

---

## REVIEW PAPER ON STUDY USING DEMOLISHED CONCRETE FOR PAVEMENT CONSTRUCTION

Mintu Singh<sup>1</sup>, Shivani<sup>2</sup>

<sup>1</sup>Student, Sat Priya Group of Institutions, Rohtak, India.

<sup>2</sup>Assistant Professor Sat Priya Group of Institutions, Rohtak, India.

\*Corresponding Author

E-mail Id: mintu.singh101@gmail.com

DOI: <https://www.doi.org/10.58257/IJPREMS33411>

---

### ABSTRACT

Recycled aggregates consist of crushed, graded inorganic particles processed from the material that have been used in the constructions and demolition debris. The aim of the present study is to determine the strength characteristic of recycled aggregates for the application in concrete pavement construction. The scope of the thesis is to determine and compare the compressive strength, flexural strength and sulphate resistance of concrete by using different proportions of recycled aggregates. The investigations were carried out for workability test, compressive strength test, flexural strength test and sulphate resistance test. A total of five mixes of M-40 grade concrete with replacement of coarse aggregates with 0%, 10%, 20%, 30% and 40% recycled coarse aggregates were studied. The water cement ratio was kept constant at 0.38. The workability of concrete in general was decreased with the increase in recycled aggregates in concrete. For the strength characteristics, the results showed that the strengths of recycled aggregate concrete were comparable to the strengths of natural aggregate concrete.

**Keywords-** inorganic particles, recycled aggregate, demolition debris, workability test, compressive strength

---

### 1. INTRODUCTION

In the era of construction, concrete has been the leading building material since it was discovered and found viable for future due to its durability, easy maintenance, wide range of properties and adaptability to any shape and size. Concrete is the composite mix of cement, aggregates, sand and water. Concrete gets hardened like stone on mixing water with cement and aggregates. Concrete has two types of ingredients namely active and inactive. The active group consists of water and cement. The inactive part consists of sand and coarse aggregates. Concrete has high compressive strength and low tensile strength. To overcome this shortcoming, steel reinforcements are used along with the concrete. This type of concrete is called reinforced cement concrete (RCC).

Concrete structures that are designed to have service lives of at least 50 years have to be demolished after 20 or 30 years because of deterioration caused by many agents. Old buildings require maintenance for better and higher economic gains. The rate of demolition has increased and there is a shortage of dumping space and also increase in cost of dumping. Instead of dumping this demolished concrete, use of demolished concrete as recycled concrete would not only reduce the cost but also conserve the non-renewable energy sources. The use of demolished concrete will further result in reduction in use of natural aggregates. The usage of natural aggregates is causing damage to natural resources resulting in imbalance in environment. Recycled aggregates consist of crushed, graded inorganic particles obtained from the materials that have been used in constructions. Recycled aggregates are generally obtained from buildings, roads and bridges which are demolished due to completion of life, wars and earthquake.

#### Background

#### Developments

Earthquakes and bombarding in wars causes a lot of destruction of buildings and roads causing generation of lot of concrete waste. In Second World War, bombardment caused demolition of buildings and roads. Transportations and reconstruction were the restrains in economy. At the same time, disposal of concrete waste was also a big problem. The idea of reusing demolished concrete as aggregates gave a solution to this problem and hence was justified as alternative material source in 1976. Worldwide aggregate use is estimated to be ten to eleven billion tons each year. Of this, approximately eight billion tons of aggregate (sand, gravel, and crushed rock) is being used in Portland cement concrete (PCC) every year [Naik 2005, Mehta 2001]. Also there is a critical reduction of natural aggregate and an increasing amount of demolished concrete [Hansen 1984]. It is estimated that 150 million ton of concrete waste is produced in the United States annually [Salem 2003]. In 2005, the American Society of Civil Engineers reported US infrastructure in poor condition with an estimated repair cost of \$1.6 trillion over five years.

