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Use of Demolished Concrete in Construction

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Abstract: ***Huge quantities of construction and demolished waste are generated every year in developing countries likes India .the disposal of this waste concrete requires a large area to get disposed, recycle allow to utilize that area for other meaningful purposes. reuse of waste concrete involves breaking , crushing and removing contaminated & irrelevant materials from existing concrete ,the target of the present thesis work is to determine the strength characteristics recycled aggregate for the application in concrete pavement construction . the scope of the thesis is to determine and compare the compressive strength ,flexure strength and sulphate resistance of concrete by using different percentages of recycled aggregate . The investigation was carried out by using workability test, compressive strength test, flexural strength test and Sulphate resistance test. A total of five mixes with replacement o f coarse aggregate with 0%, 10%, 20%, 30%, 40% recycled coarse aggregate water studied. The water cement ratio was kept constant at 0.40. It was observed that workability of concrete was decreased with the increasing recycled aggregate in concrete for the strength characteristics; the results showed that the strength of recycled aggregate concrete was comparable to the strength of natural aggregate concrete.***

Keywords: concrete, strength

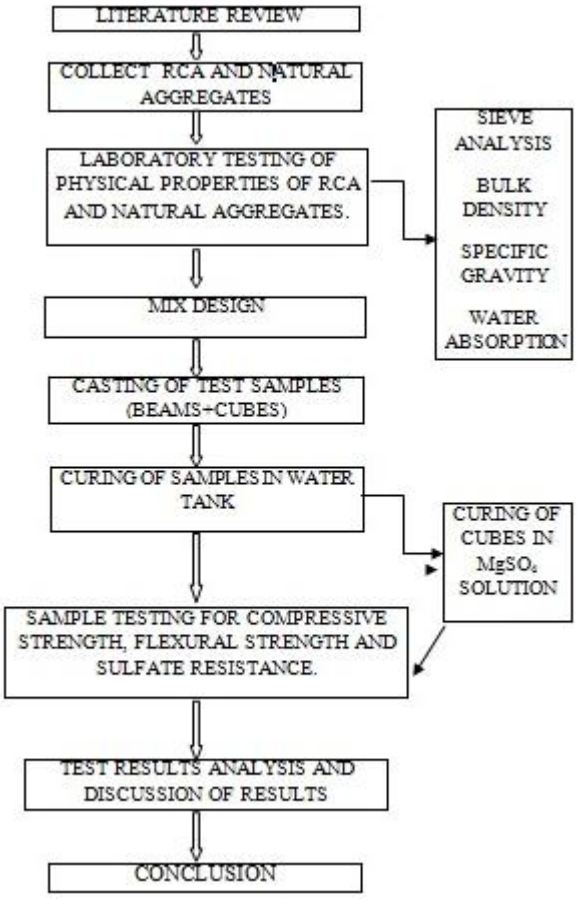
1. Introduction

Concrete is the most widely used man-made construction material in the world .It is obtained by mixing materials, water aggregate and sometimes admixtures in required proportions. Fresh concrete or plastic concrete is freshly mixed material which can be moulded into any shape hardens into a rock –like mass known as concrete. The hardening is because of chemical reaction between water and cement, which continues for long period leading to strong with age. Concrete have two type ingredients namely active and inactive. The active group consists of water and cement. The inactive part consists of sand and coarse aggregates. Concrete have 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 economics gains. The rate of demolition has increased and there is a shortage in dumping space and also increase in cost of dumping. Instead of dumping this demolished concrete, use of demolished as recycled concrete would not only reduce the cost but also will 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.

2. Methodology

This chapter covers the methods used for compressive strength, flexural strength and sulphate resistance tests of concrete with Recycled aggregates.



3. Experimental Programme

Mix design is done to select the mix material and their required proportions. There are a lot of methods to determine the mix design. The methods used in India are in compliance with Bureau of Indian Standards (BIS). The motive of mix design is to determine the proportion in which concrete ingredients like cement, water, fine aggregates and coarse aggregates should be mixed to provide specified strength, workability, durability and other specified requirements as listed in standards such as IS: 456-2000.

