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Utilization of Demolished Concrete Waste for New Construction and Comparing Their Compressive Strength after 28 Days with Normal Aggregate Concrete

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Abstract – *The mass production of construction and demolition are creating serious problems in India. In most of the countries applicability of construction and demolished wastes are restricted to non-structural concrete, pavements and backfilling. In present day Demolished Concrete waste handling and management is challenging one in all over the countries in the world. Recycle the demolished concrete has reduces the environmental pollution and protect the natural resources. In this research paper an experimental study is carried out to investigate the recycling of demolished waste concrete for new contraction. This research included a collecting a Demolished Concrete from waste and is separated with different sizes using sieve analysis. Various sizes of aggregate is treated with heating process. Finally the demolished concrete aggregate DCA is replaced by various percentage of 10%,20%,30%,50%,100% and test can be conducted and compared with nominal concrete.*

I. INTRODUCTION

1.1Background

Concrete is versatile it's durability, sustainability, and economy have made it the world's most widely used construction material. About four tons of concrete are produced per person per year worldwide. The term concrete refers to a mixture of aggregates, generally sand, and either gravel or crushed stone, held together by a binding material of cementations paste. Understanding the fundamentals of concrete is necessary to produce quality concrete according to design for the construction of durable structure.

1.2 Essentials of Quality Concrete

Workmanship, mix proportions, material characteristics, and adequacy of curing is related to performance of concrete. The production of quality concrete involves a variety of materials and a number of different processes including, the production and testing of raw materials, determining the desired properties of concrete, proportioning of concrete constituents to meet the design requirements, batching, mixing, and handling to achieve consistency, proper placement, finishing, and adequate consolidation to ensure uniformity, proper maintenance of moisture and temperature conditions to promote strength gain and durability, and finally, testing for quality control and evaluation.Many people with different skills come into contact with concrete throughout its production. Ultimately, the quality of the final product depends on their workmanship. It is essential that the workforce be adequately trained for this purpose. When these factors are not carefully controlled, they may adversely affect the performance of the fresh and hardened properties.

1.3 Defined Materials

Concrete becomes hard on drying it is basically a mixture of two components: aggregates and binder paste. The binding paste, comprised of portland cement and water, binds the aggregates (usually surkhi or sand and crushed stone or gravel) into a rocklike mass as the paste hardens from the chemical reaction between cement and water. Supplementcementitious materials and chemical admixtures can also be included in the paste to improve the quality of concrete. The paste may also contain entrapped air or purposely entrained air. The paste constitutes about 25% to 40% of the total volume of concrete. Figure 1shows that the absolute volume of cement is usually between 7% and 15% and the water between 14% and 21%. Air content in concrete ranges from about 4% to 8% of the volume.

1.4 Introduction to Construction and Demolition Waste

Balance of the supply of construction and demolition (C&D) wastes and the demand of recycled C&D waste products (Balance Theory) is an effective means of reducing these wastes. The maturity of Balance Theory requires gradual establishment of recycling facilities. These facilities are capable to accept and handle not only inert materials but also other C&D wastes—wood and wood products, cardboard, metal, and plastics. The Balance Theory requires construction workers to adopt the idea of reduction of wastes. They are educated to clean their working places constantly and collect all construction wastes they generated into separate collection spots within the construction site. A site management personnel is required to establish site facilities and set up conditions in employment contracts, and subcontracts for workers, and subcontractors to follow. The culture of separating wastes at sources must be established and widely adopted so that Balance Theory could be realized. Balance Theory advocates the amount of wastes generated from a construction project, and sent for recycling process must be equivalent (or proportional) to the amount of the recycled C&D products imported and used as construction materials for that project.Levels of waste within the construction industry need to be reduced for environmental and economic reasons.

