International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 12 | Dec 2021 www.irjet.net p-ISSN: 2395-0072

Concrete using Recycled Aggregate

Sunidhi Magadum[1], Sachin Patil[2]

[1]M-Tech (Student), Sanjay Ghodwat University, Kolhapur.
[2]Assistant Professor, Civil Department, Sanjay Ghodwat University, Kolhapur.

Abstract - *This research work presented on using recycled aggregate in concrete. In construction concrete is main material and aggregate take almost 60-70% volume of concrete, hence use of natural aggregate getting more which create environmental unbalance also there is problem of construction waste disposal. Therefore using of recycled aggregate as a replacement of natural aggregate is beneficial for environmental balance. In this paper research is done related to effect of RA on properties of concrete.*

This research was carried out testing workability test, compressive taste and flexural test, also done comparison between properties of natural aggregate and recycled aggregate. There were percentage of replacement NA with RA considered 0%, 10%, 20%, 30%, 40%, 50% and 100% . There workability of concrete decreased after increasing amount of RA in concrete, also the compression strength and flexural strength decreased.

***Key Words*: Concrete, Natural aggregate, Recycled aggregate, Compression strength, Flexural strength.**

1. INTRODUCTION

Increasing of solid waste is one of the main environmental challenge, and major portion of total solid waste production is taken by construction and demolition waste. Construction and demolition waste increase day by day due to demolition of old structures, construction of new once which is required according to population growth, damage of structure, expansion of traffic direction, rearrangement of town and natural disasters. Large amount of Construction and Demolition waste (CDW) are generated and most of it used in the landfills. But now days due to shortage of dumping site and increase in cost of transport, developing countries are facing problems of handling and disposing of such waste, India is also one of the developing countries who is facing same problem. Therefore developers, contactors and builders must consider were to pull out all construction waste generated during renovation, demolition and construction. For reducing construction and demolition waste the best option reusing of waste material. In civil engineering large amount of construction materials are replaced by reprocessed construction and demolition waste, but in most of countries the reprocessed material are not used due to lack of knowledge. In other hand concrete is playing important role in construction industry. Concrete is mixture of cement, sand and aggregate, proportion of these materials is based on the grade of concrete. The aggregate takes 60 to 70% volume of concrete for this we use natural aggregate. Also the use of natural aggregate (NA) is gating more with the advanced development in infrastructure area. The increased removal of coarse aggregate of natural resources for complete required demand, this will creates an environmental imbalance. Therefore reduce use of natural aggregate, recycled aggregate (RA) can be used as the replacement of material.

The recycled aggregate is produced by crushing and grading material processed from construction and demolition waste. These materials are collected from road, building, bridges, concrete product which are rejected, etc. Testing of recycled aggregate is very important to know the quality of recycled aggregate for manufacturing new concrete. We can use recycled aggregate for replacement of natural aggregate only if it not contains any type of hazardous. In most of case harmful things are found on the concrete surface but not on aggregate used in concrete, hence recycled aggregate can use as replacement of natural aggregate. Therefore use of recycled aggregate as replacement reduces the use of natural aggregate in concrete; also demand of natural aggregate get reduces. This is not only solves the problem of disposing waste but also reduce use of natural aggregate in large amount to maintain the ecological balance.

1.1 Recycled aggregate

Recycled aggregate is obtained by recycling construction and demolition waste, which is also, helps to reduce amount of construction and demolition waste. Recycling of waste concrete is done to reuse the aggregate in new concrete. Large amount of waste concrete generated every year in all world due to following reason a) demolition of building due to earth quake b) demolition of old structure and constructing new one C) concrete waste generated in laboratory. Disposing of this construction and demolition creats many problems, hence recycling this waste helps to solve these problems. Recycled aggregate which is used in this experiment collected from 23 year old building (Sugar factory boiler foundation). M25 is original concrete grade from which aggregate are recycled.

2. MATERIAL

The material used is OPC of grade 43, all cement properties will be test as per IS 12269:1987. Selection of natural sand which fulfill requirement of IS 383:2016, Natural Aggregate 20mm and 10 mm size of well graded coarse aggregate is used. Recycled Aggregate is collected from 23 year old building (Sugar factory boiler foundation). M25 is original concrete grade from which aggregate are recycled.

2.1 Material properties

Table 1. Properties of Aggregate

Sr. No.	Properties	Natural Coarse Aggregate	Recycled Coarse Aggregate	IS Standard
1	Shape and Texture	Well rounded, smooth, angular and rough	Angular with rough surface	-
2	Sp. Gravity	2.80	2.72	2.5-3.0
3	Impact value	16.34%	19.65%	< 20%
4	Abrasion value	17.6%	37.3%	< 50%
5	Crushing value	19.35%	24.39%	<30%
6	Flakiness index	4.85%	5.51%	< 25%
7	Elongation index	16.1%	17.45%	< 25%

3. Concrete Mix Design

Concrete mix design is done for M20 grade is done as per IS: 10262 – 2009. The Proportion of concrete mix design is given in Table2.

