Strength Studying The Use Of " Recycled Aggregate " For The Application In Concrete

Author : FAISAL ALI BHAT
Organisation : Student of M.tech(CTM) at Rayat Bahra University, Punjab ,India
Email :faisalalibhat341@gmail.com
Author :ER. SHILPA CHAUHAN
Organisation : Asst. Professor, Dept. Of civil Engineering ,Rayat Bahra University punjab ,India

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Abstract

Recycled aggregates consist of crushed, graded inorganic particles processed from the material that have been used in the constructions and demolition debris. The target of the present paper work is to determine the strength characteristic of recycled aggregates for the application in concrete pavement construction. The scope of the paper is to determine and compare the compressive strength, flexural strength and sulphate resistance of concrete by using different percentages of recycled aggregates. 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 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. It was observed that workability of concrete was decreased with the increase in recycled aggregates in concrete. For the strength characteristics, the results showed that the strengths of recycled aggregate concrete was comparable to the strengths of natural aggregates concrete.The use of recycled aggregates in concrete is an effective and sustainable way to reduce the environmental impact of construction and demolition waste. This research paper aims to provide a comprehensive review of the existing literature on the use of recycled aggregates in concrete. The paper discusses the properties of recycled aggregates, the factors affecting their use in concrete, and the advantages and limitations of using recycled aggregates in concrete.

Keywords: compressive strength, flexural strength, sulphate Resistance, Concrete

Introduction:

Concrete structures that are aimed to have service lives of at least 50 times have to be Crushed after 20 or 30 times because of deterioration caused by numerous agents [1]. Old structures bear conservation for better and advanced economics earnings. The rate of obliteration has increased and there's a deficit in jilting space and also increase in cost of jilting. rather of jilting this Crushed concrete, use of Crushed as recycled concrete would not only reduce the cost but also will conserve the non renewable energy sources [2],[3]. The use of Crushed concrete will further affect in deduction in use of natural summations. The operation of natural summations is causing damage to natural coffers performing in imbalance in terrain.Recycled summations correspond of crushed, graded inorganic patches attained from the accoutrements that have been used in constructions. Recycled summations are generally attained from structures, roads and islands which are Crushed due to completion of life, wars and earthquake.[4]

The construction industry generates a significant amount of waste, and a large portion of this waste comes from the demolition of buildings and structures. This waste includes concrete, bricks, and other building materials, which can be recycled and reused in new construction projects [5]. The use of recycled aggregates in concrete is a sustainable solution that reduces the amount of waste sent to landfills, conserves natural resources, and reduces the environmental impact of construction.It's estimated that the construction assiduity in India generates about 10- 12 million tons of waste annually. protrusions for structure material demand of the casing sector indicate a deficit of summations to the extent of about,000 million m3(chapter 4,urbanindia.nic.in). An fresh 750 million m3 summations would be needed for achieving the targets of the road sector. Recycling of aggregate material from construction and obliteration waste may reduce the demand- force gap in both these sectors.[6],[7],[8]

Waste concrete has an adverse impact on terrain. Transportation of waste concrete from point has bad impact on terrain and the waste concrete filled precious space in tips . Construction and obliteration waste makes up a large portion of all generated solid waste(Meyer 2008). In 1980 the Environmental coffers Limited in the East European Communities(EEC) estimated that 80 million tonnes of obliteration waste, substantially concrete, was produced each time. This number was anticipated to double by 2000, and triadic by 2020(Bairagi 1990). Due to enterprises with space and cost, conventional disposal of concrete waste in tips
was no longer an respectable option(Meyer 2008).

Barriers to Recycled Concrete Aggregate Use

There There are several walls in use of RCA in concrete. Cost of concrete clinchers is veritably high which increases the original cost for factory. In addition, conservation cost of concrete clinchers is also significant. Other hedge is related to quality of RCA. roadways bear quality material that meets engineering, profitable and environmental considerations(Turley 2003). still, where high performance concrete isn't needed, RCA can be used and therefore, virgin total can be conserved(Meyer 2008). A lot of fine persecuted concrete total is created during the crushing process. This redundant fine aggregatetotal requires disposal or an alternate use. The immersion, strength, and contaminations varies with the sources and type of RCA used [10] . This means that it's unworkable or that it might negatively impact the new pavement structure. " continuity performance of RCA isn't well understood because of the limited and antithetical exploration results [Salem 2003]. Concrete that contains RCA has lower compressive strength, flexural strength and sulphate resistance. It is also not known how RCA affects durability, since most studies focus only on the properties of RCA concrete [Olorunsogo 2002]. Government agencies also do not show any interest in quality assurance and are also slow to embrace the use of RCA due to concerns about quality and a reluctance to change what has worked in the past [Turley 2003].

Factors Affecting the Use of Recycled Aggregates:
Several factors can affect the use of recycled aggregates in concrete, including the quality of the recycled aggregate, the processing method used, and the proportion of recycled aggregate used in the concrete mix. The quality of the recycled aggregate is crucial, and it should meet the same standards as natural aggregates. The processing method used to produce recycled aggregates can also affect their properties, and the use of mechanical crushing methods can result in lower quality aggregates [11] . The proportion of recycled aggregates used in the concrete mix should also be carefully considered, as higher proportions can affect the strength and workability of the concrete.

