EFFECT OF RCA ON COMPRESSIVE STRENGTH IN CONCRETE

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Abstract

As there is increase in the economic growth in development and redevelopment projects in the country and successive increase in the urbanization of the cities has made construction sector to increase tremendously, but also environmental impacts from construction and demolition waste are increasingly becoming a major issue in urban solid waste management. Hence a rule was been passed in order to manage such construction & demolition waste to recover, recycle, reuse and use it as a resource in preparing one of the concrete. Local bodies are laid by rule to utilize 10-20 % material from Construction and demolished waste in municipal and government contracts. The Paper presents experimental procedure to prepare concrete with incorporation of Recycled coarse aggregate, fly-ash, Admixture in suitable proportion. In this study Recycled coarse aggregate are utilized in variable replacements of Natural coarse aggregate from 40 to 80 % with increment of 10%. The test result for acceptance characteristics such as Compressive characteristics at age of 3,7,28 days are determined and result are included here.

Index Terms: Construction & demolition waste, Recycled coarse aggregate, fly-ash, compressive strength.

I. INTRODUCTION

Concrete is a widely used construction material which is the mixture of cement, water, fine aggregates, and coarse aggregates and used almost for decades in every kind of structures, either it is roadways or buildings. The structures which have sufficient strengths may be unsafe due to errors involved in reinforcement design of the structure, the environmental conditions which can degrade the concrete, and so on.

As there is growth in urbanization many structures are been constructed nowadays. However the materials which are used for construction are now deplinshing and are available in small quantities. So in order to maintain balance of remaining materials it is necessary to use recycled materials from construction and demolition waste in Construction practices. Reusing the materials from demolished site will lead to faster rate of construction and will also reduce its adverse impact on environment due to its disposal through landfill. Protection of environment is a basic issue that is directly connected with the survival of the human resource in form of construction materials. Parameters like environmental consciousness, protection of natural resources, sustainable development play vital role in necessities of construction works. Due to modernization destroyed materials from site have to disposed off on to landfill which will have an effect on the fertility of land and hence causing damage to environment. The use of recycled aggregate typically will increase the drying shrinkage, creep & porosity to water. The recycling of coarse aggregate obtained from demolished waste obtained from RMC plant labs has now to be used in preparing in new concrete as if these materials are to be disposed in to landfill the cost of its disposal is increasing day-by-day. With the number of readily accessible disposal sites around major cities in the world decreasing in recent years due to large disposal volume. Thus, the maximum sizes of waste being restricted and the cost of dumping construction and demolition debris has increased

substantially over recent years. Due to the growing concerns over the environmental impact of aggregate extraction and the continued rise in aggregate demand, it is clear that the building and construction industry is ready to accept recycled and secondary aggregates in preparation of normal type of concrete.

II. LITERATURE REVIEW

Gyan Ranjan Nayak et al., studied "Effect on compressive strength of concrete incorporating recycled aggregate concrete with fly ash as cement replacement" and investigated the influence on compressive strength of concrete incorporating recycled aggregate and fly ash as cement replacement. Recycled concrete aggregate (RCA) is replaced by three different percentage 0%, 50%, and 100% with the natural coarse aggregates (NCA). Fly ash (FA) is replaced as 0%, 15% and 30% of cement. Water/cement ratio is taken as 0.45 throughout the experimental programme. The compressive strength of concrete is measured after 7 and 28 days of curing and compared with the normal concrete. The results show decreased compressive strength of concrete specimens incorporated with recycled aggregate and fly ash. He concluded that Workability of concrete decreases with the addition of fly ash and recycled aggregate.

Aditya G. Kutwad et al., conducted "A Study and Use of Recycled Aggregate with Fly Ash in Concrete" and concluded that R.C.A. has shown low specific gravity and high-water absorption than N.C.A. because of mortar is attached to the surface of RCA. Recycled aggregate has exhibited low resistance to mechanical action like impact, crushing and abrasion than conventional aggregate. The above properties decrease with increasing the percentage of Recycled coarse aggregate in concrete. Recycled aggregate concrete workability is more than the natural aggregate concrete because of the extra amount of water is added according to the of water absorption of RCA.

Parthasai Reddy conducted "Determination of mechanical properties of recycled aggregate concrete with fly ash". The objective of the present investigation was to assess the properties of concrete that combine both supplementary cementitious material (fly ash) and recycled aggregate. In this investigation an attempt was made to understand how the properties of concrete get affected when fly ash is used as a cement replacement and recycled concrete aggregate as a replacement to conventional coarse aggregate in different proportion. An experimental investigation was carried out to study the properties of F-RA (fly ash based recycled aggregate) concrete. Fly ash replacement with cement in different proportions, i.e. 10%, 20%, 30% and 40% is done for the optimum recycled aggregate concrete.

Dr. M.N.Bajad et al. studied "Effect of Recycled Aggregate and Fly Ash in Concrete". In this experimental study the natural coarse aggregate (NCA) is replaced with RCA at different percentage and the mechanical strength of concrete is tested. In addition, the FA is introduced as replacement of Cement. The objective of present study is to determine the sustainability of RCA as an alternate material to NCA and to compare the workability, density and compressive strength result using FA. Cubes are casted by replacing virgin aggregate and cement with 10%, 20%, 30%, 40% RCA and FA and compressive strength is checked. Obtained results are then used to establish an empirical relationship between the strength of concrete by using percentage of RCA and percentage of FA. Results shows that RCA and FA up to 30% can be used for making concrete.

III. MATERIALS

A. Cement

An ordinary Portland cement (Grade 53) conforming to IS 12269 (1987) was used as the main binder for the experimental investigation.

B. Fine aggregate

Locally available crushed sand conforming to of IS 383:1970 was used in the present investigation. The physical properties such as specific gravity=2.62, water absorption=0.01% and fineness modulus=3.33 were investigated.

