretes, since the permeability depends on pore sizes, geometry and connectivity also. This paper presents a new method for determining the permeability of pervious concrete and provides design methodology to prepare pervious concrete based on experimental characteristics test values of pervious concretes.

Keywords:- Porous Concrete, Permeability, Durability.

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INTRODUCTION

Porous pavement is a storm water drainage system that allows rainwater and runoff to move through the pavement's surface to a storage layer below, with the water eventually seeping into the underlying soil. Permeable pavement is beneficial to the environment because it can reduce storm water volume, treat storm water quality, replenish the groundwater supply and lower air temperatures on hot days. Typically, between 15% and 25% voids are achieved in the hardened concrete, and flow rates for water through pervious concrete are typically around 480 in./hr (0.34 cm/s, which is 5 gal/ft²/ min or 200 L/m²/min), although they can be much higher. Due to the increased void ratio, water is 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 the hydrological cycle: rainfall and snowmelt are conveyed back through soils into groundwater.

PROCEDURE:-

Aggregate:-

Fine aggregate content is limited in pervious concrete, and coarse aggregate is kept to a narrow gradation. Commonly-used gradations of coarse aggregate include ASTM C 33 No. 67 (¾ in. to No. 4), No. 8 (⅜ in. to No. 16), and No. 89 (⅜ in. to No. 50) sieves [in metric units: No. 67 (19.0 to 4.75 mm), No. 8 (9.5 to 2.36 mm), and No. 89 (9.5 to 1.18 mm)]. Single-sized aggregate up to 1 inch (25 mm) has also been used. ASTM D 448 also may be used for defining gradings. A narrow grading is the important characteristic. 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 aggregate size 89 (⅜-in. or 9.5-mm top size) has been used extensively for parking lot and pedestrian applications, dating back 20 years or more in Florida. Figure shows two different aggregate sizes used in pervious concretes to create different surface textures.

WATER:-

Water-to-cement ratios between 0.27 and 0.36 are used routinely with proper inclusion of chemical admixtures, and those as high as 0.40 have been used successfully. The relation between strength and water-to-cement ratio is not clear for pervious concrete, because unlike conventional concrete, the total paste content is less than the voids content between the aggregates. Therefore, making the paste stronger may not always lead to increased overall strength. Water content should be tightly controlled. The correct water content has been described as giving the mixture a sheen, without flowing off of the aggregate. A handful of pervious concrete formed into a ball will not crumble or lose its void structure as the paste flows into the spaces between the aggregates (see Figure 5). Water quality is discussed in ACI 301. As a general rule, water that is drinkable is suitable for use in concrete. Recycled water from concrete production operations may be used as well, if it meets provisions of ASTM C 94 or AASHTO M 157. If there is a question as to the suitability of a water source, trial batching with job materials is recommended.

CASTING:-

The cement and aggregate are mixed in mixer. Then add water by W\C ratio of concrete. Mix it properly in the concrete mixer and then after the mixture of concrete cast in cubes for taking tests of compressive strength, infiltration rate test.

Mix proportion of porous concrete:-

Mix	Size of coarse aggregate	Coarse aggregate (kg/m3)	w/c ratio	Cement (kg/m3)
P1	12.5	1500	0.3	300
P2	16	1564.81	0.35	350
P3	20	1600	0.4	350

ADVANTAGES:-

- There is a wide range of styles, colors and sizes of block pavers hence there are also many design possibilities.
- Block paving is considered to be more attractive than basic, plain surfaces for driveways.
- Individual blocks can be lifted and replaced if they are damaged, or stained with oil, diesel or petrol spillages.
- Because paving blocks are manufactured rather than cut from natural stone, block sizes tend to be very accurate and uniform.
- No specialist machinery is required (as there is with tarmacadam surfaces) hence small areas should not be proportionately more expensive per sq.m, as when there are high set-up costs.
- Concrete block paving is cost effective when compared to clay pavers or natural stone blocks such as granite setts.
- There is a wide choice in the depths of concrete block pavers from 50 mm to over 100 mm. This can make block paving suitable for both domestic and commercial applications.

DISADVANTAGES:-

- Concrete block paving can be expensive if specialist blocks such as tumbles or those imitating natural stone sets are chosen.
- Inadequate and poorly prepared sub-bases can result in block paving surfaces sinking in high use areas such as those which regularly take the weight of cars.
- Areas without properly installed edging restraints to picture frame the driveway and provide integrity to the surface can cause the blocks move, opening up gaps.
- Weed and moss growth can occur between the blocks as airborne seeds settle into the sand. This can look unsightly and needs to be cleaned out regularly.
- The colour of some less expensive block pavers can fade over time due to exposure to Ultra Violet light.
- Because no expensive machinery is required to lay block paving, many block pavers tend to be individuals working from home rather than established businesses which can provide a professional service backed up by credible warranties. Low machinery set up costs can invite inexperienced and unqualified paving installers into the industry.

APPLICATION:-

- Pervious Concrete as a Road pavement
- Low-volume pavements
- Sidewalks and pathways
- Residential roads and driveways
- Parking lots

- Noise barriers
- Slope stabilization
- Hydraulic structure
- Swimming pool decks

FUTURE SCOPE:-

The present investigation addressed the strength and drainage aspects of pervious concrete mixes and also the influence of CS as a FA. However, other aspects like resistance of pervious concrete mixes against chemical attack, clogging behavior with the use of geo-textiles etc., be addressed. 2. A detailed study is required to know the effects of aggregate gradation with other types of aggregate to obtain higher strength and adequate engineering properties of pervious concrete. 3. The effect of compaction energy is one of the key factors to produce high quality durable concrete. This aspect has to be studied in detail to determine the relationship between compaction energy, porosity and strength parameter. 4. Attempts can also be made to improve the 28-day flexural strength of the pervious concrete mixes using different additives like silica fume, keeping the permeability factor in mind.

RESULT:-

Mix	Aggregate size(mm)	Compressive strength (MPa)		Infiltration rate (m/s)
		7days	28days	
P1	12.5	12.85	13.58	1.121
P2	16	9.25	9.79	2.267
P3	20	8.43	9.13	2.481

Three types of pervious concrete were prepared with various size of coarse aggregate and no fines are used. From the results shown in Table 2, it can be clearly concluded that as the coarse aggregate size increases, the voids percentage increases but the compressive strength of the material drops down. This can be attributed to the fact that these pores are well connected since there is no sand is used. The reason for increase in porosity with increase in coarse aggregate is poorpacking density and higher pore sizes. The strength of the pervious concrete can be improved by the addition of the pervious concrete can be improved by the addition of five aggregate but this will read to reduction in porosity.

CONCLUSION:-

This paper gives an in depth study of pervious concrete though it appears a simple method of casting and laying. The larger the size of coarse aggregate, the larger the total void ratio. Cube compressive strength of pervious concrete drops down as the size of coarse aggregate is increased.

The aspect of clogging of pervious concrete is discussed in detail, and expression to compute effective infiltration rate is also given.

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