

SUSTAINABLE USE OF RECYCLED AGGREGATE IN CONCRETE

MISS. KALYANI RAMESH MAMDYAL

ME Student, Civil Engineering Department,
N.B.N. Sinhgad College of Engineering, Kegaon, Solapur, India

PROF. JAWALKAR G. C.

Assistant Professor, Civil Engineering Department,
N.B.N. Sinhgad College of Engineering, Kegaon, Solapur, India

ABSTRACT

In this research study, Natural coarse aggregates are replaced by Recycled coarse aggregates (RCA) with various percentage of RCA i.e. 25%, 50%, 75%, 100%. An Experimental work was performed to determine the compressive strength of recycled coarse aggregate concrete and to compare them with those of concrete made using natural coarse aggregate.

KEYWORDS: Concrete mix; compressive strength; Natural aggregates; Recycled aggregates; Different Grades i.e. M25, M30, M35

1. INTRODUCTION

Demolition of old and deteriorated building and traffic infrastructure and their substitution with new ones, is a frequent phenomenon today in most of the part of world. The main reason for this situation are changes of purpose, structural deterioration, rearrangement of city, expansion of traffic directions and increase of traffic load, natural disasters like earthquake, flood fire etc. As per Times of India report, India generates 10-12 million tons of C& D waste annually. And 50% of it is Concrete and Masonry which is not recycled in India. The most common methods of disposing this material are land filling. In these way large amounts of construction waste is generated, consequently becoming a problem a special problem of human environment. For this similar reason in developing countries, laws have been bought into practice to restrict this waste in the form of prohibitions or special taxes existing for creating waste areas. To take care of the C& D waste in India Ministry of Environment and forests has mandated environmental clearance for all large construction projects. .

Sustainable construction rather than a fancy idea now is a necessity. It was introduced due to the growing concern about future of the planet, and it applies specifically for construction industry as, this being a huge consumer of natural resource. In addition to the 1.6 billion tons (1.5 billion tones) of cement used worldwide, the concrete industry is consuming 10 billion tons of sand and rock, and 1 billion tons of mixing water annually. In short the concrete industry, which uses 12.6 billion tons of raw materials each year, is the largest user of natural resources in the world. It's the world's most widely used construction material. But at the same time it is not an environmentally friendly material too.

The possible solution to these problems is to recycle demolished concrete and produce an alternative aggregate for structural concrete. Recycled Concrete aggregates (RCA) as popularly known can be used as aggregates in concrete as partial or total replacement. Concrete made with such recycled concrete aggregate is called as Recycled concrete aggregate (RAC). However before moving further with this concept it is very important to elevate the status of recycle material through research, development and performance data for the material as compared to virgin material.

2 .EXPERIMENTAL WORK

A) OVERVIEW

For this experiment concrete was made with three different mix proportions which are M25, M30, and M35. For testing compressive strength four different percentage combinations made which are 25%, 50%, 75%&100%.

B) MATERIAL

The cement used is Ordinary Portland cement of 53 grade manufactured by J.K.Cement Company. Crushed granite stone of maximum size 20mm conforming to IS 383-1970 used as coarse aggregates. The fine aggregate used in this investigation was passing through 4.75mm sieve. The grading zone of fine aggregate was zone II as per Indian standard specification. RCA used in this research is aggregates obtained from demolition structure, of old House on Vijapur road near R.T.O. office, Solapur.

C) MIX PROPORTION

For this investigation, the concrete Grade M25, M30 &M35 for the samples was used. The detailed mix designs of different grads of concrete are given below.

Table 1.Mix proportion for 1m³ M25 Concrete

| W/C ratio | Water | Cement | Sand | Aggregate |
|-----------|-----------|-----------|-----------|------------|
| 0.41 | 231.56 kg | 480.87 kg | 645.87 kg | 1161.44 kg |

Table 2.Mix proportion for 1m³ M30 concrete

| W/C ratio | Water | Cement | Sand | Aggregate |
|-----------|--------------------------|----------|-----------|------------|
| 0.40 | 231.25 kg/m ³ | 492.9 kg | 639.23 kg | 1159.38 kg |

Table 3. Mix proportion for 1m³ M35 concrete

| W/C ratio | Water | Cement | Sand | Aggregate |
|-----------|-----------|-----------|---------|-----------|
| 0.38 | 230.78 kg | 518.42 kg | 624.68g | 1152.34g |

