EXPERIMENTAL INVESTIGATION ON THE PROPERTIES OF RECYCLED COARSE AGGREGATE CONCRETE

Ms. K. Varshasri [1], K. Vinay[2], N. Chandu[3], P. Reddy Veera Bharath[4], S. Mohammed Jaheeruddin[5], A.Siri Sai[6]

[1] *Assistant Professor, Annamacharya Institute of Technology and Sciences, Tirupati, - 517501*
[2,3,4,5,6] *U.G Students, Annamacharya Institute of Technology and Sciences, Tirupati, - 517501*

Abstract: The aim of this experimental work is to find the properties of recycled coarse aggregate. For this purpose, Natural Coarse Aggregate (NCA) is replaced with Recycled Coarse Aggregate (RCA) 10%, 20% and 30% for M25 grade concrete mix respectively. The RCA is obtained from the demolished waste. Cement is partially replaced with silica flume and GGBS 10%&20% each separately. This study summarizes the effect or influence of recycled coarse aggregate on workability and mechanical properties such as compressive strength, Rebound Hammer and Ultrasonic Pulse Velocity for M25 grade of concrete.

Keywords: - Recycled aggregate replacement of natural coarse aggregates, Silica fume and GGBS replacement of cement.

1. INTRODUCTION

As the cement industry releases a significant amount of CO_2 into the atmosphere, sustainability of construction materials, particularly concrete, is the most frequently discussed topic worldwide at the moment and will continue to be so in the future. There are two distinct phases in which cement production results in the emission of CO2 into the atmosphere. One is accomplished through the calcination of calcium carbonates, and the other is accomplished through the burning of coals as a source of energy for the production of cement.

While cement only makes up a small portion of the concrete's volume, the coarse and fine aggregates make up the majority—roughly 75 to 80 percent. As a result of rapid industrialization and urbanization, there is an annual increase in the demand for aggregates and cement used in concrete around the world. However, there are troubling indications of a lack of natural aggregates sources, which may result in future shortages. On the other hand, a lot of construction and demolition (C&D) waste is made when new buildings are built and old ones are taken down, which causes problems with landfills all over the world.

Globally, the construction and demolition industries use a lot of natural resources and dump a lot of construction and demolition debris in landfills. Not only are these methods harmful to the environment, but they are also regarded as unsustainable. Quarrying activities harm the environment and overuse of aggregates in concrete production results in overexploitation of natural aggregates. Recycled Aggregates (RA) as a viable source of structural material have rekindled interest as a result. Reused totals, acquired from neighborhood development and destruction squander, not just lessens the utilization of essential regular assets yet additionally works on the manageability by decreasing the utilization of significant landfill space.

Cement use is rising as a result of infrastructure expansion and rapid industrialization. The production of cement uses a lot of energy and releases carbon dioxide, which pollutes the environment. As a result, utilizing Pozzolana materials for the preparation of concrete and reducing cement consumption are two potential solutions to these issues. According to previous research, using Fly Ash, Silica Fume, Matakaoline, Ground Granulated Blast Furnace Slag, and Rice Husk Ash as a partial substitute for cement results in decreased cement consumption as well as increased concrete strength and durability.

To protect regular assets, various examinations have been performed by involving reused total in concrete, yet it generally brought about lower level of substantial qualities. This was because the cement paste and the recycled aggregates were not able to form a strong bond because there was still mortar on the surface.

2.LITERATURE REVIEW

2.1 Experimental investigation on Recycled Aggregate Concrete Made with Silica Fume

Experimented with the characteristics of cement mortar containing silica fume particles and recycled aggregates, resulting in stronger blended mortars after seven and 28 days. The microstructure analysis revealed that, in addition to serving as a filler to enhance the microstructure and an activator of the pozzolanic reaction, 20% silica fume was used as a partial replacement for cement on 20% recycled aggregates.