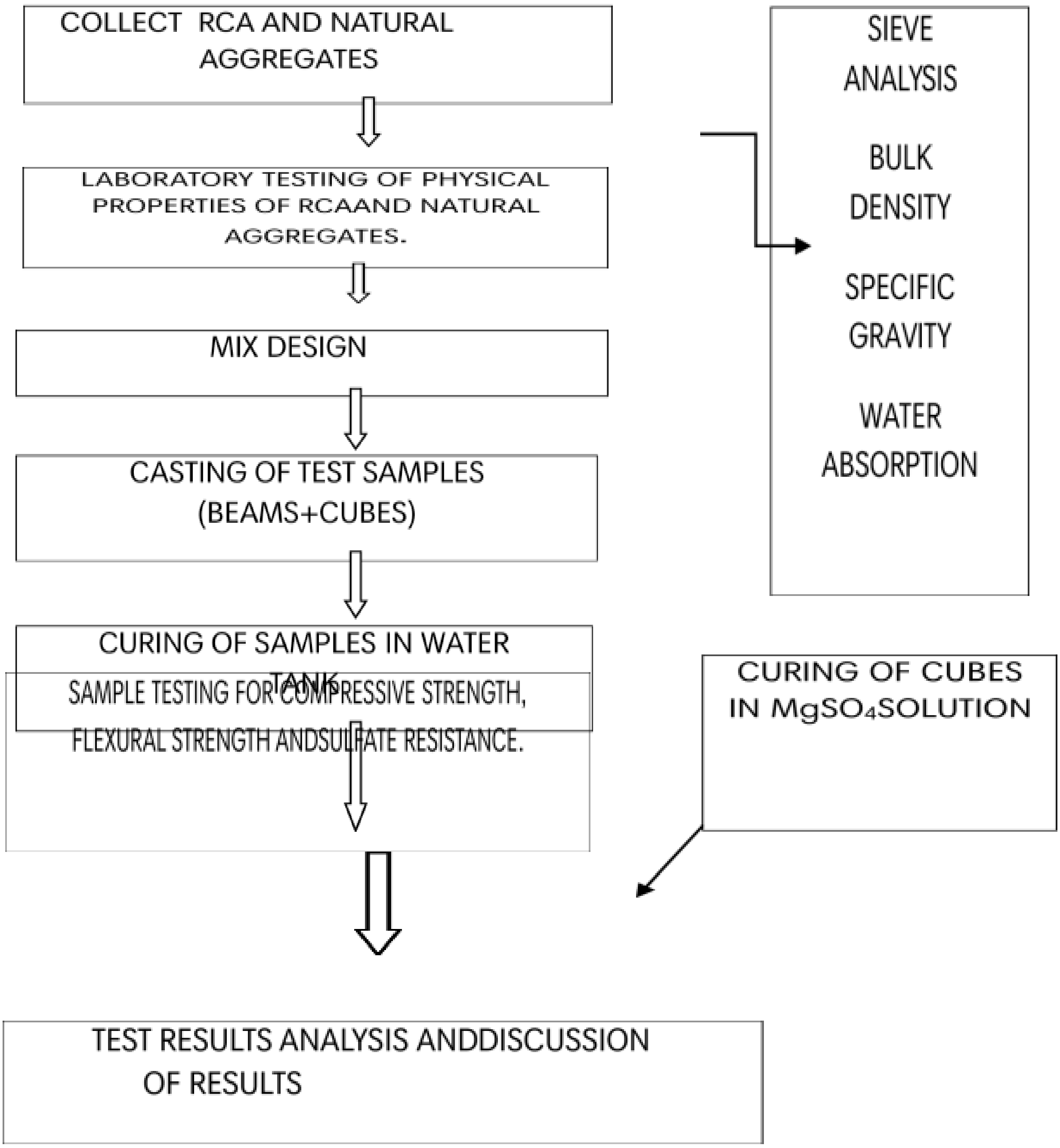
Advantages of Using Recycled Aggregates in Concrete:
The use of recycled aggregates in concrete has several advantages, including reducing the amount of waste sent to landfills, conserving natural resources, and reducing the environmental impact of construction. Additionally, the use of recycled aggregates can reduce the cost of construction materials and improve the thermal and acoustic properties of the concrete.[12]

Limitations of Using Recycled Aggregates in Concrete:
Despite the advantages of using recycled aggregates in concrete, there are also some limitations. The quality of the recycled aggregate can vary significantly, and it may not always meet the required standards. The use of recycled aggregates can also result in lower strength and durability of the concrete, and it may not be suitable for certain applications that require high strength and durability.

Objectives of the Study

- The study on use of Crushed concrete in pavement construction consists of conducting laboratory investigations on cement concrete prepared by using Crushed concrete to estimate its suitability for pavement construction. The main objectives of study are:
- To prepare mix design with recycled aggregates.
- To determine the compressive strength of the samples at the end of 7, 28, 56 and 90 days.
- To determine the flexural strength
- To determine the sulphate resistance strength of samples at the end of 7, 28 and 56 days.

METHODOLOGY



The methodology of the present study follows Indian Standard code IS: 516- 1959. Testing of strengths of concrete was carried out as per this code. Concrete mix design guidelines were as per IS: 10262-2009.

RESULTS AND DISCUSSION OF RESULTS

Testing of sample was done at 7, 28, 56 and 90 days for compressive strength. For flexural strength testing of samples was done at 7, 28 and 90 days. Testing for sulphate defiance was done at 7, 28 and 56 days. In this chapter, results of these tests are bandied along with the results of plasticity.