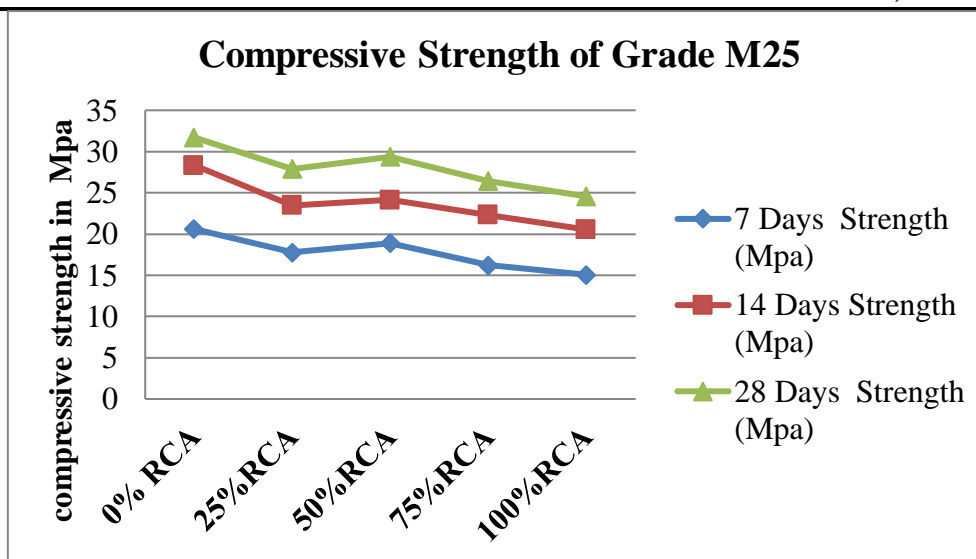
D) PREPARATION OF TEST SPECIMEN

To compare the compressive strength of RCA with normal aggregates concrete cubes of size 150x150x150 mm was used.

3. RESULT AND DISCUSSION

A) TEST RESULT OF COMPRESSIVE STRENGTH OF GRADE M25

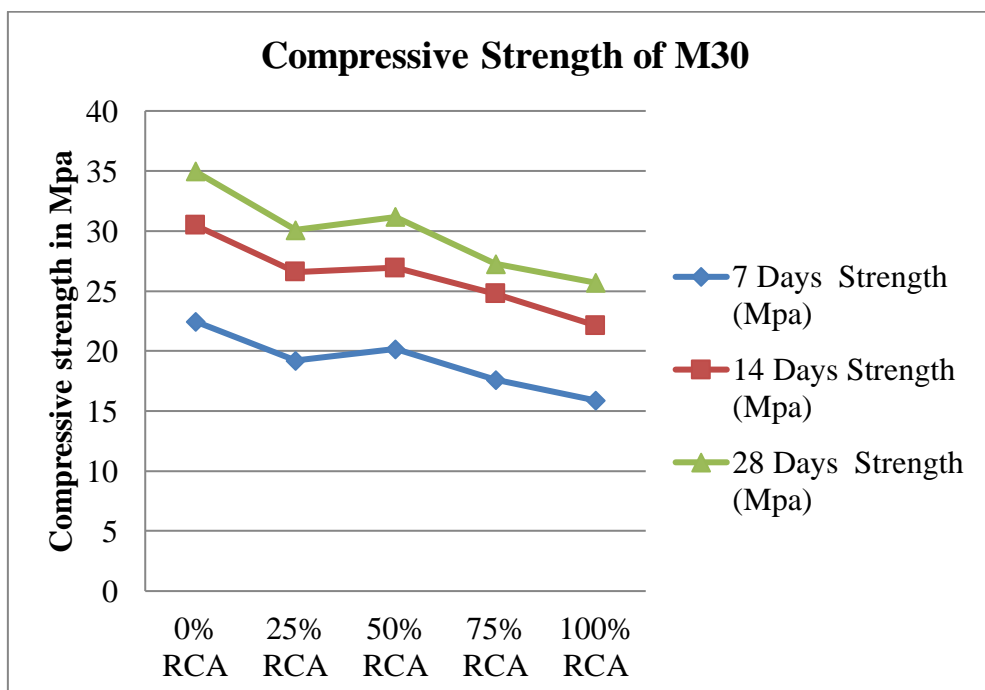
| Sample | 0% Replacement | 25% Replacement | 50% Replacement | 75% Replacement | 100% Replacement |
|----------------------------|----------------|-----------------|-----------------|-----------------|------------------|
| 7Days Cube Strength (Mpa) | 20.60 | 17.78 | 18.89 | 16.20 | 15.06 |
| 14Days Cube Strength (Mpa) | 28.33 | 23.47 | 24.12 | 22.32 | 20.54 |
| 28DaysCubeStrength (Mpa) | 31.70 | 27.89 | 29.37 | 26.41 | 24.56 |



