WATER ABSORPTION AND SPECIFIC GRAVITY OF RECYCLED CONCRETE AGGREGATE FROM DEMOLISHING WASTE OF NAWABSHAH CITY

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Abstract

Construction is increasing day by day due to the demand for new structures. New buildings are being built, old buildings are being demolished. This leads to a lot of waste material. The throwing away of this huge mass of construction waste has happened to a major social and environmental issue all around the world, mostly in developing countries. Therefore, a proper utilization of demolished waste is important in order to deal with this waste and have an alternate material for utilization in concrete.

Therefore, experimental research has been conducted to utilize this waste as recycled coarse aggregates to partially replace natural coarse aggregates. Old concrete was collected from 5 locations in Nawabshah. After collecting all the material we used 5 samples from each source, so we used 25 samples of recycled aggregates. 25 samples of recycled coarse aggregate are tested for water absorption and specific gravity to understand its properties and compare to the natural coarse aggregates. Recycled materials have a higher water absorption rate than natural materials. Among the five places in Nawabshah City, the water absorption rate of recycled coarse aggregate in New Naka's area is higher at 5.8%. The specific gravity of recycled coarse aggregate is lower than the specific gravity of natural coarse aggregates. Among these five sites of Nawabshah city, New Naka & Mehran Hotel area's have lesser specific gravity which is 2.237. So, these aggregates can be used in new constructions, but it is proposed to be initially utilized in low load areas.

Keywords: Demolishing Waste, Recycled Aggregate Concrete, Water Absorption, Specific Gravity

1. Introduction

In the earliest period, man made use of the natural environment as shelter. They used caves and trees for their minimum protection against the heat and cold Slowly and gradually as man became civilized, they changed the mode of construction for their dwellings. As the requirement of construction was changing hence the methods and modes of construction also changed from mud to stone and wood and later to the steel, concrete and glass. With the advent of these early modern methods, especially the concrete was warm welcomed, due to the flexibility and durability, It instantly spread all over the world in shortest possible time. Now a day, concrete is most widely used material in the world, and its rise to this position has played major role in shaping of civilizations.

Alternatively, a extensive range of old buildings are demolished yearly due to city renewal, developing a significant amount of waste concrete, called the development and Demolition (D&D) waste. This speedy boom in waste is ensuing not most effective in finding the proper floor for landfills but also creating environmental degradation.

Concrete waste is usually observed among construction waste, demolition waste, & manufacturing wastes. The frequently generated waste among the other wastes is demolishing building waste. To overcome such issues, the usage of this waste after recycling in new construction is the want of the day.

1.1. Aggregates from demolishing waste

As the infrastructure construction rate is increasing, the construction industry is focusing on the recycled aggregates because the usage of such waste as recycled aggregate in concrete can be a hit for both the environment and economic aspects within the construction industry. Demolished concrete has much scope to be used as coarse aggregates in new concrete. To this end demolished concrete in shape of large pieces and hammered down to required size and graded as per required standards to replace natural aggregates fully or partially.

1.2. Problem Statement

Generally recycled aggregate concrete(RAC) is a waste concrete which is generally used for dumping purpose

and sometime it is thrown in useful land that that create social and environmental problems. Therefore, this material should be properly treated, recycled and used in concrete as coarse aggregate.

1.3. Objectives of the research

The following specific objectives of the proposed result work are summarized:

1. To evaluate the basic properties of aggregates from old concrete waste and natural.
2. Aggregates for comparison.

- Water absorption of coarse aggregates (Natural + Recycled)
- Specific gravity of coarse aggregates (Natural + Recycled)

1.4. Methodology and Plan of Work

To obtain the above objectives of the proposed studies the following methodology will be adopted.

1. Old, demolished concrete was collected from five different locations of demolishing of reinforced concrete structures in Nawabshah city.
2. Large blocks of old concrete were reduced up to 25mm required size by hammering.
3. Sieving was done to get the fine aggregates.
4. Basic properties of recycled aggregates and natural aggregates were evaluated.
5. Dust and debris were removed by washing
6. Sorting of unwanted substance was done manually.
7. Washing of aggregates was done.
8. Five samples of each source were used.
9. The total 25 samples of Recycled aggregates were used.
10. Water absorption and Specific gravity were evaluated accordance with ASTM provision.
11. Water absorption of conventional aggregates was also done.
12. The result of recycled aggregates was compared with the results of natural aggregates and discussed.

2. Material & Testing

Old concrete was collected from 5 locations in Nawabshah. These are Civil engineering department, Quaid-e-Awam colony, B block hostel area, New Naka area and Mehran hotel area. Material was of reinforced concrete slab. Big pieces had been broken into small size pieces via hammering further it was broken into fine particles and then sieved from #4 sieve to get the required size. After collecting all the material we used 5 samples from each source, so we used 25 samples of recycled aggregates.

