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NO-FINES CONCRETE BY USING CELLULOSE FIBER

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ABSTRACT

No-fines concrete consists solely of normal Portland cement, water and coarse aggregate. It has been used in Europe and the United Kingdom since the 1930s. No-Fines concrete consists of an agglomeration of coarse single sized aggregate covered with a thin layer of cement paste approximately 1.3 mm thick. The purpose of this project is to assess the suitability for no-fines concrete to be used for the construction of low Traffic Pavement and to compare the properties of no fine concrete by using cellulose fiber.

Keywords : No-fine concrete, cellulose fiber, pervious concrete, low traffic volume road.

I. INTRODUCTION

No-Fines concrete is a mixture of cement, water and a single sized coarse aggregate combined to produce a porous structural material. there is presence of air voids which may be responsible for the lower strength and its lightweight nature. No-fines concrete has many different names including zero-fines concrete, pervious concrete and porous concrete.It consists of coarse single sized aggregate covered with a thin layer of cement paste approximately 1.3 mm thick.This form of concrete has the ability to allow water to permeate. While it is seen as a new and emerging application, pervious concrete does have its disadvantages. It has Poor performances in cold regions, arid regions, regions with high Portland cement pervious concrete is a discontinuous mixture of coarse aggregate, hydraulic cement and other cementitious materials, admixtures and water. By creating a permeable surface, storm water is given access to filter through the pavement and underlying soil, provided that the underlying soil is suitable for drainage. The purpose of this project is to assess the suitability for no-fines concrete to be used for the construction

of ***Low Traffic Pavement.*** This assessment will include investigating current literature on the topic and conducting some mix designs and standard concrete testing on conventional concrete and no-fines concrete to determine and compare their properties.

HISTORICAL BACKGROUND

The use of no fine concrete is extremely limited as only recently been developed for only particular application. However, Firstly NFC has been used in Australia.The earliest known application of no-fines concrete found in England in 1852 with the construction of two residential houses and a sea groyne 61 m long and 2.15 m wide .

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The use of no-fines concrete became increase during the material shortages after World War II, for cast in place load bearing walls of single and multi-storey buildings. In recent years no-fines concrete were used as a load bearing material in high rise buildings up to 10 storey's.

OBJECTIVES

The purpose of this project is to determine the suitability of no-fines concrete to be used for the construction of road pavements and paving blocks. The testing on conventional concrete and no-fines concrete to determine the suitability and comparsion of their properties.

In order to achieve these results, the following objectives had to be met:

1.To determine the strength, durability, skid resistance and cost analysis.

2.To find out the suitability of NFC as construction material for buildings.

3.To improve the strength of NFC blocks and Conventional concrete blocks.

4. To find out Suitability of NFC for pavement and non pavement material.

5. To identify the most economical mix design for blocks.

SCOPE OF INVESTIGATION

No fine concrete is modified and innovative type of concrete. (also known as pervious concrete) is a Eco-friendly and low cost material which can be used for the construction of several types of structures with great benefits. Low volume traffic parking pavements, footpaths and walkways and gardens have been built on a large scale in many developed cities and their performance has been found excellent. It also help to reduces the runoff from the pavement areas hence reduce load on drainage systems. India is facing a typical problem of ground water table falling at a fast rate due to reduced recharge of rainwater into subsoil.

II. LITERATURE REVIEW

General

Through a extensive research on literature it was found that there has only a limited amount of work is completed on this topic.There is some information relating to no-fines concrete in general. But very little relating to its use in pavement applications, the different applications do not significantly affect the properties of no-fines concrete. The following sections relate to the properties of no-fines concrete that have already been investigated.

V.M.Malhotra The initial use of no-fines concrete was in the United Kingdom in 1852 with the construction of two residential houses and a sea groyne. The density of no-fines concrete using conventional aggregates varies from 1602 to 1922 kg/m3. that the use of mechanical vibrators and ramming is not suitable for this type of concrete.

Ghafoori (1995) He undertook a considerable amount of laboratory investigation to determine the effective used of no-fines concrete as a paving material. There appeared to be only a negligible difference in strength between the different curing methods. No-fines concrete with a compressive strength in excess of 20 MPa when using an aggregate-cement ratio of 4:1.

Sai Sindhu He determined that the compressive strength of no-fines concrete increases with age at a similar rate to conventional concrete. The no-fines concrete specimens tested had aggregate-cement ratios varying from 6:1 to 10:1.

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And the compressive strength of NFC varying with different proportional with the aggregate-cement ratio. He concluded that the most plausible explanation for the reduced strength was caused by the increased porosity of the concrete samples.

Heather J. Brown He investigated the effect on the properties of no-fines concrete with the addition of sand. He found that when a small amount of sand was added to the mixture, the compressive strength of the concrete increased from 10.3 MPa to 17.2 MPa. With more than 30 percent sand the concrete started to display the properties of conventional concrete and did not have sufficient voids necessary for water flow.

Paul James Harbor(2005) He had found that variation of strength using different size of aggregate. This showed that no fines concrete acts in a manner similar to what was found in the conventional concrete sample. A major difference found was that the no-fines concrete deformed more than the conventional sample before failure. This shows that a no-fines pavement has the ability to deform under the loading of traffic.

III. METHODOLOGY

Introduction

Pervious concrete can be defined as an open graded or “NFC” concrete that allows rain water to percolate through surface to the subsoil. The principal ingredients are quite similar to conventional concrete: aggregate, Portland cement, admixtures, fine aggregate (optional), and water. The main difference is the percentage of void space within pervious concrete. Pervious pavement provides a solution for many highly developed urban areas where an excessive amount of contaminated water is diverted into storm and sewer systems and left untreated before entering natural water sources such as rivers and streams.