Workability

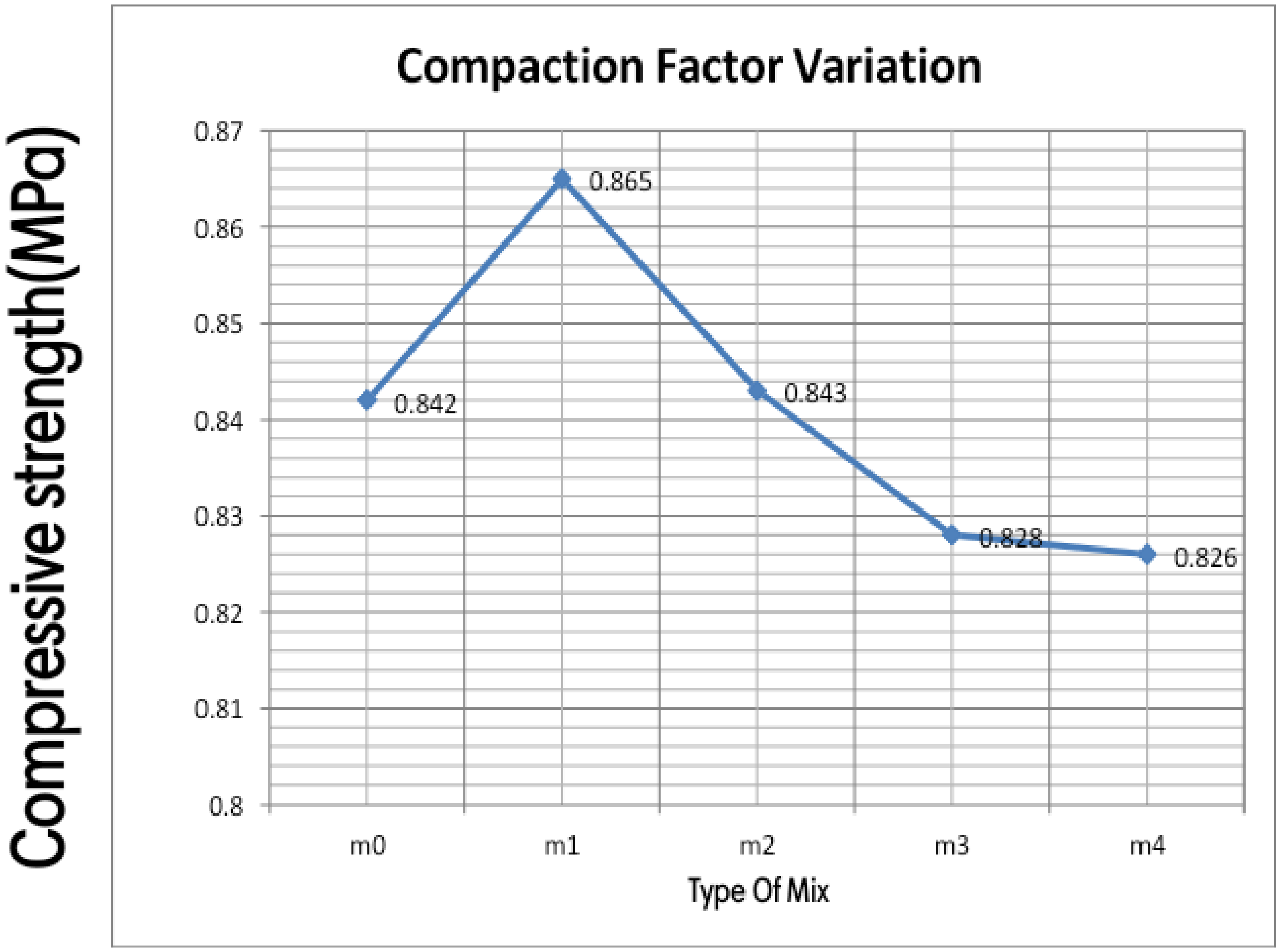


Figure 1 Variations of Compaction Factor Values with Type of Mix Used.

Variation of Compressive Strength with Age

4.1 gives the test results of compressive strength at 7, 28, 56 and 90 days. Water cement rate was kept as0.38 for all composites. Super plasticizer used was0.6 of cement. Table5.2 gives the chance reduction in compressive strength for all composites at different number of days.

From above numbers and tables it was observed that the compressive strength doesn't follow an invariant pattern of proliferation or reduction when RCA is used rather than natural total. All of the composites reached a target strength of 48.26 in 28 days.

Table 1.1 Test Results for Compressive Strength

S.No.	Mix	W/C	Compressive strength (MPa)			
			7 Days	28Days	56 Days	90 Days
1.	m0	0.38	42.43	50.06	51.20	51.8
2.	m1	0.38	42.47	50.36	50.89	51.23
3.	m2	0.38	41.84	50.20	50.68	50.80
4.	m3	0.38	42.60	49.11	50.68	51.4
5.	m4	0.38	40.27	52.36	53.24	53.26

Table 1.2 Percentage Reduction in Compressive Strength at Different Ages.

S.No.	Mix	Age (in days)	%age Reduction in Compressive Strength				
			m0	m1	m2	m3	m4
1.	1:1.23:2.52	7	-	100.1	98.6	100.4	95
2.	1:1.23:2.52	28	-	100.5	100.3	98.1	104.5
3.	1:1.23:2.52	56	-	99.4	98.8	98.9	106
4.	1:1.23:2.52	90	-	98.8	98	99.2	104

Figure 1.2 : Shows the comparison of compressive strength of different mixes at 7, 28, 56 and 90 days.

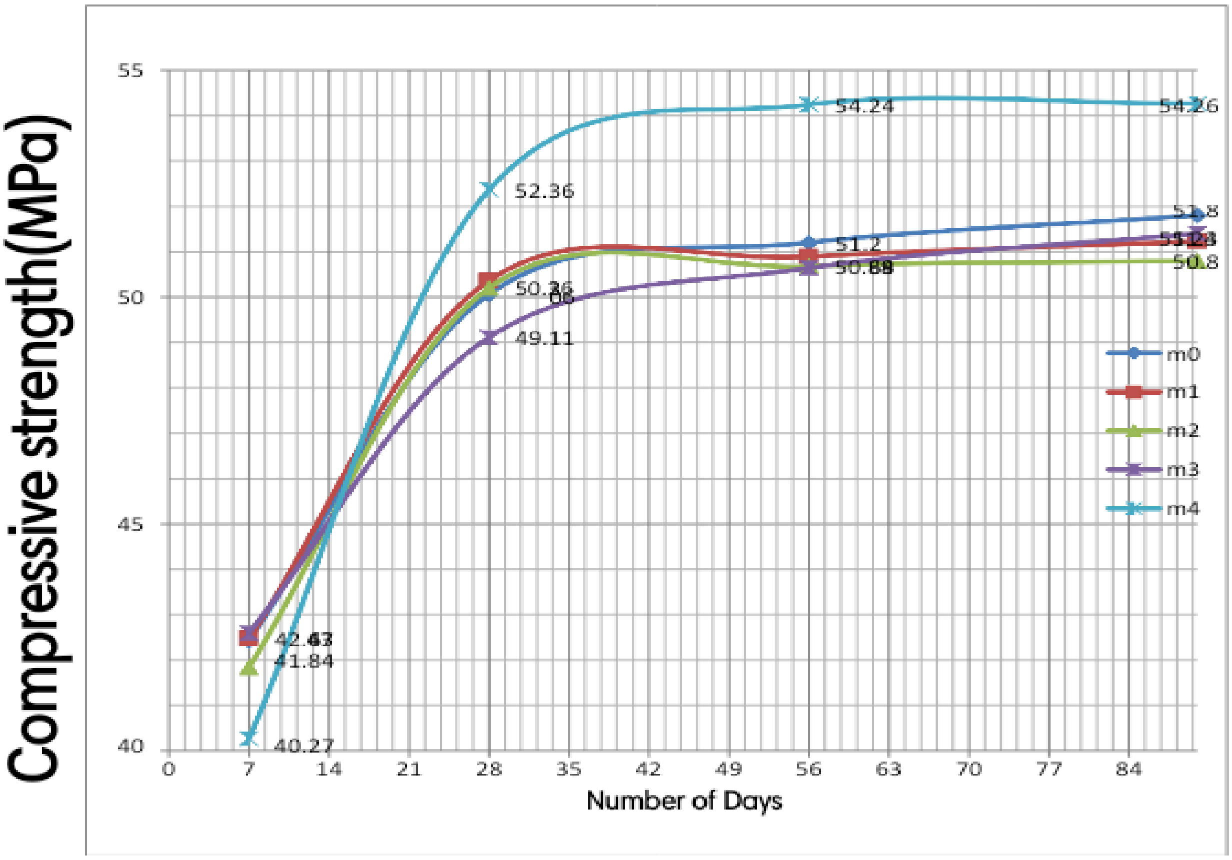


Figure 1.3 Comparison of Compressive Strength of all Five Mixes with Age of 7,28, 56 and 90 Days.

Figure 4..4 to Figure 4.7 show the variation of compressive strength at 7days, 28 days, 56 days and 90 days with different mixes used in tests. The results showed fluctuations from mix to mix. In case of m4, it was observed that the compressive strength was suddenly increased as compared to other mixes.

