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Evaluate the Use of Recycled Aggregate in Concrete

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ABSTRACT

Recycling is a key component of modern waste reduction. The application of recycled aggregate has been started in many construction projects in Australia, America and other Asian countries. This research is an attempt to study the basic properties of recycled aggregate. The properties of the recycled aggregate were also compared with natural aggregates. Additionally, the properties of recycled aggregate.Concrete were also determined and explained here. Concrete cylinders were cast at different replacement of fresh aggregate such as 20%, 40%, 60% and 80%. A total of 45 concrete cylinders of standard size were produced comp rising of 36 cylinders with recycled aggregate and 9 cylinder with fresh aggregates. The basic concrete properties were determined. The compressive strength, UPV and Rebound Hammer test were performed at the age of 7, 14 and 28 day s. Furthermore, the recycled aggregate concrete cylinders properties were also compared with the fresh aggregate concrete cylinders specimen's properties.

1. INTRODUCTION

The rapid development and fast growing urbanization has led us to the utmost increase in the utilization of available resources and energy, thereby resulting increasing amounts of waste. Therefore, for environmental sustainability recycling techniques are essential. In order to properly implement demolition procedures changes must be made to the already existing demolition and construction techniques .

There is s till controversy in construction industry over the idea of appropriate demolition. However, a detailed economic analysis of conventional versus s elective demolition [1] as well as other environmental impacts specifically caused by climatic change, acidification, summer smog, nitrification and amount of heavy metals [2]. Utilization of recycled aggregates, as an alternate for natural aggregates, in construction activities has been considered one of the most effective idea for recycling specific materials from demolition of existing structures, thus contributing to a greater sustainability in construction.

Recycled masonry aggregates may include: bricks, tiles and concrete blocks [3]. The aggregates obtained from demolition works are characterize as three main types. These materials are crushed concrete, masonry and mixed debris. [4, 5].

Aggregates obtained from mixed demolition debris , or mixed recycled aggregates (MRA), are a mixture of the two main components obtained from the crushing and separating debris into valuable substances or waste by any of a variety of techniques of construction and demolition works : crushed and graded concrete and masonry rubble. The British standard institution [6, 7] states that recycled aggregate are composed of les s than 90%, by mas s, of Portland cement -based fragments And NA. It is imperative to realize the idea of the quality of Recycled Aggregate because these aggregate are highly affected by various factors and also influence the properties of resulting concrete. There are several properties such as type, size and their pulverization and crushing of debris [8].It was found in previous research that concrete with fine Recycled Coarse Aggregate is more susceptible to chloride ion penetrability, mainly because of the fine Recycled Coarse Aggregates ' greater adhered mortar content and thus enhanced permeability up to a large extent [8,9]. The recycled concrete aggregate and recycled masonry aggregate were mixed at different proportion and their effects on chloride ion migration were also observed, [10]

OBJECTIVES

The aim of this research is to investigate the strength characteristic of recycled aggregate for application in concrete and to investigate the NDT. Furthermore, to compare natural aggregate with recycled aggregate in terms of durability and economy.

2. MATERIALS AND METHODS

The methodology for this project included two series of tests: the first series of test is based on fresh aggregates and the second series is based on recycled aggregates. The tests were first performed on cylinders by using fresh aggregates and after that performed on recycled aggregates cylinders . The experimental program has been performed in a number of phases in order to enhance better learning and achieving the primary objectives.The data gathered from the experimental procedure on the concrete ingredients is tabulated as under.

Table 1 Material properties and mix design

Nominal Maximum size of coarse aggregate	1 inch
Fineness Modulus of fine aggregate	2.4
Specific Gravity of coarse aggregate	2.64 %
Moisture Absorption of coarse aggregate	1.16 %
Moisture Content in coarse aggregate	1 %
Specific Gravity of fine aggregate	2.45 %
Moisture Absorption of fine aggregate	1 %
Moisture Content in fine aggregate	1.17 %
Rodded Bulk density of coarse aggregate (lb/yd^3)	101.97
Water Cement Ratio	0.57
Cement (lb/yd^3)	526.76
Fine aggregate (lb/yd^3)	1107.84
Coarse Aggregate (lb/yd^3)	1948.49

3.1.4.1. Mix Design Ratio for Recycled Aggregate Concrete

For 20% replacement of fresh aggregate
1: 2.10: (0.74+2.96)

For 40% replacement of fresh aggregate

1: 2.10: (1.48+2.22)

For 60% replacement of fresh aggregate
1: 2.10: (2.22+1.48)

For 80% replacement of fresh aggregate

1: 2.10: (2.96+0.74)

PHASE I:

First cast the concrete batch with natural aggregate for 7 days , 14 days, 28 days test which comprised of total 9 concrete cylinders of standard dimension (12"x6").