## 2. LITERATURE REVIEW

In road construction recycled aggregates are used as granular base course. They have proved better than the natural aggregates when used as granular base course. In case of wet sub grade areas, recycled aggregates stabilize the base and provide an improved working surface for pavement structure construction. Recycled aggregates are used as base, sub base course and sometimes for foundation purpose also. In USA, the use of recycling technology in a number of full scale pavement rehabilitation projects has been accomplished since 1976 [Kumar, Satish,2002].

In Iowa [Kumar, Satish,2002] recycled concrete was first used in 1976 for the production of new concrete where a 41 years old pavement was crushed and demolished concrete was used for the construction of 1 mile long and 22.5 cm thick highway pavement. In other construction of 17 mile long and 20 cm thick highway pavement, crushed concrete was used in Iowa in 1978. The Minnesota department of transportation recycled 16 mile long plain concrete pavement into a new concrete pavement on trunk highway in 1980. In Netherland, recycled aggregates are used for partition walls in apartments. After the damage caused in Second World War, countries like Germany, England, Netherland and other European countries have tried to use recycled concrete in new construction and made a lot of investigations over it. Some countries have developed code of practice for the use of recycled aggregates. In India recycled aggregates are not much used, but its future seems bright and one can predict remarkable contribution of recycled aggregates.

### Compressive Strength

The ability to resist compression loads is called Compressive strength. It was found that the use of RCA in the concrete mix decreased compressive strength compared to natural aggregate. But it was also found that, at 28 days, all mix designs usually exceeded 50MPa compressive strength [Shayan 2003]. In one study, it was found that the compressive strength of natural concrete was 58.6 MPa, and the RCA concrete ranged from 50.9 to 62.1 MPa. The compressive strength for 50% RCA concrete was higher than 100% RCA concrete [Poon 2002]. In other study, it was found that the loss of compressive strength was in the range of 30-40% for the concrete made with RCA at 28- days [Katz 2003]. There was very less reduction in 28- and 56-day compressive strength when natural aggregate was partially replaced with RCA and a much greater reduction when RCA was used in full [Abou-Zeid].

In 2002, Buyle-bodin, et. al. showed a comparison between the behavior of RAC and natural aggregates. The affect of both the composition and the curing conditions was discussed. It was observed that durability of RAC was controlled by flow properties of high total W/C ratio and air permeability. The diffusion of CO<sub>2</sub> was faster, that lead to a weaker resistance of RAC to environmental attacks.

In 2003, Hendricks, et.al developed the approach called design for recycling that could be used to optimize design of constructions for later use and the design for disassembly that could be used for demolition. For the technical aspects two models were developed concerning degradation processes and the high graded applications. These models were based on life cycle assessment method.

A lot of investigations have been done for use of demolished concrete and it was found that the use of recycled aggregate is an appropriate solution to the problem dumping and transportation of demolished concrete. It was found that the recycled aggregates are valuable building material in environmental, economical and technical aspects. Initially, recycled aggregates were used as landfills but now a day they are used for construction for buildings and roads. Recycled aggregates have been used in concrete kerb and gutter mix in Australia [Shing Chai NGO,2004]. In the project of Lenthall Street in Sydney, 10 mm recycled aggregates and blended recycled sand are used for concrete kerb and gutter mix.

Market development study for recycled aggregates products [Shing Chai NGO,2004] stated that recycled aggregates can be used in embankment fill. The embankment site is on the wet sub grade areas, recycled aggregates can stabilize the base and provide an improved working surface for the remaining work. In Hongkong they are used as paving blocks. Norwegian Building Research Institute mentioned that RCA can be used as backfill materials in pipe zones.

The compressive strength is most affected by the w/c ratio [Lin 2004]. Other influential parameters include fine recycled aggregate content, cleanness of aggregate, interaction between fine recycled aggregate content and crushed brick content, and interaction between w/c ratio and coarse RCA content [Lin 2004]. At a constant w/c ratio, air-dried RCA containing concrete had the highest compressive strength compared to oven-dried and saturated surface dry RCA [Poon 2003]. Particularly at lower w/c ratios. unwashed RCA reduces compressive strength. Compressive strength is 60% of virgin concrete at 0.38 w/c and 75% at 0.6 w/c.