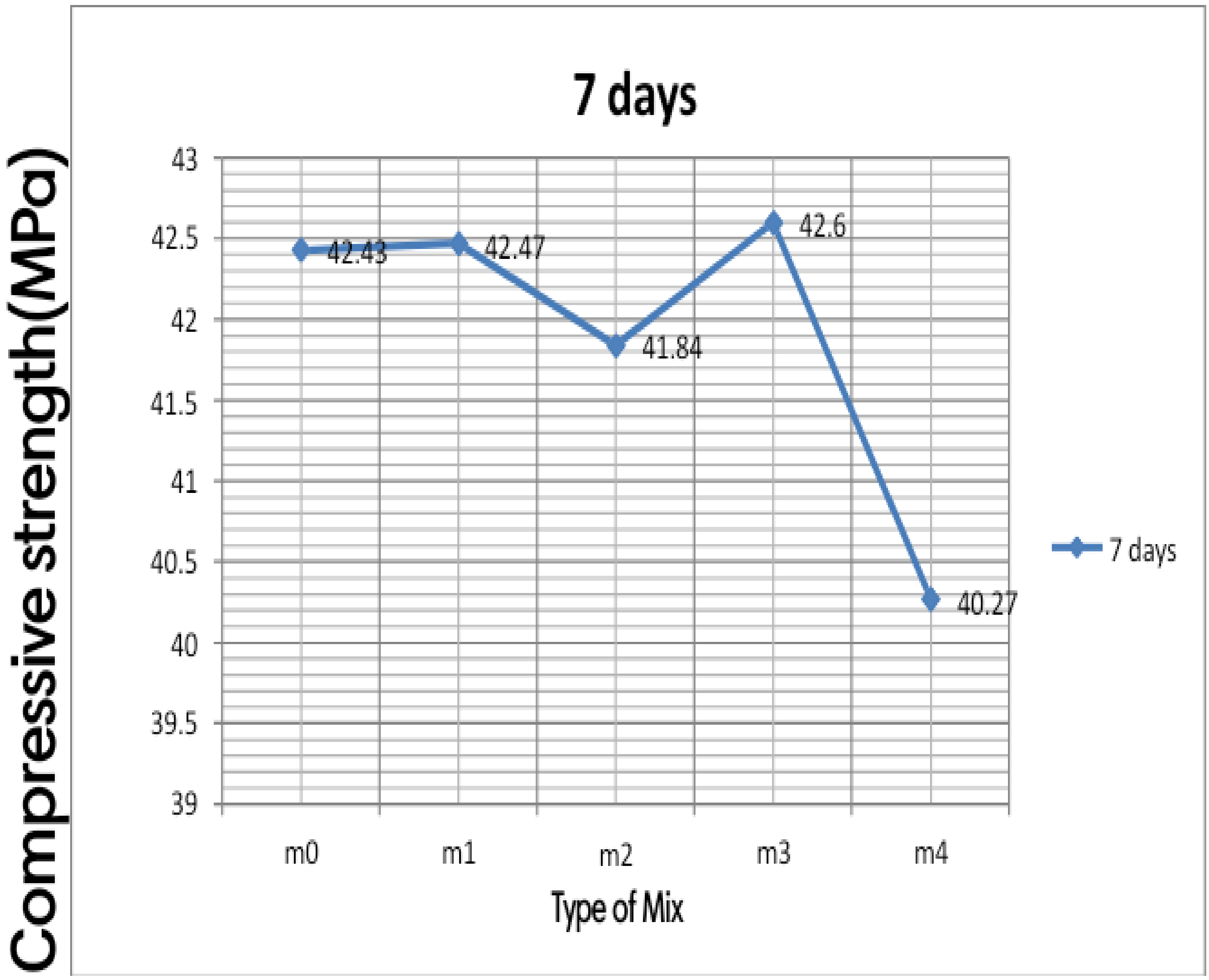
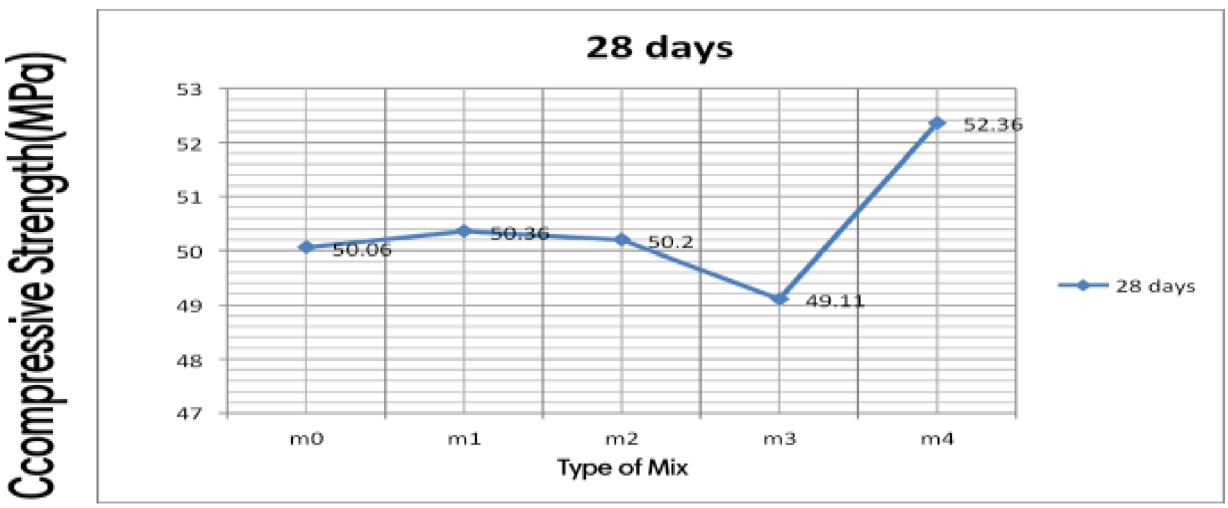