We understood its properties through tests like water absorption test and specific gravity test and gradation of both the aggregates. The properties were giving the idea of recycled aggregate size, shape and porosity of recycled aggregate to compare the natural aggregate. Figure 1 shows the large pieces of concrete blocks. Figure 2 shows natural coarse aggregates and figure 3 shows recycled coarse aggregates.

Fig. 1: Large pieces of recycled concrete aggregate

Fig. 2: Natural Coarse aggregates

Fig. 3: Recycled coarse aggregates

2.1. Experimental details

In this particular study, we calculate the value of water absorption & specific gravity of both the aggregate of 25 samples which we obtain from 5 different sites. Recycled aggregate concrete had been accumulated

from Nawabshah town. The accrued recycled aggregate concrete become hammered to get aggregate of minimum size of 25mm. Sieving turned into achieved to get the recycled coarse aggregates (Passing from 1" sieve and retained at sieve #4). Table 1 shows total materials in this research work.

Table 1: Total material used

NCA	2kg
RCA	50kg

2.2. Testing of aggregates

2.2.1. Water Absorption & Specific Gravity Test

Water absorption of aggregates is the % of water absorbed by using air-dried mixture while immersed in water for a duration of 24 hours. The water absorption test uses to find the water conserving ability of the aggregates.

Specific gravity of an aggregate is taken into consideration to be degree of power of quality of the substances. Stone having low specific gravity are normally weaker than the ones of higher specific gravity values. This test helps within the identification of stones. Figure 4 shows the setup of water absorption and specific gravity test.

Apparatus used:

Buoyancy Balance, Bowel,Towel and oven

Procedure:

1. Take an aggregate sample thoroughly washed and oven dried.
2. Immersed the sample in water for 24 hours.
3. Take the weight of aggregate in water by means of buoyancy balance.
4. Dispose of the sample from the water and roll it in a big absorption cloth or towel until all of the seen film of water is eliminated.
5. Place the sample in the oven at 110°C for about 18Hrs and then take the oven dried weight.

Fig. 4: Water Absorption & Specific Gravity test Setup

Results of water absorption and specific gravity test:

Natural coarse aggregates (NCA):

Sample (2kg = 2000gm)

- ✧ Oven dried weight of aggregates (A) = 1986gm
- ✧ Saturated surface dry weight of aggregate (B)= 2010gm
- ✧ Weight of aggregate in water (C) = 1245gm

$$\text{Water absorption of aggregates} = \left(\frac{B-A}{A}\right)\times 100$$

$$= \left(\frac{2010-1986}{1986}\right)\times 100$$

$$= 1.2\%$$

$$\text{Specific gravity of aggregates} = \left(\frac{A}{B-C}\right)$$

$$= \left(\frac{1986}{2010-1245}\right)$$

$$= 2.59$$

Table 2: Water absorption and specific gravity of recycled coarse aggregate from different places of Nawabshah city

S.NO	Location	Avg. Water Absorption (%)	Avg. Specific gravity
1	Civil Engineering Department	5.05	2.357
2	Quaid-e-Awam Colony	4.59	2.45
3	B Block Hostel Area	4.87	2.28
4	New Naka Area	5.8	2.237
5	Mehran Hotel Area	5.3	2.237

3. Results & Discussion

In an experimental evaluation, recycled aggregates were collected from five different sites in Nawabshah city. The water absorption of recycled coarse aggregate is higher than the water absorption of natural coarse aggregates. Among these five sites of Nawabshah city, New Naka area's recycled coarse aggregates have greater water absorption which is 5.8%. Figure 5 shows the comparison of water absorption of conventional coarse aggregates and recycled coarse aggregates. The specific gravity of recycled coarse aggregate is lower than the specific gravity of conventional coarse aggregates. Among these five sites of Nawabshah city, New Naka & Mehran Hotel area's have lesser specific gravity which is 2.237. Figure 6 shows the comparison of specific gravity of conventional coarse aggregates and recycled coarse aggregates. The difference in the results of water absorption and specific gravity of natural and recycled coarse aggregates shows the following reasons.

- The difference in the properties is particularly because of the age, dryness and vintage cement connected with the aggregate and greater water requirement. this is why recycled coarse aggregates have more water absorption value than natural one.
- Recycled coarse aggregate (NCA) acquired from vintage mortar sucks extra water reasons in increment the burden of the aggregates, as a result consequences in lesser specific gravity. additionally, the identical sucks greater quantity of the water than conventional aggregates and results in higher water absorption.
- The recycled aggregate has less compressive strength than the conventional aggregate because of its less value of water absorption.
- The number of pores available in recycled coarse aggregate is more than the conventional one that it has more water content.

This definitely suggests that the water requirement of the aggregate must be addressed, while selecting the water/cement ratio of the concrete.

