Use of Recycled Aggregate and Fly Ash in Concrete Pavement

DivyaVishnoi, Rajan Choudhary, Mukul Sharma, YogeshKumar Sharma, Vinod Meena
Department of Civil Engineering
Poornima Group of Institutions, Jaipur,
Rajasthan

Abstract: **- Use of recycled coarse aggregate in concrete can be useful for environmental protection and economical terms. Recycled aggregates are the materials for the future. Same as fly ash is also a byproduct from various industries.This project presents the result of mix design developed for high strength concrete by adding the different kinds of unwanted material which is not be used and also the demolished concrete. In this research work the locally available constituents of concrete were selected for the purpose of determining their relative quantities and proportions for best result. In general, the RCA (Recycled Coarse Aggregate) has high water absorption due to the cement paste from old concrete. It will result in the inferior material properties of recycled aggregate concrete. Presently, the mix design with RCA was developed to get the desired amounts fly ash and recycled aggregate. The objective of this study is to evaluate material properties of concrete containing varying amounts fly ash and RCA. In the beginning, casting of different mould having different ratio of fly ash and RCA. After casting analyze the characteristics strength in 7, 14 and 28 days respectively. Suitable concrete pavement will constructed on the basis of analysis of result according to their compressive strength. The objective of this proposed research investigation was to assess the suitability of using concrete aggregates that are recycled from (1) concrete pavements, and (2) building rubble, for use as a highway construction material (i.e. in structural pavements, shoulders, base, sub base and subgrade in pavements) in the state of Indian.**

Keywords - Recycled Aggregate, Fly Ash, Concrete Pavement

I. INTRODUCTION

Recycled aggregate is produced by crushing concrete, and sometimes asphalt, to reclaim the aggregate. Recycled aggregate can be used for many purposes. The primary market is road base. For information on recycling asphalt pavement into new asphalt pavement. Recycling of concrete is a relatively simple process. It involves breaking, removing, and crushing existing concrete into a material with a specified size and quality. See ACI 555 (2001) for more information on processing old concrete into recycled concrete aggregates [1]. The quality of concrete with RCA is very dependent on the quality of the recycled material used. Reinforcing steel and other embedded items, if any, must be removed, and care must be taken to prevent contamination by other materials that can be troublesome, such as asphalt, soil and clay balls, chlorides, glass, gypsum board, sealants, paper, plaster, wood, and roofing materials. Demolition by-product of old concrete structures such as: Roadways, Foundations, Retaining Walls, Concrete Pipes.

This project presents the result of mix design developed for high strength concrete by adding the different kinds of unwanted material which is not be used and also the demolished concrete. In this research work the locally available constituents of concrete were selected for the purpose of determining their relative quantities and proportions for best result. In general, the RCA (Recycled Coarse Aggregate) has high water absorption due to the cement paste from old concrete. It will result in the inferior material properties of recycled aggregate concrete. Presently, the mix design with RCA was developed to get the desired amounts fly ash and recycled aggregate The main motive is to present the result of mix design developed for high strength concrete by adding the different kinds of unwanted material which is not be used and also the demolished concrete [2]. Development of mix design method plays a key role in concrete technology; it also involves the process of determining experimentally the most suitable concrete mixes in order to achieve maximum strength with at low economic expenditures. In this research work the locally available constituents of concrete were selected for the purpose of determining their relative quantities and proportions for best result. The application of Recycled Concrete Aggregate (RCA) in concrete started in the U.S. in 1942 by using demolished concrete pavement as recycled aggregate for stabilizing the base materials for road construction. In general, the RCA has high water absorption due to the cement paste from old concrete. As we seen in our present scenario the demolished concrete waste product is increasing day by day and our environment get polluted, so to consume the waste material, we use this concrete waste in concrete pavement construction and decreasing waste product to save our environment. Construction of concrete pavement structure by the use of RCA and Fly ash and protect the environment from the waste product. The objective of this study is to evaluate material properties of concrete containing varying amounts fly ash and RCA. In the beginning, casting of different mould having different ratio of fly ash and RCA. After casting analyses the characteristics strength in 7, 14 and 28 days respectively [3]. Suitable concrete pavement will constructed on the basis of analysis of result according to their compressive strength.