Figure 1.4 Variation of Compressive Strength at 7 days with Five Mix Used



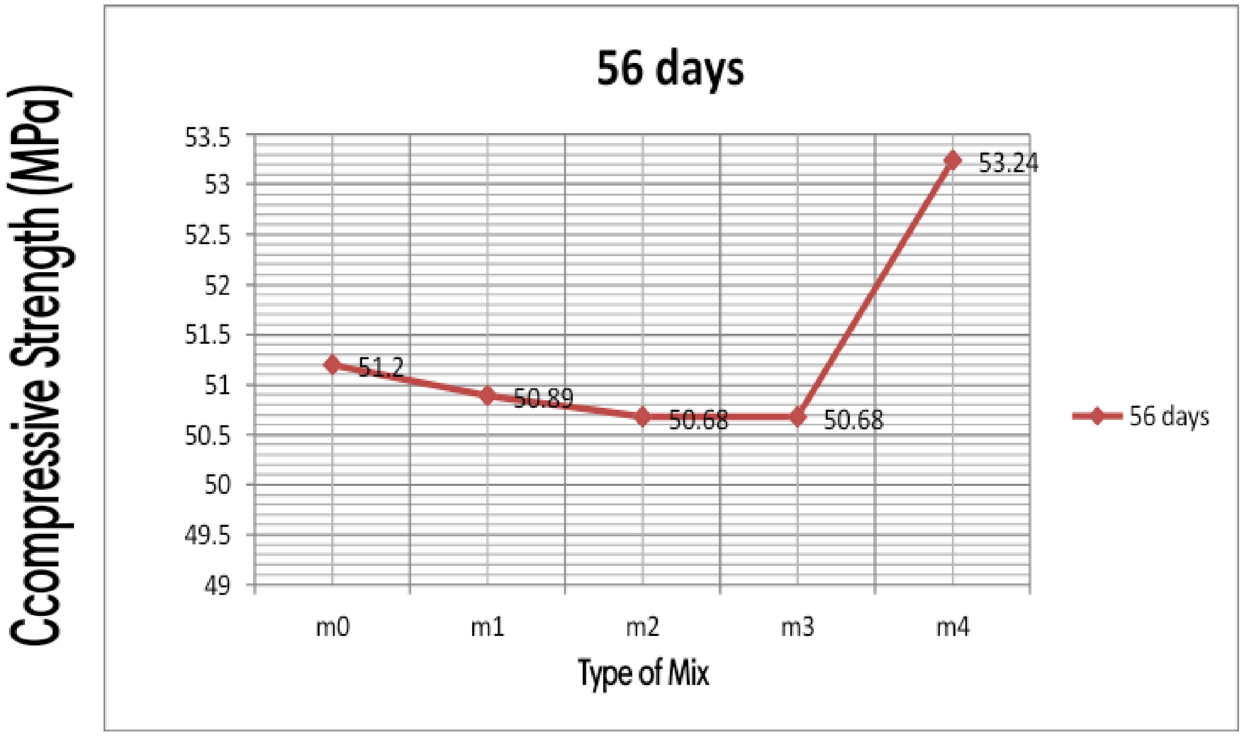


Figure 1.6 Variation of Compressive Strength at 56 Days with Five Mix Used

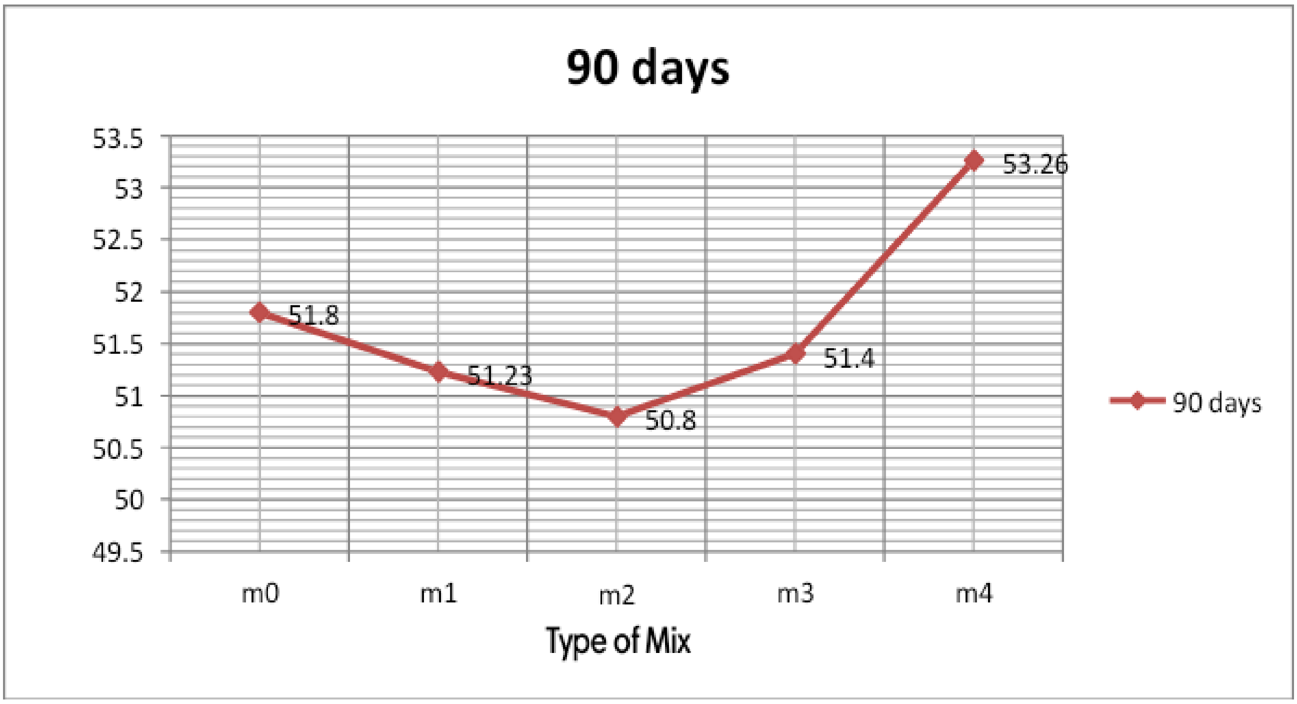


Figure 1.7 Variation of Compressive Strength at 90 Days with Five Mix Used.

From above numbers and tables it was observed that the compressive strength doesn't followed a invariant pattern of proliferation or reduction when RCA is used rather of natural total. All of the composites reached to target strength of48.26 in 28 days.

Variation of Flexural Strength with Age

Table5.2 gives the chance reduction in compressive strength for all composites at different number of days. From above numbers and tables it was observed that the compressive strength doesn't followed a invariant pattern of proliferation or reduction when RCA is used rather of natural total. All of the composites reached to target strength of48.26 in 28 days.

Table 4.3 Results of Flexural Strength

S.No.	Mix	W/C	Flexural strength (MPa)		
			7 Days	28Days	90 days
1.	m0	0.38	4.20	5.32	5.64
2.	m1		4.31	5.60	5.67
3.	m2	0.38	4.10	5.40	5.8
4.	m3	0.38	4.12	5.38	5.62
5.	m4	0.38	4.22	5.40	5.58

Table 4.4 Percentage Variation of Flexural Strength at Different Ages.