1.5 Present Scenario of Demolished Waste used in India

Construction and demolition waste (C&DW) management is gaining attention from policy makers in India. This article estimates C&DW generation from urban building, rural building, and non-building sectors in India and calculates material, energy, and emissions savings from C&DW recycling. The method used in this study is top down up material flow analysis approach. The results indicate that India generated between 112 and 431 million tonnes of C&DW in 2016 depending upon the assumptions, which are orders of magnitude higher than official records indicate. Although per capita waste generation from rural area is less than urban areas, rural areas as a whole generate more waste than urban areas, as rural population is still over two times the urban population in India. Additionally, it was estimated that formal C&DW recycling can save upto 2–8% of natural minerals, such as sand and aggregate in urban areas, energy and emissions savings were negative, implying that recycled C&DW materials are likely to be more resource and environmentally intensive as compared to natural materials.

1.6 Demolished waste of concrete as a material

Recycling of concrete debris can make a contribution to reducing the total environmental impact of the building sector. To increase the scope for recycling in the future, aspects of recycling have to be included in the design phase. Besides, aggregate sources near Metro Manila are almost depleted, so aggregates have to be brought from far quarries. Consequently, reclaiming aggregates from concrete debris would lead to environmental and economic benefits.

II- LITERATURE REVIEW

KATAM AVINASH Huge quantities of construction materials are required in developing countries due to continued infrastructural growth and also huge quantities of construction and demolition wastes are generated every year in developing countries like India. The disposal of this waste is a very serious problem because on one side it requires huge space for its disposal while on the other side it pollutes the environment. In recent years demolished concrete waste handling and management is the new primary challenging issue faced by the countries all over the world. It is very challenging and hectic problem that has to be tackled in an indigenous manner, it is desirable to completely recycle demolished concrete waste in order to protect natural resources and reduce environmental pollution. In this research paper an experimental study is carried out to investigate the feasibility and recycling of demolished waste concrete for new construction. The present investigation to be focused on recycling demolished waste materials in order to reduce construction cost and resolving housing problems faced by the low income communities of the world. This investor concluded that demolished aggregate posses relatively lower bulk crushing, density and impact standards and higher water absorption as compared to natural aggregate. The compressive strength of the concrete is decreases with increasing the percentage of demolished material from 0% to 50%. The 28 days tensile strength of the concrete is decreases with increasing the percentage of demolished material.

VEERASELVAM , K In present day Demolished Concrete waste handling and management is challenging one in all over the countries in the world. Recycle the Demolished Concrete has reduces the environmental pollution and protect the natural resources. This research is focused on utilising the Demolished Concrete waste and reduces the generation of construction waste. This research included a collecting a Demolished Concrete from the demolition of building at site, Crushing Demolished Concrete waste and is separated with different sizes using sieve analysis. Various sizes of Aggregate is treated with heating and chemical process. Finally the Demolished Concrete Aggregate (DCA) is replaced by various percentages of 10 %, 20 % , 30 % adding with fibre and test can be conduct and compared with nominal Concrete.

Based on the experimental investigations carried out, the following conclusions are drawn On Comparing Compressive strength of Nominal Concrete and Demolished Concrete Aggregate, the percentage of DCA replacement upto 20%, the strength increased as 2.5%. On Comparing Split Tensile Strength of Nominal Concrete and Demolished Concrete Aggregate, the percentage of DCA replacement upto 20%, the strength increased as 7.07%. On Comparing Flexural strength of nominal Concrete and Demolished Concrete Aggregate, the percentage of DCA replacement Reducing the strength From the study the Replacement of DCA Concrete allowed to use up to 20 % with adding fiber. For more replacement of DCA Concrete has decreasing in strength.