C. Coarse aggregate

In this study, natural coarse aggregates type crush rock obtained from a local supplier were used. The recycled aggregates were obtained from RMC site were used for present study. The maximum size of aggregate was limited to 20mm.

D. Fly-ash

Fly ash or pulverised fly ash is a residue from

the combustion of pulverised coal collected by mechanical separators, from the fuel gases of thermal plants. This fly ash is pozzolanic in nature, and contains less than 7% lime (CaO).

E. Admixture

The superplasticizer used was Type G high range water reducer based admixture. The main reason of utilizing superplasticizer in concrete it reduces the amount of water by 12% to 30% while maintaining certain consistency and workability.

IV. METHODOLOGY

The recycled concrete aggregates were obtained by breaking concrete cubes of M30 grade concrete discarded after compression testing. The concrete cubes were obtained from a ready-mix concrete plant located in Malad. As shown in F concrete cubes were broken down using hammer and chisel and sieved to obtain recycled concrete aggregate size range between 20 mm to 10 mm. However the Natural coarse aggregate are been replaced by suitable proportions of recycled coarse aggregate in order to re-use this materials and hence it solve the problem of its disposal, leading to sustainable development.

The concrete mix were prepared by replacing coarse aggregate with recycled concrete coarse aggregate and adding fly ash as partial replacement for cement. The concrete mix design for M-30 is done as per IS 10262:2009. Four trial mix with recycled concrete aggregates and fly ash were prepared. The replacement percentages were 40%,50%,60% and 80% by weight of coarse aggregate in the concrete mix. The trial mix were designated as TM2 with 40% recycled concrete aggregate replacement, TM3 with 50% recycled concrete aggregate replacement, TM4 with 60% recycled concrete aggregate replacement, TM5 with 80% recycled concrete aggregate replacement.

Fig no: 1 Sieving of recycled aggregate

V. RESULTS

Once the concrete is been prepared its hardened state properties which include Compressive strength is been measured at 3, 7, 28 days curing time. The compressive strength is measured using cube specimens. The size of the cube specimen is 150 mm × 150 mm × 150 mm. The cubes after been casted are kept for curing for period of 3, 7, 28 days. After desired curing period the cubes are tested on Compressive testing machine. Table 3.2 represents the compressive strength of the cube corresponding the day it was examined on. The results are presented along with their graphical plots and discussions.

I. Compressive strength test results

Sr No	Trial mix	Time(days)	Compressive strength(N/mm^2)
1	TM2(40%RCA)	3	30.31
		7	37.14
		28	41.36
2	TM3(50%RCA)	3	18.63
		7	41.55
		28	41.35
3	TM4(60%RCA)	3	15.77
		7	16.25
		28	30.91
4	TM5(80%RCA)	3	8.89
		7	11
		28	17.7

From the test results, the compressive strength seems to increase slightly with the addition of RCA. This could be due to the higher absorption capacity of the recycled aggregate. When the water is absorbed by aggregate, more space left by the water being absorbed can be occupied by aggregates in a unit volume.

Fig no: 2 Cubes tested on Compressive testing machine

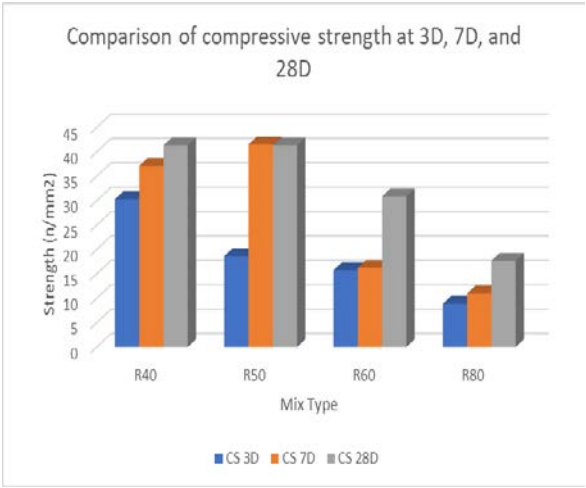

Fig no 3: Comparison of Compressive strength at 3,7,28 days

Thus it can be concluded that RCA upto 50% is satisfactory to use. It will also be economical with the reduction in transportation cost of dumping the aggregates. Primary reason of strength reduction may be the adhered mortar to the RCA and other non-aggregate material. This can be corrected by using proper cleaning techniques of recycled aggregate and advanced casting methods under highly skilled supervision.

VI. CONCLUSION

From the experimental work carried out on concrete using Recycled coarse aggregate, the following conclusion can be drawn:

1) There is a significant scope for utilization of recycled aggregate as an appropriate and green solution for sustainable development in construction industry.
2) The effect of recycled coarse aggregate on the compressive strength of concrete is evident from the results. However the loss in strength was not considerable, but with addition of suitable recycled aggregate and proper method of mix design slight increase in strength can be achieved.
4)The compressive strength of concrete containing 50% RCA has strength in close proximity to that of normal concrete.
5)The strength of concrete is high during initial stages but gradually reduces during later stages.
6) Due to lack of treatment process for RCA adequate strength is not achieved but by applying more advanced and sophisticated treatment process the strength can be improved.
7) R50 means 50% replacement of natural coarse aggregate with recycled coarse aggregate is feasible for construction according to government law through demolished structure.

Thus the usage of RCA in concrete mixture is found to have strength in close proximity there to of natural aggregate and will be used effectively as a full worth component of new concrete. Even though with only 50% replacement of recycled aggregate was found to feasible. But for now even with partial replacement of Recycled coarse aggregate and with addition of Suitable admixture it will exhibit almost desirable strength for M-30 grade of concrete.

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