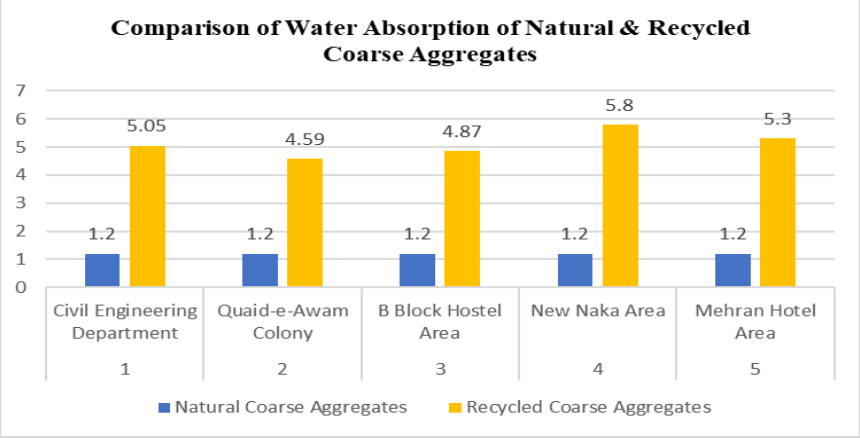

Figure 5: Comparison of Water Absorption of NCA & RCA

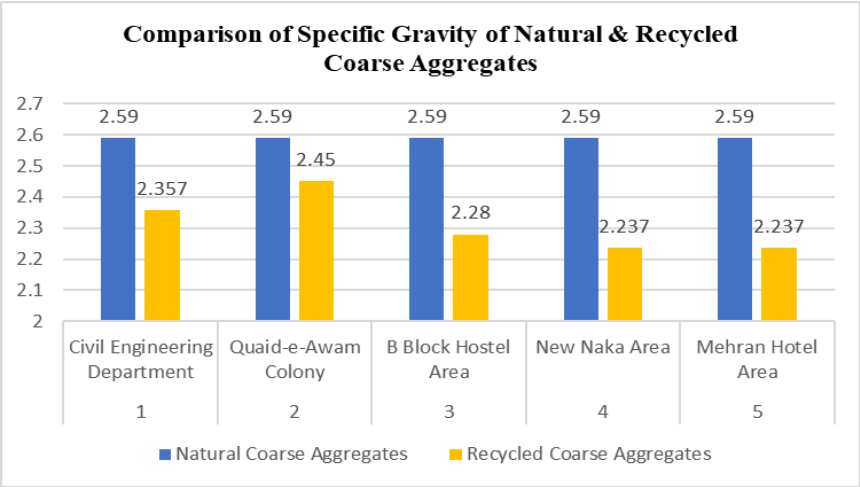

Figure 6: Comparison of Specific Gravity of NCA & RCA

4. Conclusion

An experimental program was conducted to have a look at the properties of these recycled concrete aggregates, consisting of water absorption and specific gravity, in order to understand their behavior for potential use as partial or entire replacements for natural coarse aggregates within the manufacturing of structural concrete. The experimental consequences display that recycled aggregates exhibit different values compared to natural aggregates. To obtain this objective, demolished concrete was accumulated from five different sites of Nawabshah city.

The results of these are presented in the results section. The obtained results show the water absorption of recycled coarse aggregate is greater than the conventional coarse aggregates. Among these five sites of Nawabshah city, New Naka area's recycled coarse aggregates have greater water absorption which is 5.8% and The specific gravity of recycled coarse aggregate is lower than the conventional coarse aggregates. Among these five sites of Nawabshah city, New Naka & Mehran Hotel area's have lesser specific gravity which is 2.237.

Based on outcomes, the following conclusions were obtained:

- The water absorption of recycled aggregates is higher in comparison to natural one.
- The specific gravity of recycled aggregates is lower than natural or conventional one.

So, these aggregates can be used in new constructions, but it is proposed to be initially utilized in low load areas.

5. Suggestions

In this experimental study only five samples of each source were used. Subsequently, 25 samples were tested. Therefore, to understand the impact up to 100% replacement of conventional aggregates with recycled coarse aggregates from old concrete following suggestions are made.

1. We cannot fully replace recycled coarse aggregate with the natural coarse aggregate due to its change of properties.
2. It's has less compressive strength than natural aggregate so it can be used in big projects.
3. It can also replace partially to the natural aggregate due to its change of properties.
4. Recycled aggregate is used according to the project demand, but it can partially replace where the project is on small scale.

With above suggestions, it is hoped that the results particularly water absorption of recycled aggregate and specific gravity will improve than reported based on this work. The outcome will not only improve the literature on the subject but also will prove landmark for practicing engineers but also give better idea to researchers and scholars of the field.

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