Comparative Study of the Compressive Strength of concrete when Natural Crushed Stone Coarse Aggregate is replaced by Recycle Aggregates and Coconut Shells

Vikash Kumar Singh, Pradeep Tiwari, Devansh Jain

Abstract— **Construction in growing all over the world, due to this availability of natural building material becomes less. When we talk about the coarse aggregates the first thing comes in our mind is natural crushed stone. In the present scenario availability of natural stone is less, and also natural stones are not easily available. To reduce this problem there are certain wastes by which Natural Crushed stone can partially can replaced. In this paper natural crushed stone (NCS) is partially replaced by Recycle Aggregates (RA) and Coconut Shells (CS). In Concrete Mix of M30 was prepared in that coarse aggregate was replace by 5%, 10% and 15% of Recycled aggregate (RA) and Coconut Shells (CS).**

Index Terms— **Coconut Shells, Recycled Aggregate, Concrete, Natural Crused Stone, Aggregate**

I. INTRODUCTION

Over the last decade growing concern about global environmental impact is forcing the civil engineering and construction industry to review its concrete production methods by replacing its ingredient with suitable alternatives. Due to the less availability of natural aggregates, many scientist research on the fully and partial replacement of aggregates. In this this paper we done experimental study on the partial replacement of coarse aggregate with recycle aggregates and coconut shells. Construction Industry is an active Industry. This due to gaining the aim for becoming as a developed country in 2020. However scarcity of reducing in natural resources has turn main issue [1]. In the last decade industry has been conducted research on the utilization of waste product in concrete, each waste product has its specific effects on properties of fresh and hard concrete, the use waste product in concrete is not only makes it economical but also solves some of the disposal problems [2].

The use of coconut by products has been a long time source of income for some people in the country and The coconut has many uses, cocnut furit itself is used in many industries not only as food but for other uses as well[3]. The energy industry has also seen the potential of the coconut as the coco-disel was created as an alternative to the fossil fueled oils, aside from its ornamental use, the shell has been powdered and use as activated carbon and used as filter material for the masks and air-conditioning systems[3]. In the construction industry, the husk is used as a mat in pre-venting the erosion of soils, Boards are created from the husk of the coconut by acquiring the fibers from husk [3].

The demolished building rubble in India generally goes to waste in landfills. After few years construction and demolition waste will be more than half of the National total waste in most countries of the world so recycling of these concrete waste materials from building demolition can provide a solution to this problem. Landfills are becoming increasingly difficult to find, are too remote from the demolition site, or are too costly to maintain. At the same time sources of supply of suitable aggregate for making concrete are continuously being exhausted. The recycling of building demolition waste materials into new buildings can provide a solution to these problems. Grinding reinforced concrete buildings can reduce the volume of land filled debris by roughly 80%. While volume reduction itself is beneficial, recycling the waste creates a product that can be sold or used for fill, bank stabilization, pavement for trails and other purposes, thereby reducing further environmental burdens by substituting recycled aggregates for natural virgin aggregates.

II. LITERATURE REVIEW

Early studies shows that recycle aggregates gives satisfactory result while it is partially replaced by natural aggregates, recycled aggregates can also replace along with micronized biomass silica(MBS) and it has been find that recycled aggregate concrete (RAC) obtained lower slump value while only RAC gives higher slump value. RAC with MBS posses higher compressive strength then RAC without MBS [1]. Coconut shells is replaces by coarse aggregates in Concrete Hollow Blocks (CHB) and it has been found that compressive strength of CHB with coconut shell and fiber attained the highest average loads and stress compared to commercial CHB, thermal conductive of CHB with Coconut shells (CS) increased, the good indicator of CHB with cocnut shell and fibers are particles shape and and texture, resistance to crushing, absorption and surface moisture, grading, resistance to freezing and heating and lightweight[3]. When cockle shell partially replaced natural coarse aggregate in concrete, it has been found that workability of concrete is reduced but at the same time when cockle shell replacement upto 20% possess higher compressive strength compare to controlled specimen[4]. Cockle shell produces harsh mix which cause diffculites to produce dense concrete thus disrupt

Manuscript received Aug 29, 2014

Vikash Kumar Singh, M.tech Scholar, Laxmi Narian College of Technology, India
Pradeep Tiwari, Assistant Professor, Laxmi Narian College of Technology, India
Devansh Jain, Assistant Professor, Laxmi Narian College of Technology, India

the strength performance[4]. When ceramic waste(CW) is replced by coarse aggregates it has been found that it can gives better result when it replaced 10-20% of natural aggregates[4].

