

Properties of No Fine Lightweight Concrete

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Abstract: *The main objective of this project is to develop Normal concrete and no fine concrete and simultaneously motivate the people about no fine light weight concrete. No fine light weight concrete is a type of concrete that incorporates lightweight aggregates to reduce its density and overall weight. Its commonly used in construction to improve insulation, reduce dead load on structures and enhance fire resistance. The main focus of this concrete is to low density and thermal conductivity, ultimately there Is reduction of dead load, faster building rate in construction and lessen haulage and handling costs. This focuses on tests such as Compressive test only. The results obtained are interesting and useful to compare the results with that of traditional concrete. No-fine concrete is produced by using ordinary Portland cement, coarse aggregates, and water. This concrete is tested for its properties, such as slump value, porosity and compressive strength. The results showed that compressive strength of no-fine concrete is grade M20 and water/cement ratio is 0.36 there are compressive strength is 7.93 N/mm². The normal concrete has a density of 2200 to 2600 kg/m³ and no fine concrete has a density of 1600 to 2100 kg/m³. In the present study, an attempt has been made to partially replaced coarse aggregate and fully replaced fine aggregate by lighter weight material to achieve concrete of lighter density. This concrete is mix with different ratios of aggregate/cement and it helps find different properties like physical and mechanical.*

Keywords *Lightweight Concrete, No Fine, Compressive Strength, Properties, Density.*

1. INTRODUCTION

Light-weight concrete has become more popular in recent years owing to the tremendous advantages it offers over the conventional concrete. Modern technology and a better understanding of the concrete have also helped much in the promotion and use of light-weight concrete. A particular type of light-weight concrete called structural light-weight concrete is the one which is comparatively lighter than conventional concrete but at the same time strong enough to be used for structural purposes. No-fines concrete also known as pervious, permeable, or enhanced porosity concrete (EPC) is a special type of highly porous concrete. No-fines concrete usually consists of Ordinary Portland Cement (OPC), uniform sized coarse aggregate and water ratio. The lack of fine aggregate makes no-fines concrete there is only coarse aggregate, cement, and water. It has lighter and more porous material than traditional concrete. Often generally coarse aggregate size 10 to 20 mm are used. No-fines concrete naturally allows porous for better air circulation and drainage, which makes an ideal material for construction in areas prone to heavy rainfall or flooding. No-fines concrete is becoming popular because of some of the advantages it possesses over the conventional

concrete. The single sized aggregates make a good no-fines concrete, which in addition to having large voids and hence light in weight, also offers architecturally attractive look. No-fines concrete is a form of lightweight porous concrete. It is a two-phase material – single sized coarse aggregates, surrounded by a coating of thin layer of cement paste, without any fine aggregates.

Density of the normal concrete ranges 2200 to 2600 kg/m³. while densities range from 2100, 1800, 1700, 1600 down to 300 kg/m³. Compressive strengths range from up to 40 Mpa down to almost zero for the really low densities. Generally, it has more than excellent thermal and sound insulating properties, a good fire rating, is non-combustible and features cost savings through construction speed and ease for handling.



Figure 1: No Fine Concrete

2. LITERATURE SURVEY

Pravin S Patil et.al, in this research paper the use of different size of aggregate also have greater impact on the ultimate strength as SET-B (16 mm) size aggregate gives more strength than other sizes of SET-A (10 mm). The porosity of No-fine concrete is largely affected by the smaller size of coarse aggregate used in concrete mix. Concrete mix containing 10 mm size aggregate shows higher porosity in comparison to concrete mix a containing 16 mm size aggregate. From the project study they conclude that there is a considerable saving of 12.95% in amount for construction of 1m³. From the project it clarifies that No-fine concrete can be easily use for the application of parking pavements, footpath pavements, tennis ground, rural areas with low volume traffic as per IRC. [1]

K Satham Ushane et.al, in this research paper the ultimate strength of no-fines concrete is of the range between 5 N/mm²-12 N/mm². From the investigation, the most economical mix with high strength identified was 1:6 mix ratios with 12 mm aggregate and 0.45% water content. The cost of manufacturing of no-fines concrete blocks were 3.5-5 rupees but for nominal concrete blocks it was 4.5-6.5 rupees. Hence, the no-fines concrete blocks were more economical than nominal concrete blocks. The market for building block is growing at a rapid rate, especially in the areas where burnt bricks are not easily available or of poor quality. Unfortunately, rigorous scientific studies have not been made on the strength, durability and economy of concrete building blocks. Lightweight concretes can either be

lightweight aggregate concrete, foamed concrete or Autoclaved Aerated Concrete (AAC). Such lightweight concrete blocks are often used in mason's house construction, because of their less density and self-weight, it helps for faster construction. [2]