Nikita Patel Environmentalissues such as climate change and associated global warming, depletion of natural resource and biodiversity, water and soil pollution, generation of huge amount of waste materials and their disposal are some of great challenges faced by present day civilization. Recycling of materials and reuse of the material is very important. Recycled concrete aggregates are used in concrete in replacement of nominal concrete aggregates 20mm and grit aggregates, replacement of 50%. Different various percentage of aggregate replacement gives optimum replacement content 50% in mix design of M20 without admixture using. Compressive strength of cubes are 20% more than nominal concrete cubes and getting strength 30 KN/mm2 nominal mix design at 28 day and 25 KN/mm2 for replacement of 50% recycled aggregate in M20 design. For same way in 56 days result analysis compressive strength 25% increased than nominal mix design, compressive strength is 25 KN/mm2 and 28 KN/mm2 for nominal M20 and 50% replacement of recycled aggregate M20. Split tensile cylinder test result shows almost 10% and 15 %increase in recycled aggregate concrete to nominal concrete at 28 day and 56 day result. Flexural strength of beams test result show that 20% and 15% increase in recycled aggregate concrete to nominal concrete aggregate at 28 day and 56 day result analysis. All result data comparison to NDT test of rebound hammer is done.Using recycled aggregate in concrete, is best way to recycled demolished concrete and achieve the strength better than nominal concrete aggregates. The different result of compressive strength of 3 day, 28 day and 56 day show that replacement of recycled aggregate of 50% to achieve the M20 and get higher strength than nominal concrete. Split tensile strength and flexural strength gives almost same result and without admixture M20 strength can achieved. At the end comparison with compressive strength to rebound hammer number gives better analysis to understand comparison of NDT and mechanical test analysis.

Aiyewalehinmi E.O This study investigates the engineering properties of demolished concrete aggregates wastes along Arakale Road, Akure. The purpose is to recycle and reduce the amount of construction wastes materials going into landfills and dumping pits. The study identifies about 15% to 20% of construction waste materials go into landfill and dumping pits in Akure. Four different mixes at 0.5, 0.55, 0.60 and 0.65 water/cement ratios were performed and a total of 96 (48 each) concrete cube samples were cast, cured and crushed. The results showed that at lower percentage water/cement ratios, the compressive strength of used aggregates at day 28 were much lower than virgin aggregates (16.89N/mm2, 19.93N/mm2) while at higher percentage water/cement ratios, the compressive strength of used aggregates at day 28 was almost the same as Virgin aggregates (18.07, 18.37). It shows that the used aggregates can attain the same compressive strength as virgin aggregates at higher water/cement ratios.