Material Properties

Aggregate :- We are used single size coarse aggregate of size 10mm and 20mm. The size of the aggregate also has an important role in pervious concrete. Increasing the percent amount of larger aggregates will increase the void ratio in pervious concrete, but will decrease the compressive strength. The aggregate generally used in no-fines concrete applications usually ranges from 10 mm to 20 mm.

Fig no 1- 10 mm size aggregate Cement-:

The history of cementing material is as old as the history of engineering construction. It is believe that the early Egyptians mostly used the cementing material, obtained by burning Gypsum. Not much light has been thrown on cementing material, used in the construction of the cities of Harappa and Mohenjodaro. The most common cement used is OPC available are 33 grade, 43 grade and 53 grade.The Ordinary Portland Cement 53 grade conforming to IS: 12269-1987 is used. The tests conducted on cement such as specific gravity, consistency tests, setting time tests. . Water-to-cement ratios can range from 0.27 to 0.30 with ratios as high as 0.40. Careful control of water is critical.

Admixture-:

Cellulose fiber

Cellulose fibers are fibers made waste material from textiles industries and wastage paper which can be obtained from the bark, wood or leaves of plants, or from a plant-based material. Besides cellulose, these fibers are compound of hemicelluloses and lignin, and different percentages of these components are responsible for different mechanical properties observed. The main application of cellulose fiber in textile industry as chemical filter, and fiber-reinforcement composite, due to their similar properties to engineered fibers, being another option for biocomposites and polymer composites. The cellulose fiber is raw material for this study.

Fig no 2- Cellulose Fibre used in concrete

Water-:

Water is an important ingredient of concrete as it actually participate in the chemical reaction with cement. Hence it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked very carefully. Potable water pH value between 6 to 8.5 is generally considered satisfactorily for mixing and curing and concrete. Water use for mixing and curing should be free from particulate materials as per clause 4.3 of IS:456-2000. Water cement used is 0.45 for M25 grade of concrete.

Air voids content-:

The cement paste is only a thin layer and does not contain air bubbles, so the voids are obtained through mostly interconnected spaces of the aggregate particles. The air content is by definition the sum of the available voids between the aggregate particles and any entrained or entrapped air within the cement paste. The void content is dependent upon the aggregate-cement ratio and thus varies greatly. The amount of void space is dependent on the amount of water needing to permeate through to the sub-base.

Shrinkage:-

Drying shrinkage in no-fines concrete is comparatively small but does vary depending on the aggregate-cement ratio. A reduction in the aggregate-cement ratio means there is more cement paste available to undergo volumetric contraction and shrinkage.

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MIX DESIGN

General

Mix design is defined as the process of selection the suitable ingredients and determine their suitable proportional to achieve the required strength and durability.

Cube mould:

Standard size cube mould are kept position on surface and then apply the oil inside of all side of cube. To prevent the sticking of concrete.

Mixing-:

Prepared concrete mix well by hand or mechanical mixer with water cement ratio 0.4 to 0.45.

Placing-:

Place the concrete in cube up to under beneath of cubes and spread it along sides with the help the trovel.

Compaction-:

Hand compaction is done for all cubes with the help the rod each layer should be well compacted. Each layer should be tamped 15 times with the help of rod.

Curing-:

The mould should remove after 24 hrs of casting. The curing are depend on testing days such as 7, 14, 28 days.PH (6-7.5) maintained water should be used for curing.

Testing-:

The testing of concrete plays an important role in controlling and confirming the quality of cement concrete cubes for it compressive strength.

Compression Test

The cubes are tested after curing by using CTM machine to apply the load and check the compressive strength of cubes.

following formula is used to calculate compressive strength

Compressive Strength = Total Failure Load/Area of the Cube N/mm^2

Following are the mix design done for 1m^3 as per IS 10262:2009.

Table No 1-: ***Mix design for M25 concrete***

Grade of mix design	25
Charateristic compressive strength Kg/cm^2 at 28 days	15 to 25 N/mm^2
Nominal max size of aggregate - mm	20mm
Type of course aggregate	Crushed

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Type or Brand of cement	OPC 53Grade
Type of Exposure	Moderate
Water cement ratio (fig I - IS 10262 - 2009)	0.4 To 0.45
Water required per Bag as IS	186 Litr
Slump	100mm
DETERMINATION OF CONTENT for 1 Cum	
W/C ratio	0.4 to0.45
Cement Content	413.33 Kg
Coarse Aggregate	702.12Kg
Cellulose fiber	2.5Kg

IV. RESULT AND DISCCUSION

The compressive strength is vary with design proportional and water cement ratio. The selected water cement ratio for testing is 0.4 to 0.45. The water cement ratio have greater impact on compressive strength of concrete. The sized of aggregate we used is maximum sized 20mm, it also impact on permeability and strength of concrete. The ultimate strength of concrete is between 19 to 25 N/mm. The permeability rate is varying with different sized of aggregate.

V. CONCLUSIONS

i) In this investigation the slump of NFC is found to be 100mm.

ii) The effect of water/cement ratio have greater impact on ultimate strength as 0.4 water content gives more strength .lower water cement ratio more the compressive strength.

iii) It increased skid resistance that the no-fines concrete possesses is an extremely valuable characteristic that increases the safety for all road users. No fines concrete has many positive attributes that make its useful benefits to society.

IV) No-fines concrete is a variable material that has the potential to replace the use of traditional concrete pavements in situations where heavy traffic is limited, such as car parks, residential streets and driveways.

V) The use of water content more than 0.45 causes the flow of cement to the bottom of specimen and causes segregation at the top of specimen.

VI) No fine concrete by eliminating fines becomes more suitable to meet the pavement area requirement such as to reduce the storm water runoff, to increase the ground water level, to eliminate the costly storm water management practices.

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