In 2006, Poon et.al studied the environmental effects of using recycled aggregates. Concrete mixes were prepared with varying proportions of recycled aggregates. The proportion of recycled aggregates was kept varying from 0% to

100%. Target strength was kept 35 MPa. The investigations were made on affect of recycled aggregates on slump value and bleeding. The effects of delaying the bleeding tests and using fly ash on the bleeding of concrete have been examined. From this study, it was found that the use of recycled aggregates caused higher rate of bleeding. The slump of concrete mixes or without recycled aggregates was increased due to replacement of cement by 25% fly ash. It reduced bleeding rate and bleeding capacity with only minor negative effects on concrete strength at or before 28 days, but it gave positive effects on strength at age of 90 days.

### 3. CONCLUSION

The present study of air entrained concrete has given a number of conclusions. Whilst some results remain fruitful for future aspects, other makes the use of AEA's to be a troublesome issue.

While enumerating the advantages, the noticeable change in workability has been noticed and shortened time and vibrations for proper consolidation. Decreased strength of concrete is the major concern towards the usage of AEA's. Hence, the practical implication towards the usage of AEA's can be attributed to the fact that how much strength of a structure can be sacrificed so as to optimise the usage of AEA's. However, after the series of test results being achieved, a consolidated conclusion regarding the parameters being considered in the present study can be summarised as follows:-

Since workability depends upon the slump value and the compaction factor as well; a gradual increase can be observed in the workability of the concrete as the quantity of air entraining agent is being increased, in general, the slump value increased with increase in the proportion of air entraining agent. Compressive strength has been noticed to increase with age while obtaining the test results of the study. Whilst considering the compressive strength for a particular mix at specified ages, an increasing trend is being seen.

For M0, compressive strength of 38.13 MPa at 7 days rises to 52.37 MPa at 90 days. For M1, compressive strength of 31.56 MPa at 7 days rises to 38.89 MPa at 90 days. For M2, compressive strength of 31.03 MPa at 7 days rises to 39.40 MPa at 90 days. For M3, compressive strength of 30.86 MPa at 7 days rises to 31.80 MPa at 90 days. For M4, compressive strength of 29.70 MPa at 7 days rises to 31.71 MPa at 90 days.

At a particular age, M0 has the highest compressive strength while M4 having the lowest; a decremented pattern can be seen. At 7 days, compressive strength of M0 is 38.13 MPa which further decreases to 29.70 MPa for M4. At 28 days, compressive strength of M0 is 48.29 MPa which further decreases to 30.24 MPa for M4. At 56 days, compressive strength of M0 is 51.76 MPa which further decreases to 31.10 MPa for M4. At 90 days, compressive strength of M0 is 52.37 MPa which further decreases to 31.21 MPa for M4.

### 4. REFERENCES

- [1] Bloem, D. L. Air-Entrainment in Concrete, National Sand and Gravel Association and National Ready Mixed Concrete Association, Silver Spring, Maryland, 1950.
- [2] Barbee, IF (1961) "Effect of Mixing Time and Overloading on Concrete Produced by Stationary Mixers," Highway Research Board Bulletin 295, HRB, Washington:
- [3] Dodson (1990) "Air-Entraining Admixtures," Concrete Admixtures, Van Nostrand Reinhold, New York.
- [4] Attiogbe, E.K., et al. (1992) "Air-Void System Parameters and Freeze-Thaw Durability of Concrete Containing "Air Entraining Agent" Concrete International. American Concrete Institute.
- [5] Detwiler, R. J. et al. (1996) "Supplementary Cementing Materials for Use in Blended Cements, "Research and Development Bulletin RD112T, PCA, Skokie.
- [6] Buenfeld, N.R. and Okundi, E. (1999) "Release of Air from Unsaturated Aggregate during Setting of Concrete," Construction and Building Material.