International Journal of Civil Engineering (IJCE)
ISSN (P): 2278–9987; ISSN (E): 2278–9995
Vol. 10, Issue 1, Jan–Jun 2021; 55–62

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

EXPERIMENTAL STUDY ON LIGHT WEIGHT CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT, FINE AND COARSE AGGREGATE WITH RICE HUSK ASH, SAWDUST AND SINTERED FLY ASH AGGREGATE

Prerak Kumar Swami, Anuj Verma, Akash & Vineet Kumar

Research Scholar, Rajshree Institute of Management and Technology, Bareilly, India

ABSTRACT

The concrete mix ratio of 1:1.63:3.28. Was prepared using water/cement of 0.50 with 0%, 25% and 50 Sawdust, Sintered fly ash aggregate and fly ash as partial replacement for fine and course aggregate respectively Cement is also partially replaced by the rice husk. The aggregate crushing value (ACV) obtained is within the specified value as specified by the Indian standard. The strength showed in results shoes grater changes in strength, workability, and economical aspects. It may be lots of change in material but also as we see that these material available in enough amount around us. Previous research also shows that these changes will help increase the strength and workability. In light weight concrete also it necessary to lower the density/weight of the concrete and it shoes grater changes as per other combination with adequate results.

KEYWORDS: *Light Weight Concrete, Sintered Fly Ash, Sawdust, Workability Etc*

Article History

Received:* *23 Jun 2021* | *Revised:* *25 Jun 2021* | *Accepted:* *30 Jun 2021

INTRODUCTION

As we know that concrete is most important part of our construction industries, it is still used in construction even we have other types of construction method like steel, wooden, etc. Normally in concrete we used aggregate (coarse & fine), cement, and water. Presently, various types of materials such as fly ash, silica fume, rice husk ash, and other have been widely used as pozzolanic material in concrete. Also there are various types of admixtures used in concrete to increase and decrease of workability, water- cement ratio, strength and quantity of cement. It is not used as main material it has been used only in small dosage. Normally with these types of, material the concrete having density about 2200-2400 kg/m^3, so recently we are using Light weight concrete LWC so concrete with less density and same volume. Its density about 1800-2000 kg/m^3.the structure made of light weight concrete with variety of aggregate much lesser in weight, defined as light weight aggregate LWA have been widely used for research in recently. This light weight aggregate concrete LWAC work same as Normal weight concrete bearing the tensile strain, heat and sound insulation ability, reduction in thermal expansion and increase in strength. But for some reason it is not world widely used because of the gap in the material properties and for some reason it is experimentally discovered that LWAC shoes higher brittle characteristics as comparison of Normal weight concrete. With advanced research of LWAC the new development of high strength light weight aggregate concrete HSLWAC having high strength and much more mechanical behavior as compare of light weight aggregate concrete. Now days with the increasing amount of concrete used natural environment and resources are extremely and excessively unfairly, so synthetic light weight aggregate concrete SLWAC produced from environment waste like fly ash ,Plastic, bottom ash, crushed clay brick, waste tyre rubber etc are the viable new resources of structural aggregate material. The use of the light weight concrete enhances greater design flexibility, cost saving, dead load reduced better fire system, improve loading structural less reinforcement and lower the foundation cost. It may be relatively new material but it gives approximately crushing strength same as normal weight concrete win same density. The lower modulus and ductility of light weight concrete may also have advantage in the seismic design of structures.

LITERATURE REVIEW

Kumar, V. kavin[1] et al[2020] stated that In the research of light weight concrete from last decade It is put into practice that developing the every situation like production, Mix Design, methodology so we can produce low density concrete as compare to normal density concrete .in previous year there are many attempt are carried out to develop these light weight green concrete those density will vary between 600-1700 $kg/m^{3,}$ Also others factors like curing ,strength etc develop the new aspect for researchers.

Rav preet Kaur[1] et al [2020] Addressed that from the past studies on Steel fibre reinforced concrete, it has been established that the performance of concrete can be enhanced by fibres and it may be waste materials from the commercial benefit and environmental aspect. Reinforcing the concrete with steel fibers (SFRC) increases the tensile strength of concrete and also improving its brittle behavior. The major applications of SFRC being used in tunnel lining, underground structures, flooring roof slab, foundation etc. The further analysis presented that the light weight concrete when incorporated with the waste steel from reinforcement and formworks with different fibre contents full strength and the results comparably as the already studied fibre reinforced concrete.