The designed concrete mix must define the material and strength, workability and durability to be attained. Concrete mix design guidelines are given in IS: 10262-1982. In the study, 5 batches of mixes were prepared. These batches were designated as m0, m1, m2, m3 and m4. Batch m0 was taken as control mix. The natural coarse aggregate was replaced by recycled aggregate in proportion of 0%, 10%, 20 %, 30% and 40% in m0, m1, m2, m3, and m4 respectively as given in table 4.1. Content of sand, cement and water were kept constant in every batch. In the study properties of concrete such as compressive strength, flexural strength and sulphate resistance of concrete were determined.

Table 1: Proportions of Natural and Recycled Aggregates in Batches

Type of Mix Used	Recycled Aggregate (%)	Natural Aggregate (%)
m0	0	100
m1	10	90
m2	20	80
m3	30	70
m4	40	60

Quantities of recycle coarse aggregate in concrete for cube

Volume of concrete for 60 cube mould= 0.2025 m^3

Cement Volume

(1/1+1.6+2.35)×0.2025 = 0.0409 m^3 = 58.94 kg

(By using 0.0409/0.0347)

Coarse aggregate weight for 60 cube mould = 2.35×58.94 = 138.52 kg

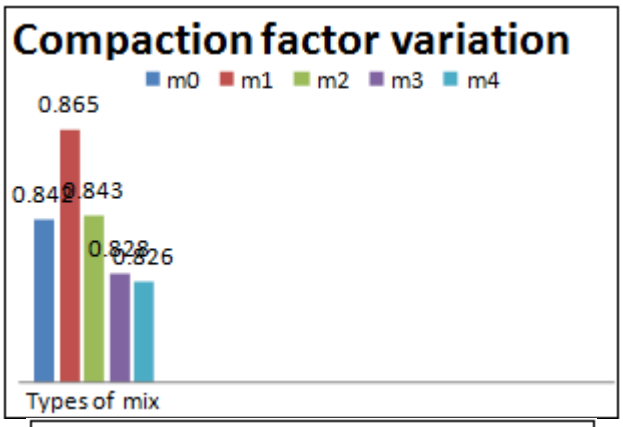
For 12 cube = 27.7 kg

Table 2: Properties of Fresh Concrete (Slump values and Compactor Factor value)

S.No.	Mix	W/C	Super Plasticizer	%RCA	Slump Value(mm)	Compaction Factor Value
1.	m0	0.38	0.65%of cement	0	42	0.842
2.	m1	0.38	0.65%of cement	10	43	0.865
3.	m2	0.38	0.65%of cement	20	40	0.843
4.	m3	0.38	0.65%of cement	30	38	0.828

4. Results and Discussion

As discussed in chapter 4, workability varied with change in proportion of demolished aggregates. The slump values and compaction factor values did not show a uniform pattern as the percentage of demolished aggregates was uniformly varied. Super plasticizer was used to maintain the workability as water absorption increased due to presence of demolished concrete aggregates water cement ration (W/C) water kept constant (0.38). Figure 5.1 gives the variation of slump values versus type of mixes. Figure 5.2 gives the variation of compaction factor versus type of mixes.