III. EXPERIMENTAL PROGRAM

A. Material Used

1. **Cement:** Ordinary Portland Cement of Grade 53 is used, which conforming IS 12269. 53 grade cement of ultra tech with a remarkably high CS3 (tricalcium providing long-lasting) durability to concrete structures. Produces highly durable and sound concrete due to very low percentage of alkalis chlorides, magnesia;
2. **Fine Aggregate:** Natural river sand conforming to Zone II as per IS 383 (1987) was used. The fineness modulus of sand used is 2.64 with a specific gravity of 2.59.
3. **Coarse aggregate**

a. **Natural Crushing Stone** Crushed granite coarse aggregate conforming to IS: 383 (1987) was employed. Coarse aggregate of size 20 mm down having the specific gravity of 2.77 and fineness modulus of 7.21 was applied.

b. **Recycle Aggregates:** Recycle aggregates is collected from a currently demolished building site in Bhopal, recycled aggregate used is strictly passed from 20 mm sieve with specific gravity

c. **Coconut Shells:** Coconut Shells is collected from mahaveer trades in vidisha, and cocnut shells used is strictly passed from 20 mm sieve.

B. Mix Proportions: The mixture proportions for the controlled concrete of M30 grade were arrived at from the trail mixes. Concrete mix of M30 grade was designed as per specification of IS 10262 : 2009, for water cement ratio 0.5. in this project 10,15 and 15% on natural aggregate are replaced by coconut shells (CS) and recycled aggregate (RA). The mix which was prepared are given in table 1.

S.No.	Mix Name	Specification
1.	CC	Control Concrete
2.	CS10	Natural Aggregate is 10% replaced by Coconut shells.
3.	CS15	Natural Aggregate is 15% replaced by Coconut shells.
4.	CS20	Natural Aggregate is 20% replaced by Coconut shells.
5.	RA10	Natural Aggregate is 10% replaced by Recycle Aggregates.
6.	RA15	Natural Aggregate is 15% replaced by Recycle Aggregates.
7.	RA20	Natural Aggregate is 20% replaced by Recycle Aggregates.

Table: 1 Mix Design names with specifications.

C. Preparation of Test Specimen:

The ingredients for various mixes were weighed; required water was added and mixed by using a tilting drum type concrete mixing machine. Precautions were taken to ensure uniform mixing of components. The specimens were cast in steel mould and com- pacted on a table vibrator. The specimens of 15cm × 15 cm× 15 cm size of cubes were put as per Indian standard IS: 516 (1959) according to which it is the size to be used for coarse aggregate size of up to 20 mm for the determination of compressive force at different ages and for the durability properties. Healing of the specimens was started as soon as the top surface of the concrete in the mold was hard enough. Spreading wet gunny bags over the mold for 24 hours after the casting was carried away in the initial healing. The specimens were later demoulded and placed immediately in water tank for further curing.

D. Curing: :

Healing of the specimen done as per IS 516 : 1959, The test specimen shall be stored on the site at a place free from vibration, under damp matting, sacks or other similar material for 24 hours +- ½ hour from the time of adding the water to the other components. The temperature of the place of storage shall be inside the range of 22o to 32o C. After the period of 24 hours, they shall be noted for later identification, taken away from the molds and, unless required for testing within 24 hours, stored in clear water at a temperature of 24o to 30oC until they are sent to the testing lab. They shall be committed to the testing laboratory well packed in damp sand, damp socks, or other suitable material so as to arrive there in a damp condition not less than 24 hours before the time of the trial. On arrival at the testing laboratory, the specimen shall be stored in water at a temperature of 27o+- 2oC until the time of the trial. A platter of the daily maximum and minimum temperature shall be kept both during the menstruation of the specimen remain on the website and in the laboratory, and test conducted for the specimen after 7, 14 and 28 days.