Dr.S.Sidhardhan[1] et al [2020] stated in light weight study that there are different types of light weight of concrete those having different characteristics and different use. Cellular concrete is also types of light weight concrete. It is create a possibility of using different types of recycled material such as crushed glass, plastic waste, crushed red brick etc as substitute the fine aggregate. Another constituent also used as a foaming agents for binding and lower the density of concrete, for this study protein based foaming agents used. This paper stated that if recycled material such as glass and plastic waste as filler. The compressive strength, flexural strength tensile strength and density will be differs as compare to normal weight concrete. Light weight concrete always depends on fillers and their binding agents to lower the density. We can also use the fly ash to improve the cellular light weight concrete.

Záleská, et at [2019] In this study author trying to use alternative for the coarse material used in light weight concrete. For replacing the coarse aggregate material by rubber tires is good use of waste tires because there is no eco-friendly process for dumping and disposal. So it is very good use of waste tires as eco-friendly and economically. The experimental study on the rubber tires as aggregate replacement ratio about 10-20% is used in this studies and shoes that it will be way more effective for mechanical and structural properties and also shoes good thermal conductivity; it also enhanced the thermal insulation, sound absorption and also lowers the density of concrete as compare of normal weight concrete.

Gopalakrishnan, R., et al[2019] Here other author also investigate the foam concrete to develop the light weight concrete because of their novel usefulness in construction. One of the main reason of foam concrete is we can easily replace the river send as filler by using quarry dust, marble Dust that may change the properties of concrete and may increase the strength. Author used the fly ash for replacing the some amount of cement and quarry dust replacing the half of the river sand. It produce the compressive and tensile strength and durability properties to see if the percentage of fly ash and quarry dust and other material produced the better results for foam concrete as light weight concrete.

Jin Chai, et al [2016] As we previous studied that light weight concrete were used for construction of many light structures but if we used for heavy structures such as bridge, Dam etc then we need high strength concrete so for developing the light weight concrete many researchers work on the high strength light weight aggregate concrete so it can provide many advantages. Different types of material used in HSLWAC like fly ash, rice husk ash, oil palm etc. In this study in high strength light weight concrete aggregate replaced by fly ash and oil palm clinker that has been produced in solid waste plant from oil palm industries with light friction. The result shoes that grater change in normal light weight aggregate concrete strength as well as tensile strength that is suitable for the heavy structures. And also shoes that if we raised the percentage of oil palm clinker in concrete it shoes greater strength but decease the workability and that is solved by increasing the amount of fly ash quantity.

Vakhshouri, Behnam, and Shami Nejadi et al [2015] Here author used the different types of chemical and mineral for enhancing the properties like strength and durability of the concrete light weight concrete is very useful solution for lowering the heavy weight of structure. In this author study that light weight self compacting concrete LWSCC is a new field of research in light weight. Consider the structure's light weight and ease of installation. LWSCC (light-weight self-compacting concrete) may be the answer to the growing demand for slender and heavily reinforced structural components. In the last 12 years, twenty-one laboratory experiments on the mix proportion, density, and mechanical properties of LWSCC have been reported, and these are analyzed in this review. The data gathered will be used to examine the proportions of chemical and mineral admixtures, light and regular weight aggregates, fillers, cement, and water in the mix. Statistical expressions are used to present the effects of the analysis. It will be very useful in future research to choose the appropriate components with various ratios and curing conditions in order to achieve the required concrete grade for the intended use.