With increase in water/cement ratio from 0.5 to 0.55, there is an increase in compressive strength of both concretes. ii. With the increase in water/cement ratio from 0.55 to 0.60, natural aggregate concrete shows reduction in compressive strength whereas discarded/recycled aggregate concrete shows increase in compressive strength. iii. With the increase in water/cement ratio from 0.60 to 0.65, there was a reduction in compressive strength of both concretes. iv. At higher water/cement ratios (0.65) the compressive strength of discarded concrete is close to that of natural concrete at all curing level (7, 14, 21, and 28 days). Specifically at day 28 day the compressive strength of discarded concrete attained 84.7% while virgin concrete recorded 84.37. This trend indicates with increase in water/cement ratio the compressive strength of discarded/recycled aggregate concrete may likely attain the same compressive strength standard. **Avindana John & Dr. Suhil Kumar Mittal1, N.K Dhapekar** Construction and Demolition waste (C&D) is a serious concern now a days. In construction projects lot of waste is generated during the stage of demolition. Approximate composition of C&D waste is: 40%-50% -Recycled Coarse Aggregates, 22%-25% -Fine Aggregates 15%-20% - plastics, ceramics , glass materials etc. Optimizing utilization of demolition waste (coarse and fine recycled aggregates) can reduce environmental impact and natural reserve can be saved .Research paper highlights the limitations regarding effective utilization of C&D waste. The recycling and re account of construction and annihilation (C&D) ate as an alternative to aggregates for the construction sector. Construction and Demolition waste administration is advised to advance development for sustainability, aegis of ambiance and optimum use of accustomed resources in this research paper. Production of construction and annihilation waste is not approved like borough solid waste. Authorities should construct a plan by which nominal accuse can be imposed on the agencies bearing construction and annihilation waste. As this breadth is new one in India, accelerated efforts are appropriate for marketing the recycled articles and to body assurance amidst consumers. IS 456 or IRC112 do not admittance applications of construction and annihilation waste abstracts added than those acquired from accustomed sources. Looking at all-embracing advancements and experimentations there is huge curtailment of aggregates from accustomed sources beyond the country and it is time that recycled abstracts acquired from construction and annihilation waste should be acceptable for reclaim in accurate constructions. An ample framework is appropriate based on which acceptable blueprint can be fatigued up by. Framework of able guidelines and rules should animate able reprocessing, recycling and reclaim of aggregates acquired from waste materials. **N.K. Dhapekarand S.P. Mishra** This paper discusses rules for management and use of construction and demolition wastes. Innovative steps to reduce, recycle and reuse of wastes are also proposed in this paper. Construction and Demolition waste management is designed to promote development for sustainability, protection of environment and optimum use of natural resources. Promotional and confidence building measures are discussed in detail. Rules for effective utilization of construction and demolition waste by various government bodies are highlighted in this paper. Rules and suggestions for construction and demolition waste are also presented in research paper. Production of construction and demolition waste is not regular like municipal solid waste .Authorities should design a plan by which nominal charges can be imposed on the agencies producing construction and demolition waste. As this area is new one in India, intensive efforts are required for marketing Production of construction and demolition waste is not regular like municipal solid waste .Authorities should design a plan by which nominal charges can be imposed on the agencies producing construction and demolition waste. As this area is new one in India, intensive efforts are required for marketing. **Mohammed Ali &Mohammed Al-Bared** Demolished concrete material (DCM) is a waste material produced in large quantities during the demolition activities of old buildings and structures associated with design errors. The amount of waste generated during the demolition processes is massive and creates several environmental problems. This waste is biodegradable and considered harmful due to the existence of cement within the mixture of DCM. It is normally dumped in landfills or illegal dumping sites resulting in polluting the surrounding and consuming a large space. The massive production of concrete demolished material calls for recycling this material for environmental sustainability, greener production, and economical reuse. This material could be utilized as coarse or fine aggregates in producing sustainable civil engineering materials. Besides, it is also used to enhance the engineering properties of soft soils in order to meet the engineering requirements. This paper presents a comprehensive literature review on the amount of waste of DCM, applications of DCM in producing construction materials, and soil stabilization in the past 10 years period. The review showed the ability of DCM to be used as sustainable material in the production of construction. 1. The amount of demolition waste was approximately 20 to 30% of the daily generated solid waste in Malaysia. 2. The utilization of DCM in the production of concrete resulted in the production of a modified concrete with similar properties with the normal concrete mix. 3. DCM can be used to replace aggregates during the production of pavement and it showed similar results to the one obtained using normal aggregate. 4. The usage of DCM in soil improvement revealed an increase in the strength, maximum dry density and other properties. The improvement was due to the formation of some cementation compounds and that is due to the existence of cement within the DCM.

III- CONCLUSION OF LITERATURE REVIEW

Many researchers have worked in this field some had collected the information about the production of demolished waste in different area , huge amount of waste is degraded in India also ; some of them worked in the replacement of coarse aggregate with demolished waste in some percentage only; some of them founded the strength benefits using this waste and many more about different properties of concrete for eg : durability, flow ability, workability, tensile strength etc., Here I found a big research gap about the 100% replacement of Coarse aggregate with demolished waste whether it is possible to gain suitable strength or not.