Concrete aggregate collected from demolition sites is put through a crushing machine. Crushing facilities accept only uncontaminated concrete, which must be free of trash, wood, paper and other such materials. Larger chunks may go through the crusher again. After crushing has taken place, other particulates are filtered out through a variety of methods including hand-picking and water flotation. The use of recycled concrete aggregate (RCA) as a road base has lowered costs of road construction while preserving virgin aggregate resources. Laboratory column leach tests have shown that leachate produced by RCA is persistently highly alkaline, potentially threatening groundwater quality. However, field-monitoring studies of RCA road base have not produced similar alkaline leachates. Both field and laboratory methods were employed to further study, compare, and predict leaching characteristics of RCA as a road base. This study produced first flush field data to determine the initial leaching characteristics of RCA. Congruent laboratory tests were also run to compare with field data. This study will provide the data necessary to predict environmental impacts associated with the uses of RCA as a road base in road construction.

II. METHODOLOGY

The experimental work has been carried out to develop mix design for high strength concrete.Four basic ingredients will used in this experimental work. The recycled coarse aggregate, crushed aggregate having maximum size 10mm, fly ash and sand. Ordinary Portland cement is used as binding material. Hyper plasticizer is used in order to increase workability & strength of concrete .The first step in the experimental work is air dry the aggregate sample so as to avoid lumps and to prevent clogging of fine sieve. The gradation of coarse and fine aggregate is done according to IS:CODE(INDIAN STANDARD CODE).The second step in the experimental program is to find the specific gravities of fine, coarse aggregates and cement which were 2.68, 2.7 and 3.04 respectively. The fineness modulus of fine aggregate used is 3.48. In third step batching of ingredients of aggregates and cement is done by weight mix ratio. A mixing machine is used for mixing the various constituents of concrete. A small amount of water is fed first followed by all the solid materials simultaneously into the mixer i.e. the sand fed first, then part of the coarse aggregate, cement and water and then finally the remainder of the coarse aggregate is fed into machine so as to break up any modules of mortar. The specific gravity of hyper plasticizer which is used is approx. 1.9[4]To check workability slump test is performed. The specimens will cast in steel mould. The mould will be properly greased which is used for the mould order to prevent the adhesion of concrete to the steel moulds. The concrete is poured into the mould in three layers each layer being compacted by 25 blows with a standard 16mm diameter steel rod, rounded at the end. After compaction third layer the upper surface of the concrete is levelled and after when its surface is dry then give it proper finishing. Precautions were taken to avoid over compaction which loads to segregation. After 24 hours in the moulds the specimens were removed and placed in water tank for 7 days 14 days and 28 days. Specimen will tested after 7, 14 and 28 days. Crushing strength will perform after two hours of removal from the curing tank. Load will apply continuously with the use of CTM (Crushing Strength Machine). The load is applied till the cracks in the specimen were develop which mean that the failure of the specimen has occurred at the point, the reading of the load in KN is noted from dial gauge.

A. Collection of aggregate

Two kinds of aggregate samples are required for the project. They are Fresh/Virgin aggregate sample and Scrap/Used aggregate sample. Recycled Aggregate samples were needed for the project which was obtained by combining fresh and used aggregate samples respectively in the ratios of 60:40, 70:30, and 80:20.

B. Testing of samples

The second step involved in the project after collection aggregate samples were laboratory analysis. Laboratory analysis of aggregate samples involves a set of quality control tests to be performed on each aggregate sample using appropriate lab equipments to know their characteristics better. The following quality control tests were performed on all four aggregate samples, Shape Test, Impact Test, Crushing Test, Specific Gravity Test, Los Angeles Abrasion Test, All the tests were performed with reference to proper Indian Standard and IRC (Indian Road Congress) guidelines.

C. Mix design

In this research comparison is carried out on two concrete grades that are M25 and M30. The desired characteristic strength of 25 N/mm² and 30N/mm² at 28 days was used in this study. IS 10232:2009 method was applied in designing the mixture. A total of 60 cubes and 20 beams were prepared for this study in 10 sets. A w/c ratio of 0.55 is taken for control mix [5]. Samples from each set of the mix were tested at the age of 7 and 28 days for compressive strength and 28 days for flexural strength. The coarse aggregates are usedproject which were obtained by combining fresh and used aggregate samples respectively in the ratios of 60:40, 70:30, and 80:20.