E. Test Conducted

1. **Compressive Strength:** compressive strength is the capability of a material or social system to withstand loads tending to reduce size. It can be assessed by plotting applied force against deformation in a testing machine. Some material fracture at their compressive strength limit; others deforms irreversibly, so a dedicated measure of deformation may be regarded as the limit for compressive load. The compressive strength of concrete was determined using 150mm concrete cubes. The concrete was made by replacing 10, 15, 20% of the coarse aggregate by recycling aggregate and Coconut shells. Also concrete cubes without RA and CS were cast in comparison. Compressive strength is often measured on a universal testing machine; these range from very small tabletop systems to ones with over 53 MN capacity. Measurements of compressive strength are affected by the specific test method and conditions of measurement. Compressive forces are commonly described in relation to a specific technical standard
2. **Workability:** Workability is one of the physical parameters of concrete, which affects the intensity level and durability as well as the price of labor and

appearance of the finished ware. **Concrete is said to be workable when it is easily laid and compacted homogeneously Slump cone test was taken to determine the workability of concrete admixture.** Metal molds, in the form of the frustum of a cone, open at both goals, and furnished with the handle, top internal diameter 4 in (102 mm), and bottom internal diameter 8 in (203 mm) with a peak of 1 foot (305 millimeter). A 2 foot (610 millimeter) long bullet nosed metal rod, 5/8 in (16 mm) in diameter. The examination is carried out employing a mold known as a slump cone or Abrams cone. The cone is positioned along a hard non-absorptive surface. This cone is filled with fresh concrete in three levels, each time it is tamped using a pole of standard dimensions. At the conclusion of the third phase, concrete is struck off flush to the height of the stamp. The cast is carefully lifted vertically upwards, so as not to stir up the concrete cone. Concrete subsides. This subsidence is termed as slump, and is appraised into the nearest 5 mm if the slump is <100 mm and measured to the nearest 10 mm if the slump is >100 mm.

S.No.	Mix	Workability (Slump) in mm
1	CC	50
2	CS10	35
3	CS15	30
4	CS20	25
5	RA10	45
6	RA15	40
7	RA20	36

Table 2: workability of different Concrete Mix

S.No.	Mix	Compressive Strength in Mpa	
		7 Days	28 Days
1	CC	26.1	38.9
2	CS10	10.16	23.56
3	CS15	17.29	22.56
4	CS20	17.82	19.33
5	RA10	28.2	38.12
6	RA15	24.4	33.1
7	RA20	22.7	31.2

Table 3: Compressive Strength of Different Mix of Concrete

IV. RESULT AND DISCUSSION

a. Workability:

Visual observation during mixing and compaction of all the concrete suggested that the concrete were homogeneous; there was no segregation and bleeding, the mixes were compactactable. The fresh state performance of the CS concrete was comparable with control concrete. The concrete had low slump the slump values of the concrete were between 25-35 mm, whereas RA concrete has low slump when it compares to control concrete and have high slump when it compare to CS concrete, values of its slump varies from 36-45 mm. observation shows the workability decrease with the increase in the CS and RA percentage. In CS concrete the slump is quiet low as compare to RA concrete, but in both concrete slump goes down with the increase in the percentage of replacement. Result of workability of difference mixes is given in table 2 and Figure 1.

b. Compressive Strength

Table 3 and Figure 2 shows the result for the Compressive Strength of different mixes in which controlled concrete results 38.9MPa in 28 days of curing where Compressive strength of CS concrete is little low when it compares to RA concrete and controlled concrete, it is due to the CS is unable to make proper bonding, the compressive strength of CS concrete is vary from 19.33 to 23.56 MPa And when it come RA concrete the results was good and satisfactory when compare to controlled concrete and CS concrete. It is also observed that the compressive strength is decreased with the increase in percentage of replacement in both CS and RA concrete. It has been observed that in CS concrete that upto 40-85% of the strength is attain in initial 7 days of curing than its strength is increased upto 28 day of curing, while in RA concrete 70-75% strength is achieved in initial 7 days of curing.