PHASE II:

Cast the recycled aggregate concrete

batch for 7 days with the replacement of 20%, 40%, 60%, and 80% which comprised of total 12 concrete cylinders of standard dimension (12"x6").

Cast the recycled aggregate concrete batch for 14 days with the replacement of 20%, 40%, 60%, and 80% which comprised of total 12 concrete Cylinders of standard dimension (12"x6"). Cast the recycled aggregate concrete batch for 28 days with the replacement of 20%, 40%, 60%, and 80% which comprised of total 12 concrete cylinders of standard dimension (12"x6").

3. RESULTS AND DISCUSSIONS

FRESH AGGREGATE CYLINDERS RESULTS:

The results of fresh aggregates and recycled aggregates are tabulated as under. The compressive strength, rebound hammer and UPV for 7, 14 and 28 days are presented in tables.

Table 2 Average Compressive strength, Rebound hammer and UPV results at 7, 14 and 28 days for fresh aggregate

DAYS	COMPRESSIVE TEST (strength)	REBOUND HAMMER TEST	UPV
7	2400 psi	2682 psi	4.2
14	2850 psi	3190 psi	4.1
28	3200 psi	3520 psi	4.2

RECYCLED AGGREGATE CYLINDERS RESULT

Table 3: Average Compressive strength, Rebound hammer and UPV results at 7, 14 and 28 days for 20% replacement of aggregate

Test	7 days	14 days	28 days
Compressive strength	2300 psi	2720 psi	3010 psi
Rebound hammer	2550 psi	3015 psi	3400 psi
UPV	4	4.1	4

Table 4 Average Compressive strength, Rebound hammer and UPV results at 7, 14 and 28 days for 40% replacement of aggregate

Test	7 days	14 days	28 days
Compressive strength	2100 psi	2500 psi	2850 psi
Rebound hammer	2300 psi	2690 psi	3000 psi
UPV	3.9	3.9	3.9

Table 5 Average Compressive strength, Rebound hammer and UPV results at 7, 14 and 28 days for 60% replacement of aggregate

Test	7 days	14 days	28 days
Compressive strength	1980 psi	2300 psi	2500 psi
Rebound hammer	2170 psi	2500 psi	2730 psi
UPV	3.8	3.8	3.9

Table 6 Average Compressive strength, Rebound hammer and UPV results at 7, 14 and 28 days for 80% replacement of aggregate

Test	7 days	14 days	28 days
Compressive strength	1770 psi	2000 psi	2350 psi
Rebound hammer	2073 psi	2350 psi	2780 psi
UPV	3.7	3.6	3.7

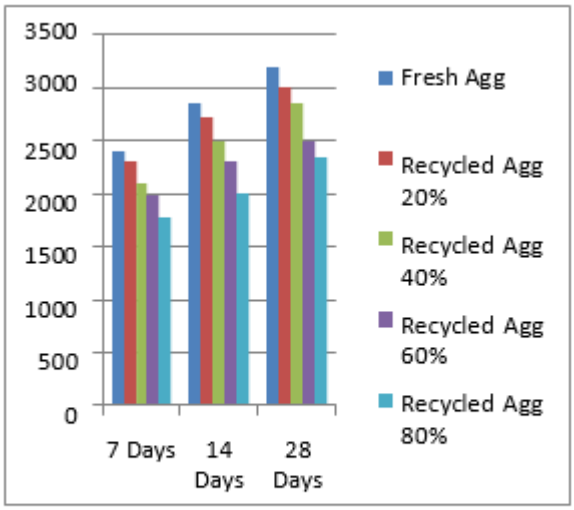

Figure 1. Comparison of compressive strength (psi) of fresh aggregate and recycle aggregate percentage