S.No.	Mix	Age (in Days)	% age Reduction in Flexural Strength				
			m0	m1	m2	m3	m4
1	1:1.23:2.52	7	-	102.6	97.6	98.06	100.47
2.	1:1.23:2.52	28	-	105.26	101.5	101	101.5
3.	1:1.23:2.52	90	-	100.5	102.8	99.64	98.9

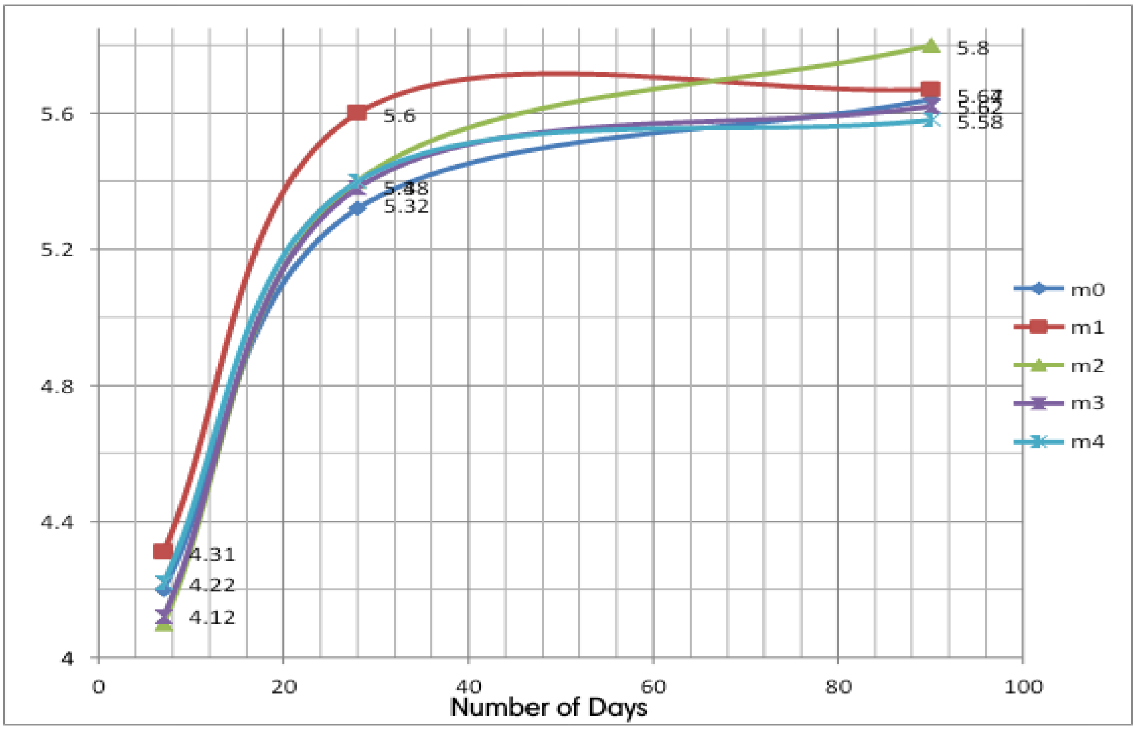


Figure 1.8 Comparison of Flexural Strength of all Mixes at 7, 28 and 90 days.

Sulphate Resistance of RCA Concrete

In this section of study, effect of sulphate result on compressive strength of RCA concrete was delved . Concrete cells were kept in MgSO4(magnesium sulfate) result for 7, 28 and 56 days after normal curing for 28- days. Compressive strength of cells was checked by using CTM. Table5.5 gives the test results at age of specified number of days. Table5.6 gives the details of chance reduction in compressive strength at the age of specified number of days.

Table 4.5 Test Results for Sulphate Resistance

S.No.	Mix	Type Of Solution	Compressive Strength(MPa)		
			7 Days	28 Days	56 Days
1.	m0	5%of MgSO4	41.75	48.74	48.3

2.	m1	5%of MgSO4	41.79	49.05	49.23
3.	m2	5%of MgSO4	38.8	48.26	47.62
4.	m3	5%of MgSO4	41.8	45.6	49.03
5.	m4	5%of MgSO4	39.53	50.73	49.38

Table 4.6 Percentage Reduction of Compressive Strength Due To Sulphate Attack

S.No.	Mix	Type of solution	% age reduction in compressive strength		
			7 Days	28 Days	56 Days
1.	m0	5%of MgSO4	98.42	97.38	94.3
2.	m1	5%of MgSO4	98.4	97.4	96.08
3.	m2	5%of MgSO4	92.73	96.13	93.96
4.	m3	5%of MgSO4	98.2	92.85	95.4
5.	m4	5%of MgSO4	98.17	96.9	92.75

Figure 1..9 gives the comparison of compressive strength of all mixes

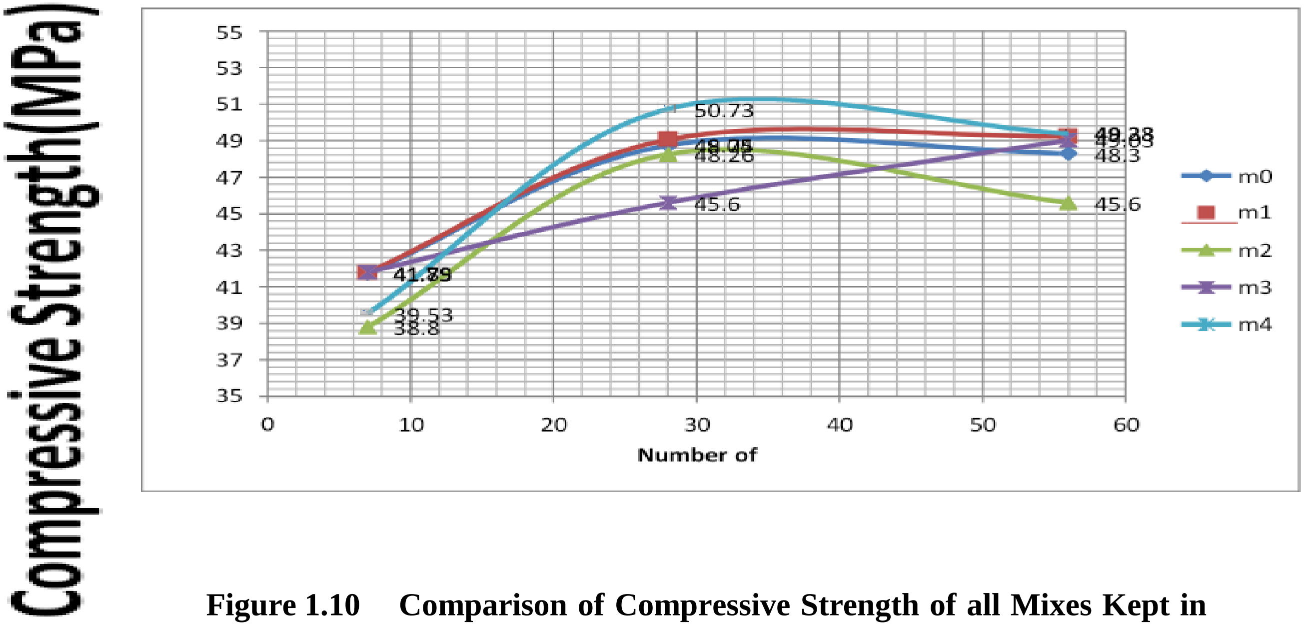


Figure 1.10 Comparison of Compressive Strength of all Mixes Kept in Mgso4 Solution at the Age of 7, 28 And 56 Days.