III. RESULT AND DISCUSSION

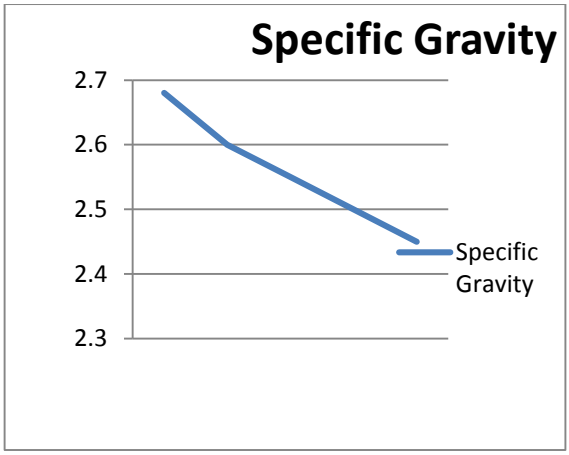

Fig 1: Specific Gravity

The above graph shows the relationship between the Specific Gravity of the recycled aggregate when the certain amount varying from 0 to 100% of the aggregate is used.

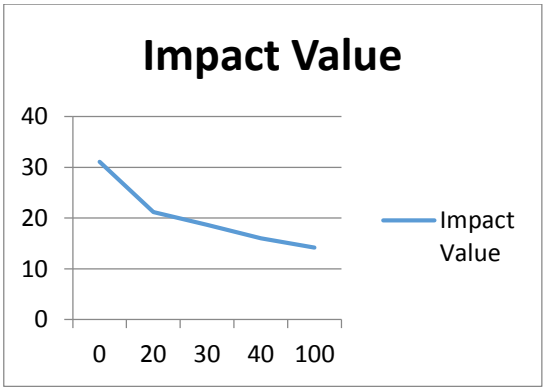

Fig 2: Impact value

The y axis represents the Impact value of the aggregate when the certain percentage of recycled aggregate is used as shown in X axis.

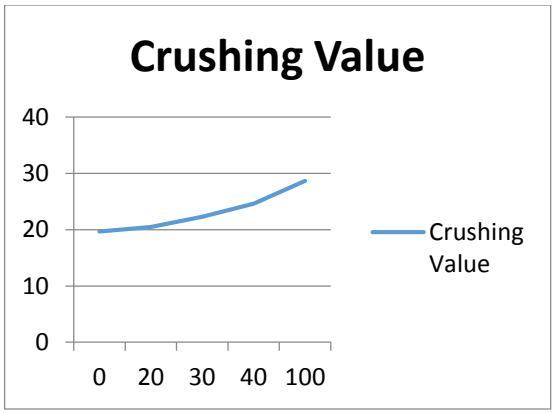

Fig 3: Crushing value

The crushing value graph represents the variation of crushing value when the amount or the percentage composition of the recycled aggregates is varied.

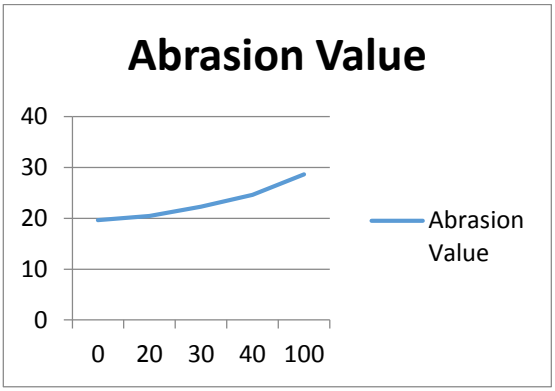

Fig 4: Abrasion value

The above particular graph shows the abrasion value variation with the change in the percentage of the recycled aggregate composition.

Table 1: Cumulative percentage for different grades of crushed sand

I. S. Sieve	Cumulative percentage passing IS sieves for grading zone (natural sand)				Crushed Sand
	I	II	III	IV	
10mm	100	100	100	100	100
4.75mm	90-100	90-100	90-100	90-100	90-100
2.36mm	60-95	75-100	85-100	95-100	75-100
1.18mm	30-70	55-90	75-100	90-100	55-100
600 micron	15-34	35-59	60-79	80-100	35-79
300 micron	5-20	8-30	12-40	15-50	8-40
150 micron	0-10	0-10	0-10	0-15	0-20
75 micron	0-3	0-3	0-3	0-3	0-15

The above table describes the cumulative percentage for different grades of crushed sand for the various sieves of the natural sand [6].By the above experimental analysis the nature of the particles and its appropriate use can be adjudged.