4.4 Comparison of Rebound Hammer

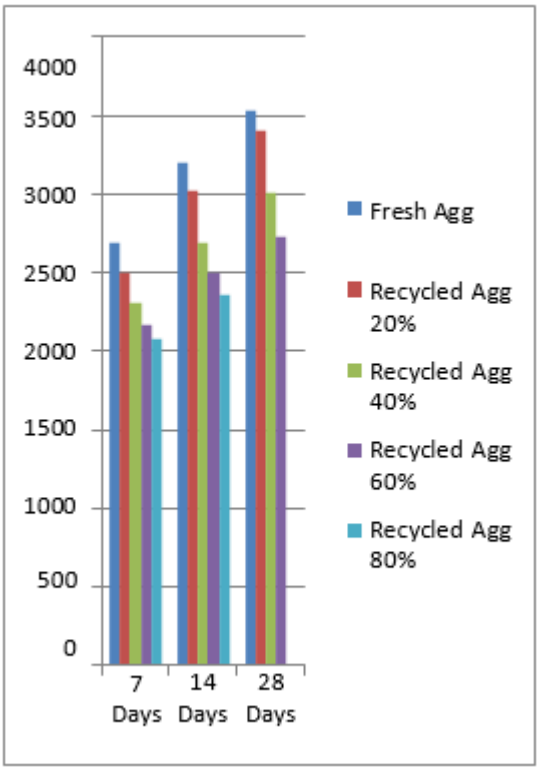

Figure 2 comparison of rebound hammer of fresh aggregate and recycle aggregate percentages

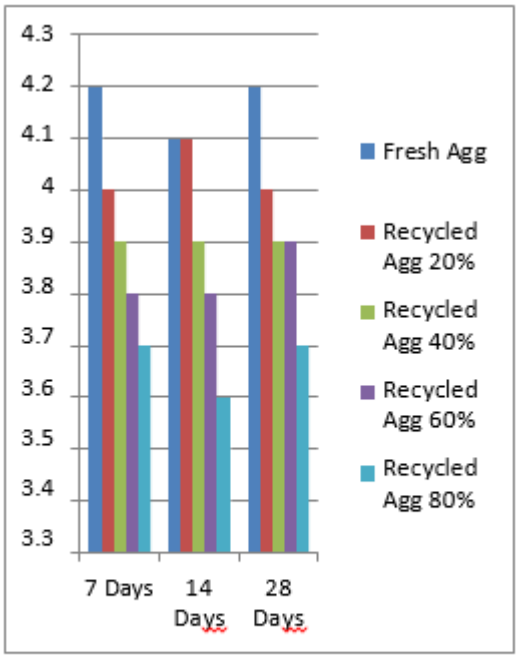

Figure 3 comparison of UPV of fresh aggregate and recycle aggregate percentages

4. CONCLUSION AND RECOMMENDATION

4.1. Conclusion

When the compressive strength of recycled aggregate and fresh aggregate were compared it was found that the fresh aggregate is comparatively s lightly better than that of recycled aggregate. The compressive strength at 28 days was approximately equal to 3000psi. On the other hand there were incremental decrease in strength for 20%, 40%, 60% and 80% reaching 2400psi strength at 80%.The non-destructive result of UPV and rebound hammer test was also found satisfactory with a s light variation in incremental increase in percentage of recycled aggregate. In conclusion the us e of 20% to 40% would be consider the best alternative for maintain structure integrity and utilization of recycled aggregate.

REFERENCES

Coelho A and Brito J. Economic analysis of conventional versus selective demolition: a case study. Resources, Conservation and Recycling. 2011

Coelho A and Brito J. Influence of construction and demolition waste management on the environmental imp act of buildings. Waste Manage. 2012

Hansen TC. Recycling of demolished concrete and masonry. London: E & FN Spon; 1992.

Silva RV, de Brito J, Dhir RK. Properties and composition of recycled aggregates from construction and demolition waste suitable for concrete production. Construction and Building M aerials. 2014

Nagataki S, Gokce A, Saeki T and Hisada M. Assessment of recycling process induced damage sensitivity of recycled concrete aggregates. Cement and Concrete Research. 2004;

Paine KA and Dhir RK. Recycled aggregates in concrete: a performance-related app roach. Magazine of Concrete Research. 2010