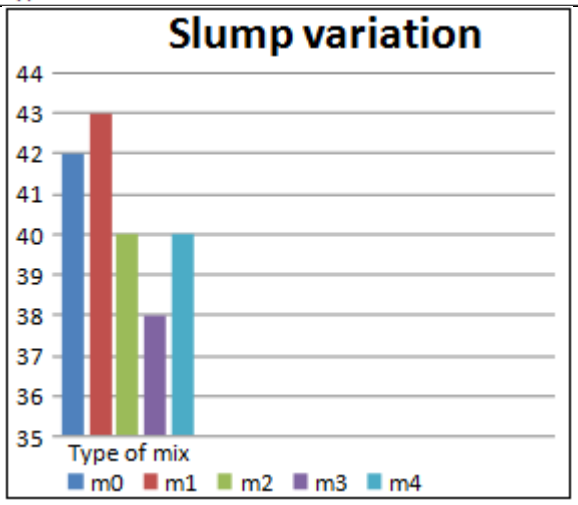
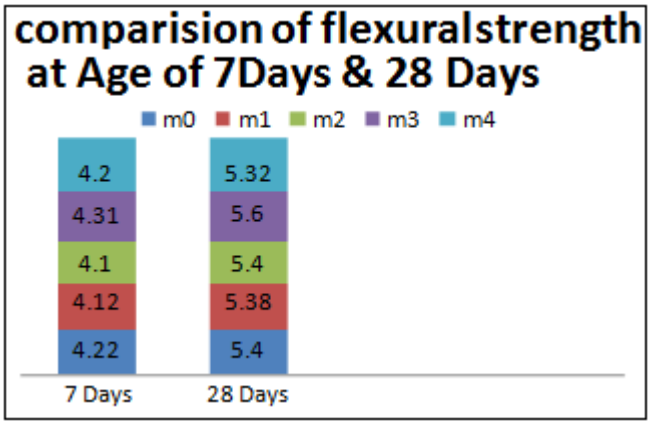


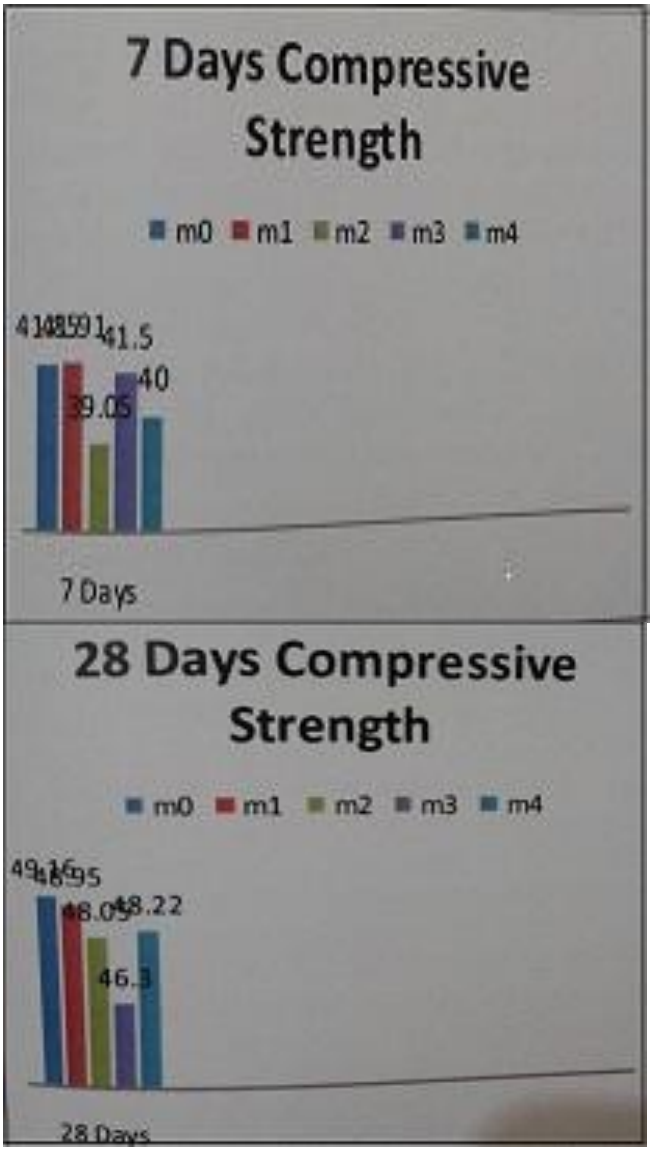
Table 3: Percentage Variation of Flexural Strength at Different Ages

Sr. no	Mix	Age in days	m0	m1	m2	m3	m4
1	1:1.1.6:2.35	7	-	102.6	97.6	98.06	100.47
2.	1:1.1.6:2.35	28	-	105.26	101.5	101	101.5
3.	1:1.1.6:2.35	90	-	100.5	102.8	99.64	98.9