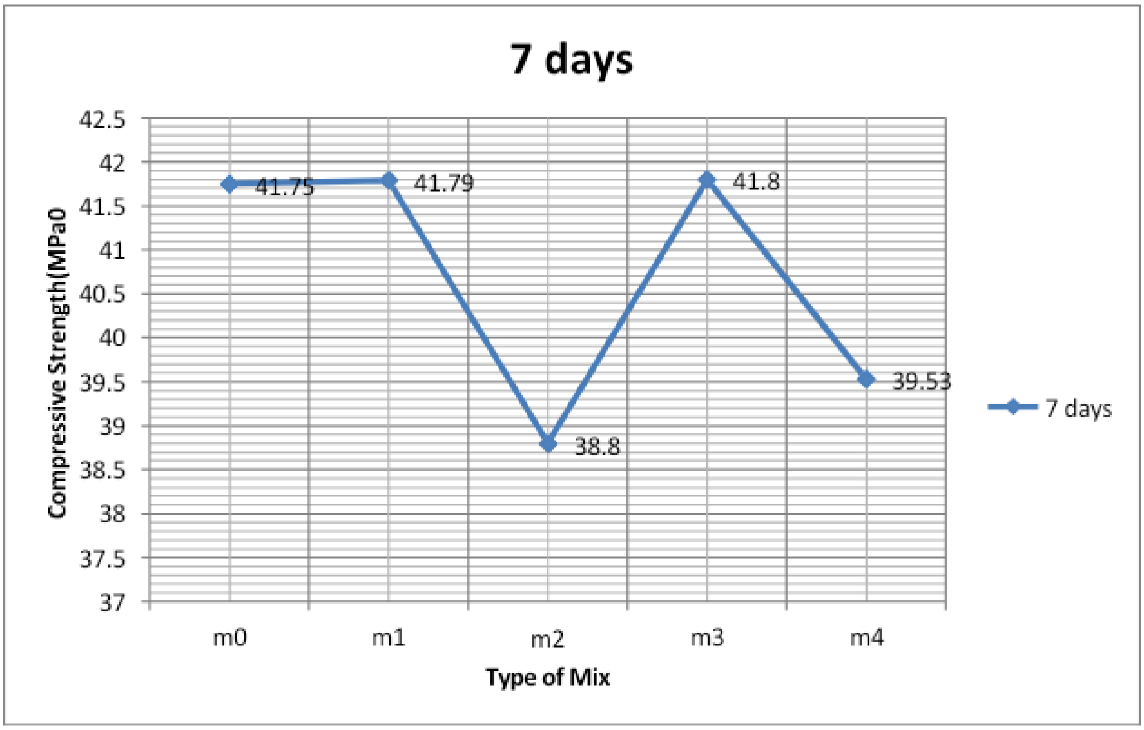


Figure 1.11 Variation of Compressive Strength at the Age of 7 Days After Attack of Sulphate Solution.

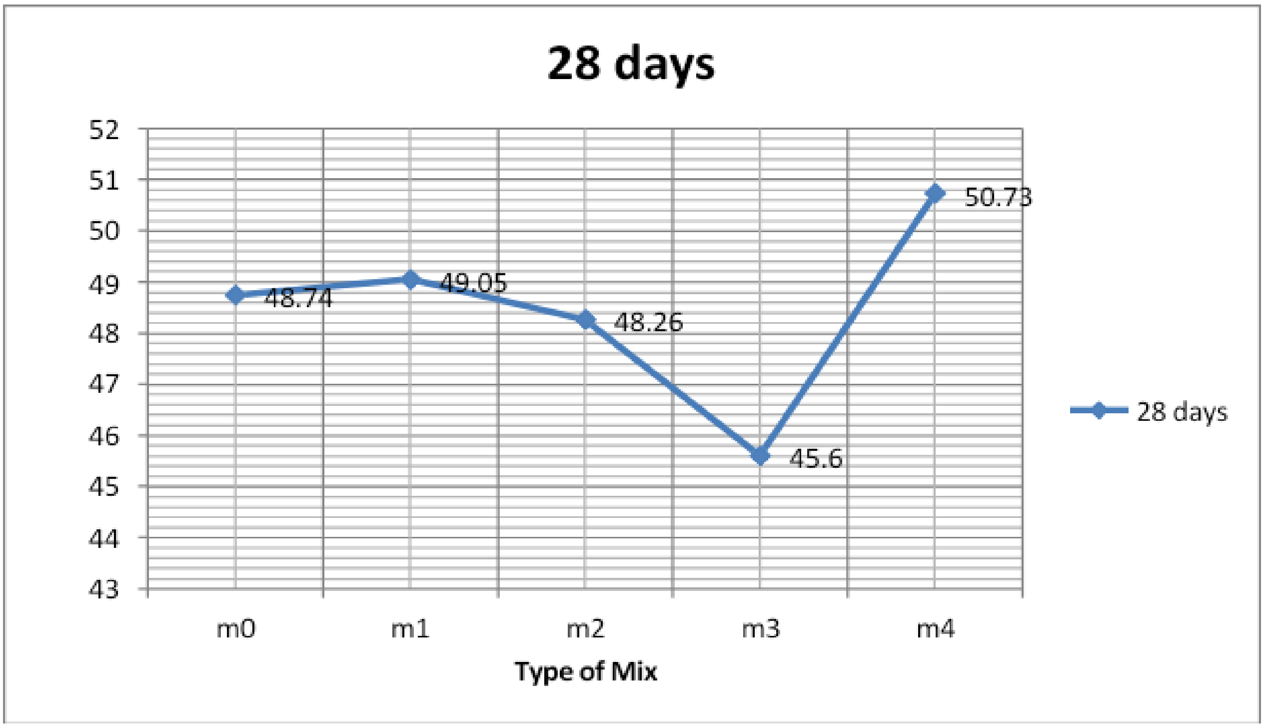


Figure 1.13 Variation of Compressive Strength at the Age of 28 Days After Attack of Sulphate Solution.