Lakshmi Kumar Minapu[1], M.K.M.V. Ratnam [2], Dr. U Rangaraju[3]et al [2014] Lightweight concrete is used extensively in the design of concrete structures to reduce density and improve thermal insulation. These may be related to structural stability as well as serviceability. If waste materials are used to substitute fine light weight aggregate, further environmental and economic benefits can be realized. Natural aggregates and synthetic lightweight aggregates are new sources of structural aggregate that are made from environmental waste. The use of structural grade light weight concrete eliminates self weight and allows for larger precast units to be constructed. The Mechanical Properties of a Structural Grade Light Bulb have been investigated in this review. In M30 concrete, light weight aggregate pumice stone can be used as a partial substitution for coarse aggregate and mineral admixture products like Fly Ash and Silica Fume. To investigate compressive, tensile, and flexural strength, 12 sets were prepared, along with a Control Mix. Each set includes four cubes, two prisms, and instruction. There are two cylinders A slump test was performed on each mix while it was still new. Duration: 28 days Compression, tensile strength, and flexural strength tests were conducted in the hardened state. The study is also being extended to include the mixing of different types of mineral admixtures into concrete. The test results showed an overall improvement in strength and weight loss in various trails. As a result, light-weight concrete is not inferior to heavy-weight concrete in any way.

MATERIAL & METHODOLOGY

For the experimental study on this light weight concrete, Following material are used-

Cement- The cement should be new and have a consistent quality. Throughout the investigation of this research work, PPC cement was used, with a laboratory test value of 3.15 as per IS 12269: 1987. If there are some lumps or foreign matter in the begging, it is not to be used.

Table: 1

S. No.	Property	Test value	Standard value	References of test value
1	Specific gravity	3.09	3-15	IS 4031 (Part 11): 1988
2	Soundness, mm (By Le-Chatelier method)	7	Max 10	IS 4031 (Part 3): 1988
3	Initial setting time, min	42	Min 30	IS 4031 (Part 5): 1988
4	Final setting time, min	350	Max 600	IS 4031 (Part 5): 1988
5	Fineness, m2/kg	370	Min 225	IS 4031 (Part 2): 1999
6	Compressive strength, Map (After 28 days curing)	53	Min. 53	IS 4031 (Part 6): 1988

AGGREGATE

- Fine aggregate is made up of locally available river sand that has been sieved through a 4.75mm IS sieve. Sand has a specific gravity of 2.57.
- Course aggregate has a maximum size of 12.5mm and a specific gravity of 2.71 with a fineness modulus of 6.61 percent. As coarse aggregate, angular recycled aggregates from a local source were used.

FINE AGGREGATE

Table: 2

S. NO	Properties	Test value	Standard value	References of Test Value
1	Specific gravity	2.58	Max 3.2	IS: 2386 (Part III) – 1963
2	Water absorption, %	2.2	Max 5	IS: 2386 (Part III) – 1963
3	Bulk density, kg/m3	1659	-	IS: 2386 (Part III) – 1963
4	Grading zone	Zone-II	Zone I-zone-IV	IS: 2386 (Part I) – 1963
Coarse Aggregate				
S. NO	**Properties**	**Test value**	**Standard value**	**References of test value**
1	Specific gravity	2.66	Max 3.2	IS: 2386 (Part III) – 1963
2	Water absorption, %	0.25	Max 5	IS: 2386 (Part III) – 1963
3	Unit weight, kg/m3	1593	-	IS: 2386 (Part III) – 1963

- Saw dust-Wood dust is another name for sawdust. It is a by-product of cutting or drilling wood with a saw or other instrument, and it is made up of small wood particles. During the sawing of logs of timber into various sizes, sawdust is formed as small discontinuous chips or small pieces of wood. During the sawing process, chips flow from the cutting edges of the saw blade to the surface, and saw ash dust using passing from 90-micron sieve.
- Rice husk ash- Rice Husk Ash is a form of ash made by burning rice husk until it has been reduced by 25%. Rice husk was collected locally for the analysis. After that, the Husk was deliberated until fine ash was made. These ashes were sieved at 600 microns to remove any remaining impurities. The specific gravity of rice husk is 2.31.
- Sintered fly ash aggregate Sintered fly ash light weight aggregate replaces natural stone aggregate/chips in concrete, resulting in a reduction in dead weight. Lightweight concrete is made of sintered fly ash, which has

densities ranging from 1651 to 2017 kg/m3. Fly ash aggregates are made using the cold bonded process, which involves combining fly ash and cement with water. After 28 days, various proportions of cement and fly ash (10:90, 15:85, 20:80, and 25:75) are tried with suitable water to produce fly ash pelletized aggregates. The specific gravity, water absorption are 2.66 and 0.25 respectively.