T Abadjieva et.al, in this research paper the results of an investigation to determine the performance characteristics of concrete mixes made without fine aggregates. Single sized coarse aggregates fraction 13.5-19 mm from Kgale Hill quarry and Ordinary Portland cement were used in the experiments. Concrete mixes with different aggregate/cement and water/cement ratios were prepared to find an optimum mix yielding the highest strength. The density and strength properties of the investigated no-fines concrete are lower than that of normal weight concrete, but sufficient enough for structural use. For practical purposes mixes with aggregate/cement ratio 6:1 and 7:1 were recommended. The suggested mixtures could be used for cast in situ walls in low-rise, low cost housing (later plaster externally to reduce air and water permeability), drainage layers and paving after more extensive research. [3]

L JiaHao et.al, in this research paper the application of no-fines concrete has been introduced to construction industries specially pavement construction. Due to its high porosity behaviour, the relative density of no fines concrete is lower than normal concrete of 2400kg/m³ which also helps in reducing dead. the main focus on physical and mechanic study for no-fines concrete has been studied and reviewed. The relative density of no-fines concrete can be varying in different mix proportion used during mixing. It is gradually decreasing with the increment of aggregates/cement ratio together with water/cement ratio. weight in the design. For porosity aspect of no-fines concrete, the volume of void can be affected by size of aggregates. Few results showed that the porosity percentage of no-fines concrete ranged between 27% to 36%. Also, the permeability increased as the porosity increased in no-fines concrete. The higher the volume of aggregates, the higher the compressive strength of no-fines concrete the optimum compressive strength of no-fines concrete achieved is 11.25MPa which is still considered low strength concrete compared to normal concrete characteristic strength. Therefore, with compiling all the properties of concrete, it is not suitable to acts as building structural member as its capacity to resist stress is low, but it is a good alternative material for pavement as its voids in concrete helps in reducing pavement surface runoff purpose. [4]

Yuwadee Zaetang et al, in this study, the use of lightweight aggregate (LWA) for making lightweight pervious concrete (LWPC) was presented. Diatomite (DA) and pumice (PA) were used as natural LWAs in pervious concretes. Three cement paste contents of 15%, 20%, and 25% by volume were used. The results were compared to those of LWPC containing recycled LWA from autoclaved aerated concrete (RA). The results indicated that the use of DA, PA, and RA as coarse aggregates in pervious concrete could reduce the density and thermal conductivity about 3–4 times compared with previous concrete containing natural aggregate. The densities were 558–775 kg/m³. [5]

Ms.S. Geethanjali et.al, in this study paper discusses the combos of pervious concrete with diverse substances like Polypropylene fiber and Super Plasticizer. Various tests like compressive strength, Flexural strength and Split Tensile strength tests are executed to observe the strength traits of Pervious concrete. The strength of the mixes like plain pervious concrete, mix with polypropylene fiber and concrete mix with both Polypropylene and Superplasticizer are in comparison. Compressive strength of the concrete attained at an age of

7 days is about 60-75% of the compressive strength of the concrete attained at an age of 28 days. The compressive strength of Polypropylene mixed pervious concrete is increased when compared to plain pervious concrete, when the fiber is added to the concrete at a rate of 0.6% of the weight of cement. The increase in strength is because of the Polypropylene fiber in pervious concrete enhances the bonding between the coarse aggregate and cement paste. [6]

Kiran Babanappa Thombre et.al, in this study the size of coarse aggregate taken for the study was 10 mm, 20 mm and a size varying from 10 to 20 mm. Cement contents used was 250 kg/m³, 275 kg/m³ and 300 kg/m³. The main aim of this study was to investigate the strength and workability of various mixes of No-Fines concrete and to propose an optimum proportion for desired strength and workability of porous concrete. Also, study focuses on the effect of particle size of coarse aggregate on the strength and workability of No-Fines concrete. Compressive strength and the workability of the porous concrete primarily depends upon the particle sizes of coarse aggregate, voids ratio and the cement content. Grading of the coarse aggregate in the No-Fines concrete largely influences its workability and strength. Uniformly graded coarse aggregate gives better results than Single graded aggregates. Decreased in the size of coarse aggregate decreases the voids ratio while increases the workability and its compressive strength. No-Fines concrete with uniformly graded coarse aggregate sizes from 10 mm to 20 mm gave the maximum strength and moderate workability at 10% voids ratio. [7]