Table 2. Mix Proportions

Weight	W/C	Cement	Fine aggregate	Coarse aggregate
Kg/m^3	160	320	717.02	1411.73
Ratio	0.5	1	2.24	4.412

4. RESULT

4.1 Compressive strength

Compressive strength of recycle aggregate concrete calculated as per IS 516-1959. They are following formula:

Compressive Strength = $\frac{P}{A}$

Where P = Load (KN)

A = Cross-sectional Area

Sample Calculation: If load, P = 464.6 KN, A = 150 X 150 mm^2.

$= \frac{418.95X10^3}{150X150}$

= 18.62Mpa

4.1.1 Compressive strength of concrete

After 7 and 28 days of curing the results are following.

Table 3. Compression strength

Sr.No	Percentage of RA	Compression Strength (N/MM)	
		7 days	28 days
1.	0%	18.62	27.92
2.	10%	18.17	27.84
3.	20%	17.74	27.72
4.	30%	17.40	27.15
5.	40%	17.17	26.46
6.	50%	16.83	24.54
7.	100%	15.96	22.80

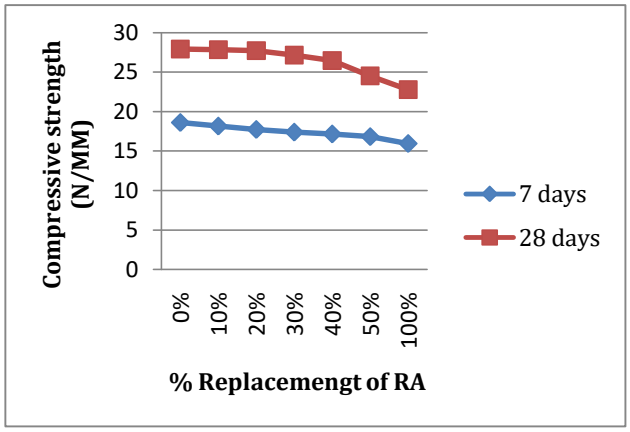

Chart -1. Comparative graph for 7 and 28 days of compressive strength

4.2 Flexural Strength

Flexural strength of recycle aggregate concrete calculated as per IS 516-1959. They are following formula: -

Flexural stress $= \frac{WL}{BD^2}$

Where, W - Load applied

L - Length of the beam

B - Breadth of the beam and

D - Depth of the beam.

Sample calculation: If, W= 4.57 KN, L=500mm, B=100mm, D=100mm

Flexural stress = $\frac{4.57X10^3X400}{100X100^2}$

= 1.79MPa

4.2.1 Flexural strength of concrete

After 7 and 28 days of curing the results are following.

Table 4. Flexural strength

Sr. No	Percentage of RA	Flexural Strength (N/MM)	
		7 days	28 days
1.	0%	1.79	3.21
2.	10%	1.71	3.15
3.	20%	1.67	3.11
4.	30%	1.62	3.01
5.	40%	1.57	2.89
6.	50%	1.52	2.81
7.	100%	1.45	2.74

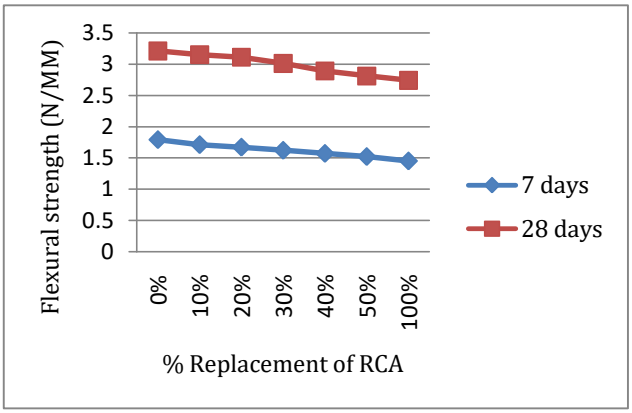

Chart-2. Comparative graph for 7 and 28 days of flexural strength

5. CONCULSIONS

1. Properties of natural aggregate and recycled aggregate stratify IS standard specification.
2. Compression strength of concrete decrease proportional to increasing percentage of recycled aggregate in concrete.
3. Also increasing recycled aggregate percentage in concrete cause decrease in flexural strength.
4. It is found that there is not much variation in strength between natural aggregate concrete and 40% recycled aggregate concrete, hence best percentage of replacing natural aggregate with recycled aggregate is 40%.

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