METHODOLOGY

- Preparation of various concrete mixes with rice husk ash as a partial substitute for cement in the proportions of 5%, 10%, and 20%.
- The percentages of fine aggregates replaced by sawdust ranged from 0 to 25 %, and 50 %.
- Specific gravity, impact value, and crushing value of fly ash aggregates were estimated at proportions of 10:90 and 15:85cement and fly ash. The best ratio of fly ash aggregates (15:85) is selected.
- Laboratory testing of the above-mentioned proportions, such as specific gravity, water absorption, compressive strength, and so on
- Comparative study of compressive strength with normal concrete.

RESULT AND DISCUSSION

- Specific gravity the specific gravity of following material proportion are described below as-
- Cement and Rice Husk Ash -3.08
- Sand and sawdust- 2.60
- Stone aggregate and fly ash aggregate- 2.66

Water Absorption of Aggregate

- Stone aggregate and fly ash aggregate 2.68
- Sand and sawdust- 2.60

Compressive strength Compressive strength or compression strength is the capacity of a material or structure to withstand loads tending to reduce size, as opposed to tensile strength, which withstands loads tending to elongate. In other words, compressive strength resists compression (being pushed together), whereas tensile strength resists tension (being pulled apart). In the study of strength of materials, tensile strength, compressive strength, and shear strength can be analyzed independently. From this study The compressive strength of concrete reduces with the increase of sawdust ash replacement ratio. This result is not related to water-binder ratio compressive strength growth of concrete is found to be increased with the increase of sawdust ash replacement ratio after 28 days. The test carried out on concrete by using fly ash coarse aggregates. The size of cubes 150mm x 150mm x150mm dimensions are selected, and the concrete specimens were prepared using fly ash aggregates by replacing with crushed stone coarse aggregates of propositions 0%, 10%, 15% and using 10% and 20% sawdust replacement of sand as fine aggregate and also rice husk ash as a partial substitute for cement in the proportions of 0%, 5%, 10%. For M25 grade of Concrete strength reduces with increase strength with curing and concrete age. Also all the tests were perform on 3, 7,14,21,28 days for compressive strength.

CONCLUSIONS

It was discovered that increasing the amount of saw ash dust in the concrete mix improves the mix's workability, and rice husk ash reduces the weight and efficiency of the concrete. Rice husk ash is a polluting substance that is readily available in rice producing areas and is an excellent supplementary material for cement replacement. It also shows we replaced the coarse aggregate material with Fly ash aggregates and reduced bleeding by adding saw ash dust to the concrete mixes at 10:90 and 15:85 proportions of cement and fly ash, respectively. Based on the crushing, effects, and water absorption values, the optimum proportion of 15:85 was chosen as the fly ash coarse aggregates for the sample. The strength properties of M25 design mix concrete specimens were tested by replacing crushed stone coarse aggregates with fly ash coarse aggregates in proportions of 0%, 10%, and 15% by volume. Better performance is accomplished with a dosage of about 5% saw ash dust and a 30% replacement of fly ash coarse aggregates. The improvement in compressive strength of concrete mixes as compared to standard concrete after 28 days of curing in water with suitable water. As opposed to standard concrete, the results showed. There was minimal weight and compressive strength loss when fly ash coarse aggregates were replaced by 30%. If the percentage of sawdust increases, the water/cement ratio rises. At 10% and 20% sawdust, respectively. Replacement of light weight aggregate with fly ash reduces weight about $2143 kg/m^3$ and it lowers production costs about 2%. As a result, it can be inferred that, in order to produce a better result in the manufacture of light weight concrete cubes, the percentage substitution of material should not be greater than 20% for each. While this provides a much better result, it still leaves something significant out.

SCOPE OF THE STUDY

The rapid growth for producing long-lasting materials is a result of today's rapidly polluting environment. As a result, we use supplementary cementation materials that must be reliable in order to fulfill the majority of the requirements for durable concrete. Rice husk ash, fly ash aggregate, and saw dust have also been discovered to be better supplementary materials for cement, sand, and aggregate to achieving the same strength and may be grater properties of concrete like density ,strength etc

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