IV-OBJECTIVE OF THE STUDY

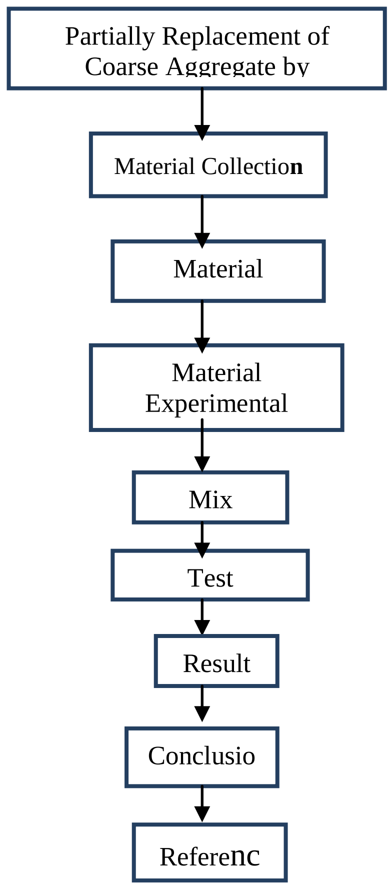
As we have studied earlier that for any type of civil engineering construction, cement concrete is the chief constituent because it can be made with local available materials, but as large construction is going on presently, and will in future too, new construction technology will be used and for large construction, hence large amount of natural materials will be required which is generally found from nature.

Extraction of natural materials fulfills the present requirement of construction, but it degrades the environment in long run, in the form of air pollution, land pollution, water pollution, and rise in temperature due to climate change.

We are seeing now a days many old structure are being demolished, and new buildings are constructed. Due to demolition of old structures large amount of construction solid waste are generated. Main Aim of the research are:

(1) In our project we are making an effort, and are trying to replace natural coarse aggregate partially and fully by demolished waste concrete.
(2) Experiments will be done on fresh as well as hardened concrete, and it will be compared with concrete made with fresh quarried natural coarse aggregates extracted from earth's surface.
(3) Also the previous researcher's had replaced some percentage of coarse aggregate with demolished waste in this theis coarse aggregate is fully replaced by demolished waste and then it is being tested .
(4) If the results are found at par with the results as per IS specifications, a recommendation will be made in future to government agencies, that demolished waste coarse aggregate can be a replacement to natural coarse aggregates and can be used for low cost housing projects.

V- METHODOLOGY



4.1 Result and Discussion

Concrete mixes were made, NAC and RAC were produced using natural sand as fine aggregate.NAC mixes were used fully Natural Aggregate as coarse aggregate in concrete mix. MeanwhileRAC mixes were used demolished waste concrete aggregate as partially or fully replacement of Natural Aggregate ascoarse aggregate. These mixes were designed according to concrete mix design. The concrete mixtureswere prepared with a water-cement (w/c) ratios 0.4, 0.45, 0.50. The slump target is between 70mm to 190mm for NAC and RAC mixes. Thecombination in concrete mixes after this will be called as RA00, RA10, RA20, RA30, RA50and RA100.Table below showed the details of concrete mixes.

Table 21 Series Of Mix Proportion Of Natural Aggregates And Recycled Aggregates

Series	Natural Aggregate (%)	Recycled Aggregate (%)
RA00	100	00
RA10	90	10
RA20	80	20
RA30	70	30
RA50	50	50
RA100	00	100

Testing of Concrete

Slump and compressive test was conducted to determine concrete's workability and compression strength. Three cubes of 150mm x 150mm x 150mmwere tested at 7, 14 and 28 days

4.1.1 Slump Test Result

The slump results are presented in Table below. It can be observed that concrete mixes at 0.4 had a lower slump compared to 0.45 and 0.50 concrete mixes. On the other hand, when replacement of RA is increased in concrete mixes, the slump of concrete mixes is decreased. It was expected because recycled aggregate is high in water absorption.