Comparison of Compressive Strength of Grade M25 with Different Percentage of RCA

B) TEST RESULT OF COMPRESSIVE STRENGTH OF GRADE M30

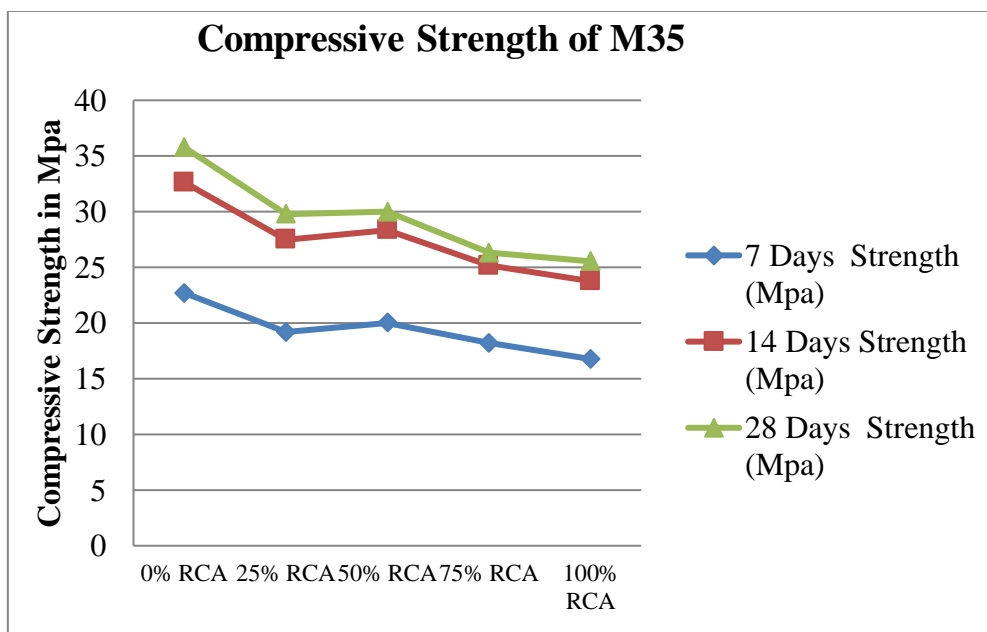
| Sample | 0% Replacement | 25% Replacement | 50% Replacement | 75% Replacement | 100% Replacement |
|----------------------------|----------------|-----------------|-----------------|-----------------|------------------|
| 7Days Cube Strength (Mpa) | 22.46 | 19.20 | 20.16 | 17.59 | 15.88 |
| 14Days Cube Strength (Mpa) | 30.47 | 26.6 | 26.94 | 24.78 | 22.13 |
| 28Days Cube Strength (Mpa) | 34.96 | 30.08 | 31.17 | 27.25 | 25.69 |



Comparison of Compressive Strength of Grade M30 with Different Percentage of RCA

C) TEST RESULT OF COMPRESSIVE STRENGTH OF GRADE M35

| Sample | 0% Replacement | 25% Replacement | 50% Replacement | 75% Replacement | 100% Replacement |
|----------------------------|----------------|-----------------|-----------------|-----------------|------------------|
| 7Days Cube Strength (Mpa) | 22.70 | 19.17 | 20.02 | 18.21 | 16.77 |
| 14Days Cube Strength (Mpa) | 32.63 | 27.49 | 28.36 | 25.16 | 23.76 |
| 28DaysCubeStrength (Mpa) | 35.78 | 29.78 | 29.98 | 26.32 | 25.54 |



Comparison of Compressive Strength of Grade M35 with Different Percentage of RCA

DISCUSSION

1. Decrease in compressive strength was observed as percentage of RCA increased for Grade M25, M30 and M35.
2. For M25Grade, replacement of 100% RCA is not giving appropriate compressive strength but replacement of 25%, 50%, and 75% RCA gives required compressive strength however replacement of 50% RCA gives better result.
3. For M30 Grade, replacement of 75% and 100% RCA is not giving appropriate compressive strength but replacement of 25% and 50% RCA gives required compressive strength however replacement of 50% RCA gives better result.
4. For M35 Grade, replacement of 25%, 50%, 75% and 100% RCA is not giving appropriate compressive strength.

4. CONCLUSION

1. Decrease in compressive strength was observed as percentage of RCA increased for Grade M25,M30,M35
2. The compressive strength of concrete containing 50% RCA has strength in close proximity to that of normal concrete.

REFERENCES

- I. "A Guide to Recycled Concrete for the 2012 Olympic Village" Business Magazine The Magazine for Business People, December 30th 2009.
- II. Andres Salas, Postdoctoral Researcher, University of Illinois at Urbana-Champaign, "Batching Effects on Properties of Recycled Concrete Aggregates"
- III. "Concrete Recycling", Wikipedia, the free encyclopedia
- IV. Cheolwood Park, Ph.D., P.E. Research Professor Department of Civil and Environmental Engineering, Hanyang University, Ansan, Korea Da Jongsung Sim, Ph.D. Professor Department of Civil & Environmental Engineering, Hanyang University: Jul. 27 2005), "Fundamental Properties of Concrete using Recycled Concrete Aggregate produced through Advanced Recycling Process".
- V. Keith W. Anderson, Jeff S. Uhlmeyer, Mark Russell, "Use of Recycled Concrete Aggregate in PCCP", June 2009.
- VI. M C Limbachiya, A Koulouris, J J Roberts and A N Fried, "Performance of Recycled Aggregate Concrete", Kingston University, UK, 2004.
- VII. M.S.Shetty, College of Military Engineering Pune, "Concrete Technology".