2.2 Study on properties of concrete using GGBS & recycled aggregates.

Ggbs Ground granulated impact heater slag utilized in concrete as concrete substitution which is concrete saving, energy saving, cost saving and besides cause ecological financial

•Impact heater slag is non-metallic side-effect delivered during the time spent iron making.

• Blast furnace slag is not corrosive to steel embedded in concrete made with blast furnace slag cement or aggregates because it is slightly alkaline and has a pH in solution range of 8-10.

•Portland cement and GGBS are combined to make concrete structures that are long-lasting.

2.3 Study on Recycled Aggregate

Commercial recycled aggregates with replacement rates of 0%, 25%, 50%, and 100% for natural aggregates. At 28 days, 100% recycled aggregate concrete's compressive strength was 12.2% lower than that of natural aggregate concrete. At a 20 percent replacement level of natural aggregate, the values of recycled aggregate concrete improved significantly after 90 days.

3.MATERIALS AND METHODOLOGY

3.1 SILICA FUME

Micro silica, also known as silica fume, is a byproduct of making ferrosilicon alloys or silicon metal. It is a fine powder substance that ranges in size from 0.1 to 5 microns and is mostly composed of amorphous silicon dioxide (SiO2). Due to its high surface area-to-volume ratio and high reactivity, silica fume is an excellent pozzolanic material.

In concrete mixtures, silica fume is frequently utilized as a additional cementitious material. Silica Fume reacts with the calcium hydroxide produced during cement hydration to form additional calcium silicate hydrate (C-S-H) gel when added to concrete. This enhances the concrete's durability, strength and resistance to chemical attack. Concrete's permeability is also reduced by silica fume, making it more resistant to water penetration and the harmful effects of freeze-thaw cycles.

Silica Fume is utilized not only in concrete but also in ceramics, rubber compounds, refractory materials, other

Fig No 3.1: Silica Fume

Table No 3.1: Properties for silica flume

S.NO	PROPERTIES	VALUE
1	SIZE, MICRON	0.1
2	SPECIFIC GRAVITY	2.2
3	BULK DENSITY	576 Kg/m^3
4	SURACE AREA	20,000 m^2/Kg

3.2 GGBS (Ground granulated blast furnace slag)

Ground granulated blast furnace slag (GGBS) is a byproduct of the production of iron that, when added to concrete improves its workability, strength and durability. Iron ore, limestone and coke are heated to approximately 1500 degrees Celsius in order to produce this substance. The process of GGBS does not directly form in a blast furnace. The production of iron results in byproducts like molten iron and slag. Alumina and silica, in small amounts, as well as oxide, make up the molten slag.

The granulation of the slag occurs as it cools. In order to accomplish this, it is permitted to travel through water of high pressure. The particles quench as a result, producing granules with a diameter of less than 5 millimeters. After that, it is dried and ground in a spinning ball mill into a fine powder, which is a spinning ball mill into a fine powder, which is caller ground granulated blast furnace slag.

Fig No 3.2: GGBS

Table No:3.2 Properties of GGBS

S.NO	PROPERTIES	GGBS
1	COLOUR	WHITE
2	SPECIFIC GRAVITY	2.8
3	BULK DENSITY	$1200Kg/m^3$
4	FINENESS	$350m^2/Kg$

3.3 METHODOLOGY

Past studies. Concrete tests are conducted to determine whether silica flume and ggbs20% are utilized in proportion Prior to beginning the work, the research consisted of a review of previously published to the cement content. PPC class 53, natural sand as fine aggregate, natural aggregate as coarse aggregate, and recycle aggregates of 20% were all used in this test. A nominal M25 design with a water-to-cement ratio of 0.45 and a ratio of 1.0:1.0:2.0 was used to test the samples. After seven days of curing, the first set was tested, and the second set was tested after 28 days.