Table 22 Slump For Different W/C Ratio Concrete Mixes

Series	W/C Ratio	Slump (mm)
RA00	0.4 0.45 0.50	128 130 160
RA10	0.4 0.45 0.50	120 127 168
RA20	0.4 0.45 0.50	117 125 167
RA30	0.4 0.45 0.50	100 115 165
RA50	0.4 0.45 0.50	80 85 163
RA100	0.4 0.45 0.50	40 45 150

4.1.2Compressive Test Of Concrete Cubes

The compressive strength results are presented in Table below. Each presented value is the average ofthree measurements. It is shown in Fig. that compressive strength of Demolished Waste Concrete (RAC) is lowered comparedto Natural Aggregate Concrete (NAC). For w/c ratio 0.4, 0.45 and 0.50 the concrete mixtures prepared with 0% , 10%, 20%, 30%,50% and 100 % replacement of demolished concrete waste, for testing 3 cubes were casted for determination of compressive strength concrete for each grade testing at different days , with different proportions of fresh coarse aggregate and demolished concrete waste. It has been found that M20 grade of concrete with 0.50 w/c gave 16.04 N/mm^2 at 7 days as compared to M25 w/c 0.45 gave 18.12 N/mm^2 ,similarly in case of 14 days M20 gave better results as compared to M25 , similarly 28th day results of M20 grade concrete was 19.57 N/mm^2 as compared to M25, 25.89 N/mm^2.Normally as RA replacement increased, compressive strength will decrease (Topcu and Sengel (2004) and Kou, Poon and Chan (2007)). The higher compressive strength may be attributed to the greater bonding force and strength when same type of aggregates was used. Otherwise, DAC still obtained lower compressive strength compared to NAC.

Table 23 Compressive Strength Results Are Presented At Different Days

Series	Grade of Concrete	W/C Ratio	7-days	14-days	28-days
RA 00	M 20	0.50	16.04	18.37	19.57
	M 25	0.45	18.12	20.28	25.89
	M30	0.40	19.34	24.97	29.99
RA 10	M 20	0.50	14.27	17.01	18.21
	M 25	0.45	16.31	18.43	23.50
	M30	0.40	18.65	22.89	28.10
RA 20	M 20	0.50	17.08	19.00	21.11
	M 25	0.45	19.11	21.90	26.01
	M30	0.40	20.02	26.03	32.56
RA 30	M 20	0.50	15.01	16.45	17.76
	M 25	0.45	16.90	18.12	23.12
	M30	0.40	17.33	22.17	27.81
RA 50	M 20	0.50	14.90	16.00	16.02
	M 25	0.45	15.43	17.11	22.67
	M30	0.40	16.32	20.32	26.43
RA 100	M 20	0.50	13.99	15.67	15.34
	M 25	0.45	14.11	16.34	24.56
	M30	0.40	15.28	19.21	24.99

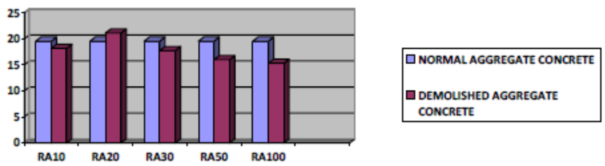


Fig 13 Graphical representation for NAC and DAC (M20 W/C Ratio 0.50)

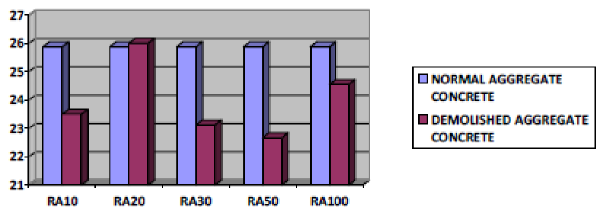


Fig 14 Graphical representation for NAC and DAC (M25 W/C Ratio 0.45)

The results obtained of concrete made with 100% demolished waste concrete as aggregates were inferior in case for each M20, M25 and M30 grades of concrete as demolished waste concrete has less bearing capacity to bear vertical loads, also bonding between the particles weakens. Hence the compressive bearing strength in case of concrete made of 100% demolished concrete waste is less as compared to concrete made with fresh broken stone coarse aggregates.

From the results fig.15 we can compare M20 grade of concrete with 0% demolished concrete waste at 7th day RA 50% is 15.98% weaker and RA 100% is 29.99% weaker of concrete made with natural aggregate.