Table 4: Percentage Reduction in Compressive Strength at Different Ages

Sr No.	Mix	Age (in days)	%age Reduction in Compressive Strength				
			m0	m1	m2	m3	m4
1.	1:1.1.6:2.35	7	-	100.1	98.6	100.4	95
2.	1:11.6:2.35	28	-	100.5	100.3	98.1	104.5
3.	1:1.1.6:2.35	56	-	99.4	98.8	98.9	106
4.	1:1.1.6:2.35	90	-	98.8	98	99.2	104





5. Conclusions

The research on usage of RCA in construction of pavement is very important because material waste is gradually increasing with the increase in urban development and increase in population. Recycled aggregates are easily available while natural aggregates need mining and their cost is much higher than the cost of natural aggregates. Recycled aggregates are cheaper than the virgin aggregates, so builders can easily afford these for construction purpose if their strength is equal or comparable to natural aggregateThe study examines the properties of RCA when used with natural coarse aggregates. A lot of studies have been carried out on use of RCA concrete in construction. But in case of highway construction some more investigation is required. The main objective of the study was to investigate whether RCA can be used as material aggregates for concrete pavement construction. Compressive strength, flexural strength and sulfate resistance of RCA concrete is examined, where it was observed that mixing of RCA cause increased water absorption. To avoid this, super plasticizer is used to reduce the cement consumption. Concrete mix of M40 was designed as per properties of aggregates. The results of this study showed that RCA concrete gave comparable strength to conventional concrete. This indicated that RCA concrete can be viable source for construction of pavements. From the results, it is also found that workability of concrete is decreased due to higher water absorption. Whenever recycled aggregate is applied, water content is monitored carefully in concrete mix as water absorption is increased due to presence of porous mortar. In this study, super plasticizer (0.6% of cement) is used to overcome this problem.

Following conclusions can be drawn from results and discussion of results from the study:

1) The compressive strength of all mixes exceeded at the age of 28 days. Compressive strength of control mix i.e. of m0 is 50.05 MPa which is greater than the target strength of 48.25 for M40 concrete. Compressive strength of m1 is slightly increased to 50.36. So the compressive strength increases by 0.5%. For m2, compressive strength is increased to 50.20 MPa, it also showed an increase in compressive strength by 0.3%. Compressive strength of m3 is decreased to 49.11 MPa that showed a decrease in compressive strength by 1.9%. But in case of m4, there is sudden increase in compressive strength that raises the compressive strength to 52.36 MPa. Compressive strength is increased by 4.5%. So the results of test show that compressive strength does not follow a regular trend from m0 to m4. But from the results it is also concluded that compressive strength never went below the target strength for 28 days. This indicates that RCA can be used as replacement aggregates for compressive strength.
2) Flexural strength also followed the same pattern as of compressive strength. Flexural strength of control mix is 5.32MPa at age of 28 days. Flexural strength of mix m1 increased to 5.60 MPa. It shows that the increase in flexural strength is 5% for m1. For m2 flexural strength at age of 28 days is 5.40MPa, which shows an increase in flexural strength by 1.5%. Flexural strength of mix m3 is 5.38 and the flexural strength increased by 1 %. For the mix m4, flexural strength is 5.40 MPa. It shows that the flexural strength increased by 1.5 % at the age of 28 days. From the results and discussion of the results it is found that the flexural strength of RCA concrete is comparable to the natural aggregate concrete which is a positive point. So the RCA concrete can be used for flexural strength by adjusting W/C ratio.
3) Use of 5% of $MgSO_4$ solution caused the reduction in compressive strength. The compressive strength of RCA mixed concrete reduced upto 7%. Effect of sulphate solution increased when quantity of demolished concrete aggregate increased. This study showed that the strength of m4 at 56 days was most affected. So with increase in sulphate caused reduction in compressive strength of concrete.
4) It was found that the RCA concrete have relatively lower bulk density, specific gravity and high water absorption as compared to natural concrete. This was due to the presence of mortar in present on recycled coarse aggregates.

In this study, trial castings were done to arrive at water content and desired workability. So it was advisable to carry out trial castings with demolished concrete.

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