4 RESULT AND DICUSSION

4.1 compressive test

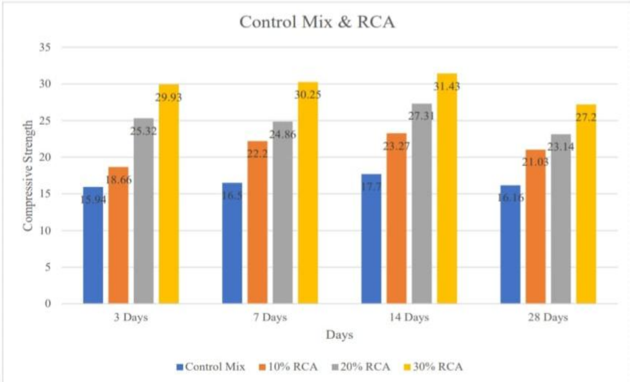
In light of this test, one can either acknowledge or dismiss a substantial establishment. The quality of the materials used, the mix design, and quality control during concrete production all affect compressive strength as a concrete property. The most common test pattern is a cube 15 cm x 15 cm x 15 cm, depending on the code.

Fig4.1 Compression strength test

4.2 COMPRESSION TEST RESULT

Table No 4.1 Compression strength of control Mix & RCA

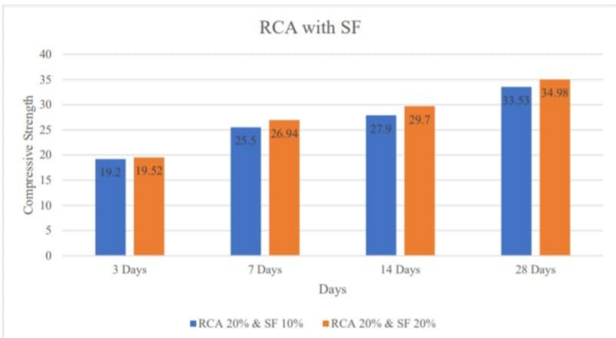
Days	Control Mix	10% RCA	20% RCA	30% RCA
3 Days	15.94 N/mm^2	18.66 N/mm^2	25.32 N/mm^2	29.93 N/mm^2
7 Days	16.5 N/mm^2	22.20 N/mm^2	24.86 N/mm^2	30.25 N/mm^2
14 Days	17.70 N/mm^2	23.27 N/mm^2	27.31 N/mm^2	31.43 N/mm^2
28 Days	16.16 N/mm^2	21.03 N/mm^2	23.14 N/mm^2	27.20 N/mm^2



Graph No:4.1 Compression strength results for control Mix & RCA

Table 4.2 Compression strength for RCA with silica flume

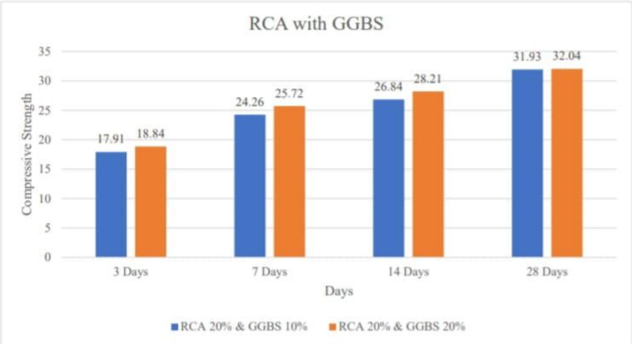
Days	RCA 20% & SF 10%	RCA 20% & SF 20%
3 Days	19.2 N/mm^2	19.52 N/mm^2
7 Days	25.5 N/mm^2	26.94 N/mm^2
14 Days	27.9 N/mm^2	29.70 N/mm^2
28 Days	33.53 N/mm^2	34.98 N/mm^2



Graph No 4.2 Compression test result of RCA with silica flume

Table No 4.3 Compression strength for RCA with GGBS

Days	RCA 20% & GGBS 10%	RCA 20% & GGBS 20%
3 Days	17.91 N/mm^2	18.84 N/mm^2
7 Days	24.56 N/mm^2	25.72 N/mm^2
14 Days	26.84 N/mm^2	28.21 N/mm^2
28 Days	31.93 N/mm^2	32.04 N/mm^2



Graph No 4.3 Compression test result of RCA with GGBS

5.0 CONCLUSION

1.The compressive strength decreased as the percentage of recycled coarse aggregate increased to more than 20%, but this effect is unaffected when recycled coarse aggregate replaces natural aggregates up to 20%.