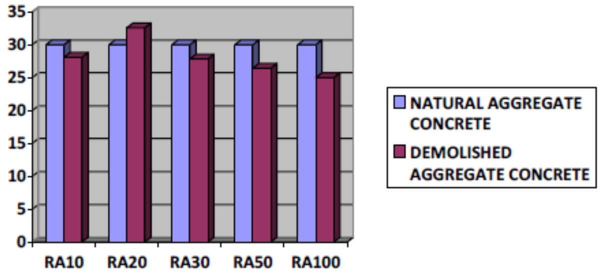


Fig 15 -Graphical representation for NAC and DAC (M30 W/C Ratio 0.40)

From the results we can compare M30 grade of concrete with 20% demolished concrete waste replacement gives better result as compared to M30 concrete with 0% demolished concrete replacement.

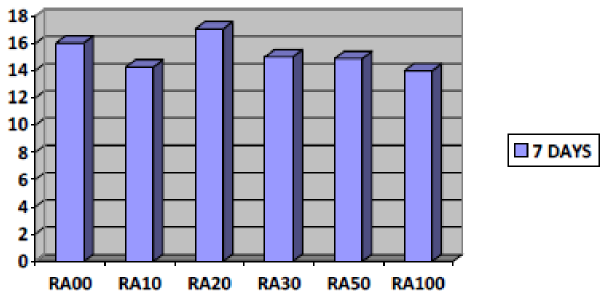


Fig 16- Graphical representation for M-20 grade compressive strength after 7 days

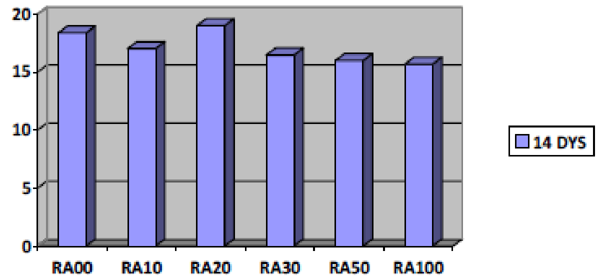


Fig 17- Graphical representation for M-20 grade compressive strength after 14 days

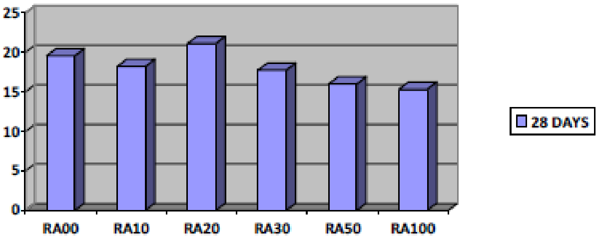


Fig 18- Graphical representation for M-20 grade compressive strength after 28 days

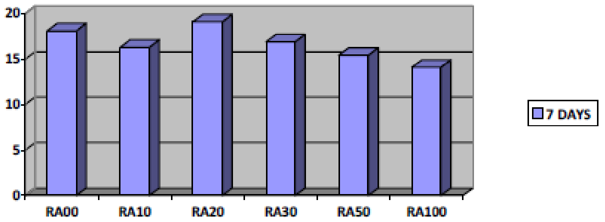


Fig 19- Graphical representation for M-25 grade compressive strength after 7 days

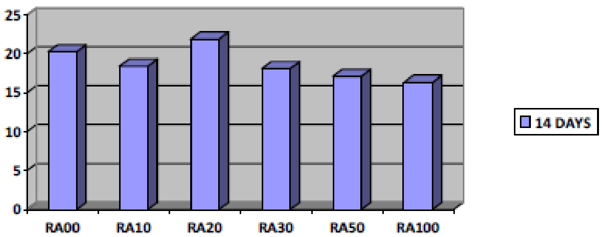


Fig 20 -Graphical representation for M-25 grade compressive strength after 14 days