CONCLUSION

Result of experiment on the basis of compressive strength and Workability (Slump Cone test) for different CS and RA replaced concrete have been presented with those of controlled concrete. The data shows the CS and RA aggregates can be in the place of natural aggregate, the main points of the this study are given below:

1) Performance of CS aggregate concrete is lower than natural aggregate concrete.
2) Performance of RA aggregate concrete is little lower than natural aggregate concrete.
3) Workability decrease as we increase percentage of CS in concrete.
4) Little Workability decrease as we increase percentage of RA in concrete.
5) Compressive strength is decreased with the addition to CS in concrete.
6) Compressive strength is good when concrete natural aggregate is replaced by RA aggregate.
7) In CS concrete its CS10 mix gives good results with 23.56 MPa and35 mm as their compressive strength and workability respectively.
8) In RA concrete its all RA10 RA15 and RA20 mix gives good compressive strength and all mix are use able with 38.12, 33.1 and 31.2 MPa as their compressive strength respectively along with good slump 45,40,36 mm respectively.
9) As study shows that both RA and CS concrete are useable but in comparison study suggest to use RA concrete.

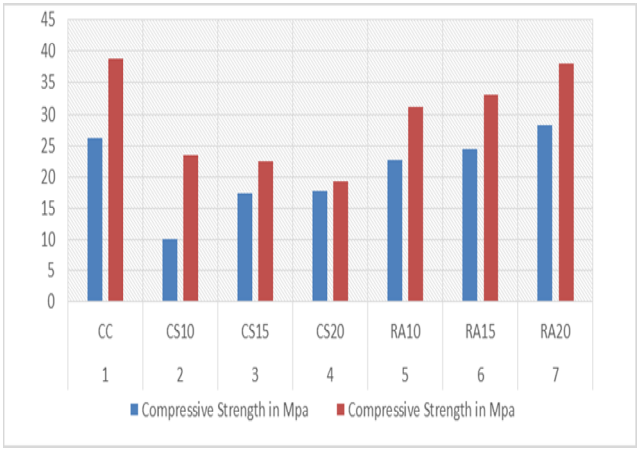

Figure 1: Workability of Different Mix of Concrete

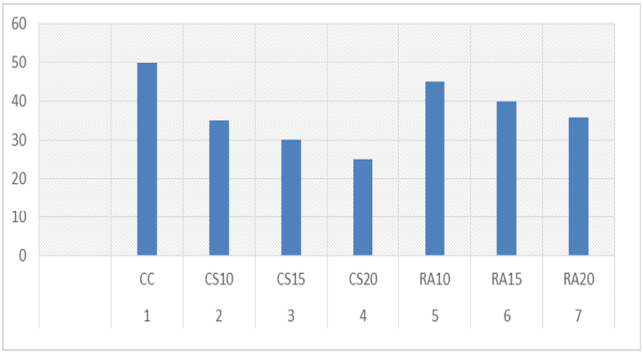

Figure 2: Compressive Strength of Different Mix of Concrete

REFRENCES

[1] "Recycled Aggregate as Coarse Aggregate Replacement in Concrete Mixes"; ASEN Australian Engineering Congress 2011, Sarawak, Malaysia.

[2] "Investigation on stone dust and ceramic scrap as aggregate replacement in concrete", international Journal of Civil and Structural Engineering, Volume 1, No.3, 2010, pp 661-666; ISSN 0976-4399.

[3] "Recycling of waste Coconut Shells as Substitute for Aggregate in Mix Proportion of Concrete Hollow Blocks|"; WSEAS Transactions on Environment and Development; Volume 9, Issue, October 2013, pp. 290-300; ISSN 2224-3496.

[4] "Cockel Shell: A Potential Partial Coarse Aggregate Replacement in Concrete"; International Journal of science, Environment and Technology; Volume 1, No. 4, October 2012, pp. 260-267.

[5] "Properties of concrete with coconut shells as aggregate replacement", International Journal of Engineering Inventions; Volume 1, Issue 6, October 2012, pp. 21-31; ISSN 2278-7461; www.ijeijournal.com.

[6] "The Use of Sawdust Ash as Fine Aggregate Replacement in Concrete"; Journal of Environmental Research and Development; Volume 3, No. 3, January-March 2009, pp. 720-726.