2.As a result, recycled aggregates and 10% and 20% of GGBS and Silica Fume are utilized.

3.When 10% and 20% of the cement are replaced with each, respectively, silica fume has a greater positive impact on compressive strength than GGBS.

REFERENCES

1. References Vyas, C.M., and D.R. Bhatt published an article titled "Use of Recycled Coarse Aggregate in Concrete" in the January 2013 issue of IJSR, an international journal of scientific research.

2.Ryu J.S. 2002. A trial concentrate on the impact of reused total on substantial properties, magazine of substantial examination. 54(1):7-12.

3.Alireza N. G., Suraya A. , Farah Nora A.A. , Mohamad A. M.(2010). " Contribution of GGBS to Concrete and Mortar Properties: Review No.

4.National Laboratory of Civil Engineering (LNEC), Portugal, by Arlindo Goncalves, Ana Esteves, and Manuel Vieria (1990). Impact of recycled concrete aggregate on the durability of concrete 2001. M. Anwar, T. Miyagawa, and M. Gaweesh Making use of silica fume as a substitute for cement in concrete. in the proceedings of the first international conference on ecological building structures held in 2001. pp. 671 - 684.

6. Saurav (2012) " Use of nanotechnology in building materials" Worldwide Diary of Designing Exploration and Applications" Vol. 2, Volume 5, Number 5,September-October 2012, pages 1077-1082"Influence of GGBS and Silica Fume on Concrete Performance," by M.Nili, A. Ehsani, and K. Shabani (2010).

8.Bjornstrom J., Martinelli A., Matic A., Borjesson L. furthermore, I.Panas (2004) "Speeding up impacts of colloidal Silica Smoke for advantageous calcium-silicate-hydrate development in concrete", Substance Physical science Letters, 392, 242-248.

9. Heasam Odoh, Andrew, and Faiz Uddin Ahmed B "Effect of Silica Fume on the Properties of Concretes With Recycled Coarse Aggregates" Mohsen Tadayon, Hamed, Mostafa Khanzadi Mohamed and Sepehri. "Influence of GGBS Particles on Mechanical Properties and Permeability of Concrete," by Seperi (2010).

11."Methods of test for aggregates for concrete," IS 2386 (Parts 1 and 3): 1963

12."Method of test for strength of concrete," according to IS 516:1959

13.Shetty's Concrete Technology S.Chand publications, first edition of M.S.,1982.

14.IS 456-2000. For practice, a clear and reinforced concrete code. New Delhi's Bureau of Indian Standards

15.IS 383-1970. specification for natural coarse and fine aggregate for concrete. New Delhi's Bureau of Indian Standards

16.IS 10262:2019. Guidelines for the proportioning of concrete mix New Delhi's Bureau of Indian Standards

17.IS 12269:1987. requirements for 53 grade OPC cement. New Delhi's Bureau of Indian Standards

18.SW. AS Tabsh. Abdelfatah, " Impact of reused substantial totals on strength properties of cement", Development and Building Materials, vol. 23, 1163-1167, 2009.

19.MC. Rao, SK. SV. Bhattacharyya Barai. " Concrete properties are affected by field-recycled coarse aggregate, according to Materials and Structures, vol. 44, 205-211, 2011

20.BRE. " Recycled aggregates," Wikipedia, London, United Kingdom, Building Research Establishment, 1998.

21.BCSJ. " Recycled aggregate concrete and a proposed standard for their use," Committee on Disposal and Reuse of Construction Waste, BCSJ, Tokyo, Japan, 1977.