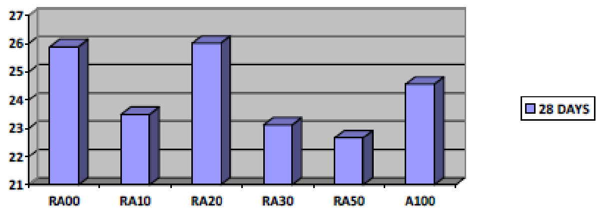


Fig 21- Graphical representation for M-25 grade compressive strength after 28 days

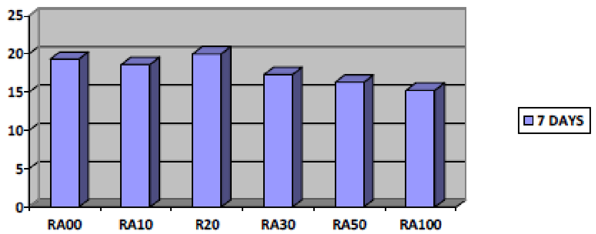


Fig 22- Graphical representation for M-30 grade compressive strength after 7 days

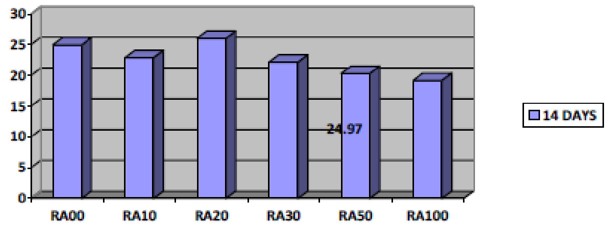


Fig 23 - Graphical representation for M-30 grade compressive strength after 14 days

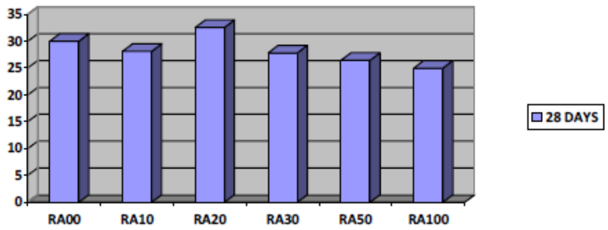


Fig 24- Graphical representation for M-30 grade compressive strength after 28 days

V-CONCLUSIONS

The following conclusions have been made based on the results of this study:

1. With the same w/c ratio, the slump value decreases if percentage of demolished aggregates is increased.
2. The compressive strength of Recycled Aggregate Concrete was lower than that of Natural
3. Aggregate Concrete but if 20% demolished waste is used then it will give more characteristics strength to that of natural aggregate used concrete i.e. 1.54 N/mm^2 more .
4. Strength decreases with 30% replacement and with 10% and 20% of demolished waste it gives more result as compared to normal aggregate concrete.
5. The relationship of w/c ratio and compressive strength of demolished waste concrete is inversely proportional.
6. Recycled concrete can be effectively used in low cost housing where slab load is not high , it can also be used in the construction of boundary wall columns and for other construction where compressive load is not too much .

7. By using recycled aggregates in concrete problem of dumping demolished waste can be minimized.
8. Using recycled aggregates in concrete also reduces environmental pollution , which would otherwise would have been produced during crushing of gravels as coarse aggregate for concrete .

VI- FUTURE SCOPE OF WORK

As the property is now a days very soon been dismantled and reconstructed according to the new patterns, designs, materials etc so the property is reconstructed inspite of all this the dismantled material is wasted in very large amount and it is been dumped into garbage. So if we are utilizing this demolished waste in our reconstruction as a replacement for coarse aggregate then the cost of the material in the project can be optimized . In this project replacement of 10%,20%,30%,50% and 100% is done. Optimum % is 20%, but if we use admixture with this replacements then the strength can be gained more with 100% replacement also. So I recommend this 100% demolished replacement with the combination of strength gaining admixtures for new researchers.

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