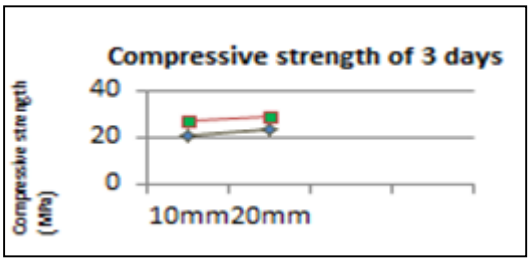

Fig 5: For the aggregate size varying from 10mm to 20mm the graph shows the compressive strength variation for three days

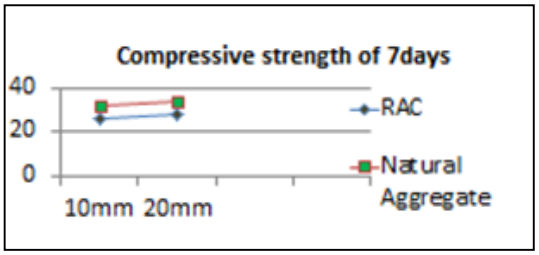

Fig 6: The above graph displays the compressive strength of 7 days for the size of 10mm and 20mm and the variation

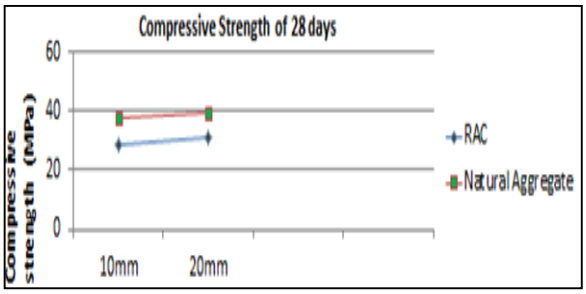

Fig 7: For the aggregate size varying from 10mm to 20mm the graph shows the compressive strength variation for 28 days

IV. CONCLUSION

When feasible, the use of recycled concrete as aggregates in concrete pavements should be allowed when it fulfil requirements of natural aggregates. In any project involving the use of recycled concrete the cost of reprocessing of aggregate and removal of steel reinforcements should be considered and, *in* addition. the savings in reduced .Landfill use should be considered as well. In general, the savings in landfill use should offset the cost of crushing otherwise the crushing process will not pay for itself and it becomes more economical to use virgin aggregates specific volume has not been found to insure that recycling the existing pavement provides economical benefits. Many factors must be taken into consideration when dealing with recycling concrete pavements and in many cases the decision may be left to the contractor to decide whether to recycle. In Indian most of the counties have at least one aggregate source. These sources might not always be conveniently located near a project and at some point consideration has to be given to how long these sources will be able to supply the aggregate. Due to environmental concerns, in some urban areas, it is less expensive and more environmentally acceptable to re-use the concrete than to dispose of it. Therefore when a concrete pavement will be removed before a new pavement is placed; the project is a prime candidate for recycling. The old pavement is a source of aggregate in the new concrete, and the need and expense of disposing the material removed can be eliminated. Further, if the project is large enough for an on-site aggregate plant, the materials' transportation costs are reduced. The use of recycled aggregate for concrete production is expected to increase in the future as both the demand for road base material and the price of recycled aggregate *is* foreseen to decrease. To date, concrete recycling has been involved primarily with the use of crushed pavement concrete as aggregate in new pavements. It has been determined that recycled concrete can best be used as a substitute for coarse aggregate only.

REFERENCES

[1] Specification for coarse and fine aggregates from natural sources for concrete (second revision), is: 383 – 1970 (reaffirmed 2002).

[2] Plain and reinforced concrete – code of practice (forth revision), is: 456 – 2000 (reaffirmed 2005)Methods of sampling and analysis of concrete, is: 1199 – 1959 (reaffirmed 2004)

[3] Methods of test for aggregates for concrete part i particle size and shape is: 2386 (part i) – 1963 (reaffirmed 2002)

[4] IRC codes (Indian road congress) for pavement design.

[5] Methods of test for aggregates for concrete part iii specific gravity, density, voids, absorption and bulking, is: 2386(part iii) – 1963(reaffirmed 2002)