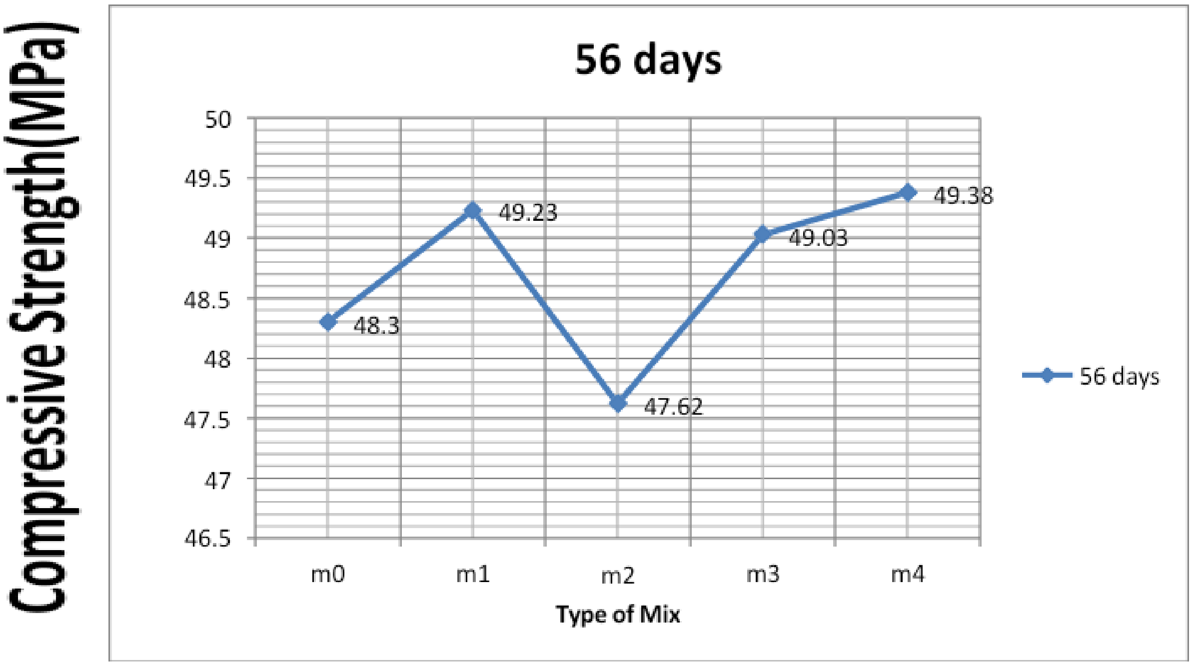


Figure 1.14 Variation of Compressive Strength at the Age of 56 Days After Attack of Sulphate Solution.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The exploration on operation of RCA in construction of pavement is veritably important because material waste is gradationally adding with the increase in civic development and increase in population. Recycled summations are fluently available while natural summations need mining and their cost is much advanced than the cost of natural summations. Recycled summations are cheaper than the virgin summations, so builders can fluently go these for construction purpose if their strength is equal or similar to natural .aggregates.

The The study examines the parcels of RCA when used with natural coarse summations. A lot of studies have been carried out on use of RCA concrete in construction. But in case of trace construction some further disquisition is needed. The main ideal of the study was to probe whether RCA can be used as material summations for concrete pavement construction. Compressive strength, flexural strength and sulfate resistance of RCA concrete is examined, where it was observed that mixing ofRCA cause increased water immersion.Concrete blend of M40 was designed as per parcels of summations. The results of this study showed that RCA concrete gave similar strength to conventional concrete. This indicated that RCA concrete can be feasible source for construction of pavements. From the results, it's also set up that plasticity of concrete is dropped due to advanced water immersion. Whenever recycled total is applied, water content is covered precisely in concrete blend as water immersion is increased due to presence of pervious matetial.

1. The compressive strength of all composites exceeded at the age of 28 days. Compressive strength of control blend i.e. of m0 is50.05 MPa which is lesser than the target strength of48.25 for M40 concrete. Compressive strength of m1 is slightly increased to50.36. So the compressive strength increases by0.5. For m2, compressive strength is increased to50.20 MPa, it also showed an increase in compressive strength by0.3. Compressive strength of m3 is dropped to49.11 MPa that showed a drop in compressive strength by1.9. But in case of m4, there's unforeseen increase in compressive strength that raises the compressive strength to52.36 MPa. Compressive strength is increased by4.5. So the results of test show that compressive strength doesn't follow a regular trend from m0 to m4. But from the results it's also concluded that compressive strength noway went below the target strength for 28 days. This indicates that RCA can be used as relief summations for compressive strength.

2. Flexural strength also followed the same pattern as of compressive strength. Flexural strength of control blend is5.32 MPa at age of 28 days. Flexural strength of blend m1 increased to5.60 MPa. It shows that the increase in flexural strength is 5 for m1. For m2 flexural strength at age of 28 days is5.40 MPa, which shows an increase in flexural strength by1.5. Flexural strength of blend m3 is5.38 and the flexural strength increased by 1. For the blend m4, flexural strength is5.40 MPa. It shows that the flexural strength

increased by1.5 at the age of 28 days. From the results and discussion of the results it's set up that the flexural strength of RCA concrete is similar to the natural total concrete which is a positive point. So the RCA concrete can be used for flexural strength by adjustingW/ C rate.

3. Use of 5 of MgSO4 result caused the reduction in compressive strength.Effect of sulphate result increased when volume of Crushed concrete total increased affected. So with increase in sulphate caused reduction in compressive strength of concrete.

4. It was set up that the RCA concrete have fairly lower bulk viscosity, specific graveness and high water immersion as compared to natural concrete. This was due to the presence of mortar in present on recycled coarse summations

5. In this study, trial castings were done to arrive at water content and asked plasticity. So it was judicious to carry out trial castings with Crushed concrete total proposed to be used in order to arrive at the water content and its proportion to match the plasticity situations and strengths conditions independently.

6. From this study it was observed that the persecuted concrete was feasible source for construction of concrete pavements. provident and environmental pressures justify felicity of RCA concrete as indispensable to the natural concrete. Where there'snon-availability of natural total from new jewels RCA can be a good or feasible relief option for natural coarse total in pavement construction.

From above conclusions it can be said that it'seco-friendly and creative to use persecuted concrete in construction of concrete pavements.

FUTURE SCOPE AND

RECOMANDATIONS

Some revision can be made for RCA to come extensively used material for construction of concrete pavements. harmonious and predictable results need to be attained when using RCA as a relief for natural total in concrete. To achieve this farther disquisition is needed in the areas of parcels of summations, blend design and proportioning, performance, testing, and modeling.

Perform petrographic analysis on the RCA samples to more probe their composition, quality and how important injurious material that can be included without affecting the performance of the concrete.

In the present study, the RCA is taken from single source. The results of RCA from different sources will be different. So it's needed to compare concrete composites with different sources of RCA including sources of RCA that are clean, polluted, and cured else.

In the present study, only five type of composites are used with proportion of RCA up to 40. This chance of RCA can be increased. Compare concrete composites with a variety of coarse RCA content to find the optimal quantum that can be added without affecting performance.

In the present study, only coarse total is used as replaced material. New study should be done that develop fresh designs that incorporate fine recycled total and concrete marshland- water to achieve a zero waste concrete.

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