Perla Mounika et.al, in this study this the runoff of the agricultural and indoors town roads is improved, water tables of those areas decreased and as current ground improvement techniques are used to beautify the secure bearing ability of ground. No fines concrete is the pleasant alternative to reap those necessities. In many advanced nations, the usage of No fines or pervious concrete for the development of pavements, vehicle parks and driveways are turning into popular. The impact of the above elements on the density, compressive, and tensile strength had been studied experimentally. The permeability of no fines concrete is extra because it having more voids. The power of no-fines concrete is a good deal while compared to ordinary concrete, however enough for structural use of pathways, parking areas etc the density and strength properties of the no fines concrete is investigated at lower than that of normal weight concrete, but sufficient enough for structural use. For practical purposes mixes with cement/aggregate ratio 1:3 and 1:6 at water/ cement ratio is 0.4 were recommended. To minimize hazard to the natural surroundings on which roads are built, in particular in city are as, permeable concrete has appropriate capability to make an advantageous contribution to sustainable street creation and life cycle control. [8]

Nura Muhammad Ali et.al, in this study reviews the studies conducted using recycled lightweight concrete aggregate and the finding revealed that; despite the satisfactory performance and waste reduction potential, concrete manufactured using recycled Lightweight concrete aggregate displayed lower performance compared to standard concrete. Therefore, more research is necessary towards improving the performance of recycled lightweight aggregate concrete. Recycled lightweight concrete aggregates have been shown to lower the mechanical properties and performance of recycled lightweight aggregate concrete and concrete in general. Despite this lowered quality, it is significant to reduce the negative environmental impact resulting from disposal of lightweight concrete. Hence, more detailed research is needed where different admixtures and careful alterations are employed

towards improving the performance of this type of concrete. More research on the influence of lightweight concrete aggregate on concrete properties such as shrinkage, crack formation, CO₂ absorption, fire resistance, acid resistance, and chloride ion resistance are required to have compressive data for further research. [9]

3. MATERIAL USED

1. Ordinary Portland cement:

Cement is any material that binds or unites- essentially glue. In civil engineering or construction, it always refers to an ingredient in concrete, mortar, or grout. Raw materials for manufacturing cement consist of basically calcareous and siliceous (generally argillaceous) material. The mixture is heated to a high temperature within a rotating kiln to produce a complex group of chemicals, collectively called cement clinker. The chemicals present in clinker are nominally the four major compounds and some minor compounds.

The four major compounds are:

- Tri-calcium silicate (3CaO.SiO₂)
- Di-calcium silicate (2CaO.SiO₂)
- Tri-calcium aluminate (3CaO.Al₂O₃)
- Tetra-calcium alumina ferrite (4CaO. Al₂O₃ Fe₂O₃)

IS: 12269 -1987 conforming to 53 Grade OPC cement use in this concrete. Cement can be stored in air tight room before use. It should be fresh cement means it should use under three months after manufacture.

Properties of cement are below:

Fineness of cement	4.1%
Consistency of cement	28%
Initial and final setting time of cement	96 mint and 260 mint
Soundness test of cement	1.5 mm

2. Coarse Aggregate

The coarse aggregate is the main component of this concrete on basis of strength. It reduces the drying shrinkage and other changes on occurring of moisture. The coarse aggregate used passes in 20 mm and retained in 10 mm sieve.

Properties of Aggregate

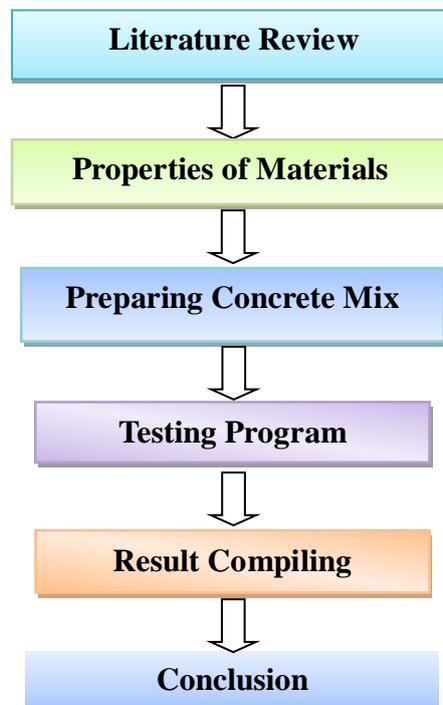
Water absorption aggregate	1.83 %
Sieve analysis of aggregate	7.17 %
Combination of Elongation index & Flakiness index	18.72 %
Impact value aggregate	7.47 %
Abrasion test of aggregate	22.7 %

3. Water

Water conforming to as per IS: 456-2000 SECTION 2, Clause:5.4 was use for mixing and curing clean and free from injurious amount of oil, acid, alkalis, salt, sugar and other substance deleterious to concrete specimens.

4. METHODOLOGY

In order to study the behavior of No Fine lightweight concrete, normal concrete testing to determine the material and structural properties of each type of No fine lightweight concrete and how will these properties differ according to a different type of mixture and its composition. Once concrete gets hardened it can be subjected to a wide range of tests to prove its ability to perform as planned or to discover its characteristics. For new concrete this usually involves casting specimens from fresh concrete and testing them for various properties as the concrete matures.



Test Procedure:

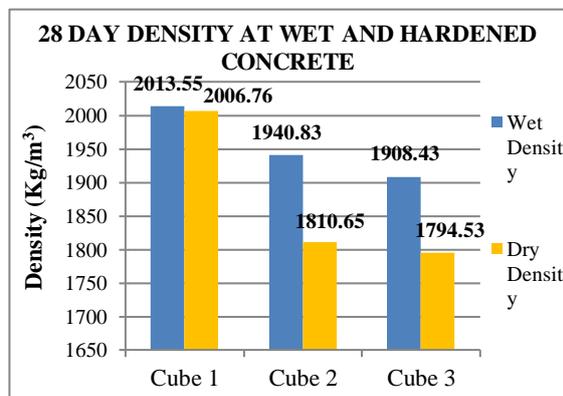
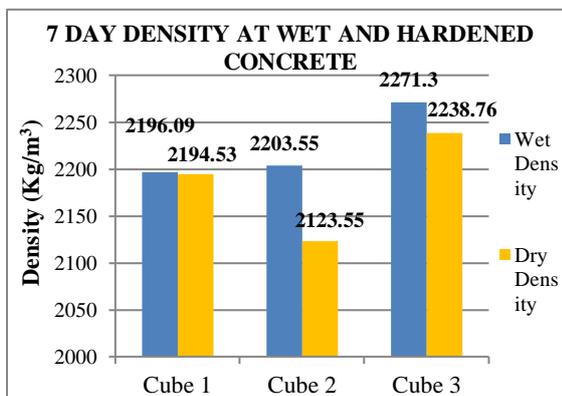
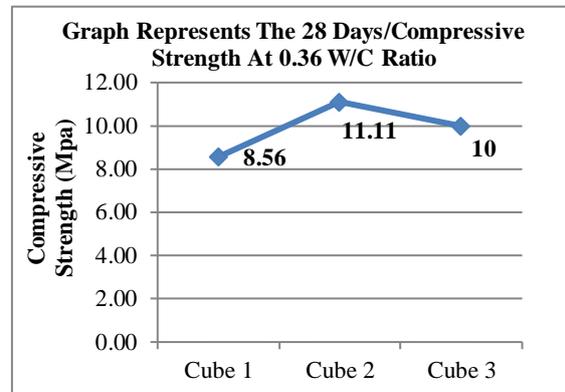
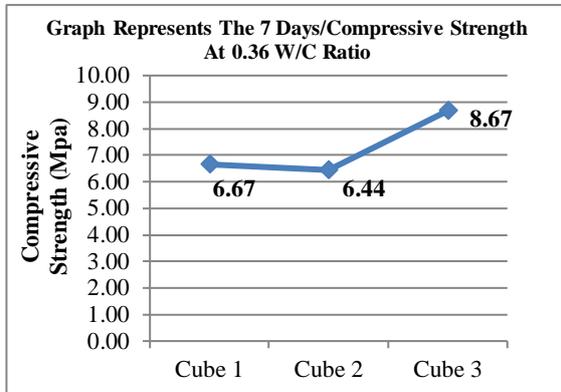
The 150 mm x 150 mm x 150 mm size conforming to IS: 10086-1982 concrete cube was used as test specimens to determine the compressive strength. The test specimen at the end of 7 days and 28 days were subjected to compressive load by compressive testing machine until failure.

5. RESULT

A. Compressive Strength:

This test gives us a thought about all the characteristics of concrete. With the assistance of this test, we will make Fresh concrete and properly worked done in test. Compressive strength of no fine concrete is determined on the 7, and 28 days for each sample. There were

three samples for each test and the results would be taken as the average of these three. Fewer variables had been set for different mixture. This variable would be changed accordingly while the others were fixed to forecast their effect on the mixture.



6. CONCLUSION

The effect of water cement ratio has greater impact over the strength of no fine concrete as 7-day result of 8.67 N/mm² and 28-day strength is 11.11 N/mm². water content gave more strength the other water content used in this study. Strength of no fine concrete increase's water/cement ratio. From this study, 0.36 water/cement ratio was observed to be ideal for no fine concrete. The density of compare with wet and dry weight of cube for 7 day and 28 day.

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