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Experimental Investigation of Modified Concrete Using Demolished Aggregate and Rubber Crumbs A Review

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ABSTRACT

The concrete material has to be demolished during ongoing or old construction. The concrete waste obtained from these processes is called "Demolished Concrete". The environmental protection and for promotion of the principles of sustainable development has led to recycled aggregate. Demolished sites and restoration schemes are sources of large amounts of solid waste, which today is being used as landfill. The reusing and recycling the demolished concrete a better economy can be achieved without an effecting of environment.

In the past studies as per literature study most of the researches done only strength parameters of concrete with the help of different percentages of demolished aggregates. In this present study in addition of strength characteristics durability is also done.

Keywords : Demolished Concrete Waste, Crumb Rubber, Coarse Aggregate, Fine Aggregate, Landfills, Mechanical Properties.

I. INTRODUCTION

Over the years there has been a change in the use of building materials. Cheap and locally available materials such as moulded earth bricks, stones, thatch, timber, steel, aluminium, plastics and fibers of various types and forms have replaced the traditional and costly materials. However, all these materials have been developed to meet specific requirements of climate, availability of skilled labour and specific raw materials to affect the desired economy.

Although construction and demolition waste materials are often grouped together under the generic term "C&D waste", the materials generated from these activities can be quite different. One reason for this is that construction activities make use of currently available manufacturing processes and materials while demolition activities often remove older structures. Older buildings can contain materials no longer used in the construction industry today, resulting in a different waste stream. An example of this is asbestos, which was a common

insulation material forty years ago, but is now regarded as hazardous waste. Differences between construction and demolition waste are also due to the nature of each process. Demolition procedures typically remove the whole structure, resulting in 20-30 times more waste material than construction activities. Materials such as metal, which is rarely wasted during the construction process, can form a significant percentage of total demolition waste when a building is torn down.

Due to the increase in the economic growth after development and redevelopment projects in the country and subsequent increase in the urbanization in the cities has made the construction sector to increase drastically, but also environmental impacts from construction and demolition (C & D) waste are increasingly becoming a major issue in urban solid waste management. Environmental issues such as increase in the flood levels due to the illegal dumping of construction and demolition waste into the rivers, resource depletion, shortage of landfill and illegal dumping on hill slopes are evident in the metro cities.

For the purpose of management of C&D Wastes in India, Construction and demolition waste has been defined as 'waste which arises from construction, renovation and demolition activities. Also included within the definition are surplus and damaged products and materials arising in the course of construction work or used temporarily during the course of on-site activities. The various streams of wastes to be considered will include

- Excavated materials,
- Concrete
- Tiles, brick, ceramics, asphalt concrete,
- Plaster,
- Glass
- Metal and steel,
- Plastics,
- Wood, asphalt, and
- Concrete rubbles, etc

The primary method adopted in waste handling is carried through by interviewing professionals like project managers, architects, civil engineers, contractors and government officials like city engineers, solid waste management officials.

Secondary information is gathered by compiled data from secondary source like various research papers, various international journals, various international reports on construction and demolition waste management. And also, proceedings of waste management organizations and also some reports of surveys did by various agencies and institution. Some information is collected thorough waste management and national authorities' websites in construction waste and demolition management.

II. Literature Review

OSAMA YOUSSF JULIE E. MILLS etc(2022)

In this research, a wide range of experimental investigations were carried out, with the aim of moving crumb rubber concrete (CRC) from the lab to the slab for the residential construction sector. Two 4 × 9 m large-scale reinforced concrete residential footings were constructed. One was cast with CRC and the other with a standard residential mix of conventional concrete (CC), both with nominal 20 MPa strength. In addition, two reinforced ground slabs with different dimensions were constructed out of CRC and CC mixes, with nominal 32 MPa strength. All mixes were provided by a commercial ready-mix company and the construction was undertaken by an experienced footing contractor. A large range of factors have been investigated and compared.

The 7-day/28-day strength ratio decreased by 13% and 2% for 20 MPa and 32 MPa mixes, respectively

when the rubber presented. The compressive strength of all CC and CRC mixes displayed some variations with time (18 month), and CRC did not show any tendency to reduce with time. No adverse effect of using rubber in concrete in developing the carbon dioxide penetration into the concrete cover was observed and rubber could possibly reduce the CO2 attack.

Sabir khan (2019)

The objective of the study was to investigate experimentally the property and strength of Crumb rubber concrete rubberised concrete with the following test compressive strength, split tensile strength. Test conducted on hard hardened concrete Crumb. In present work weight batching hand mixing is used to study cube compression test and split tensile strength on cylinder on clean and crumb rubber concrete (rubberised concrete) were carried on number of samples and these tests results are compared with conventional concrete of M 25 grade. the result stated that the addition of Crump Rubber to concrete decreases the compressive strength from 26.6 7N/mm2 to 22 .62 N/mm2 Which means decrease of compressive strength of concrete marginally. The split tensile strength decreases about 43 percentage when 15 percentage crump rubber is replaced.

Jeonghyun Kim (2022)

In the research paper, the effects of three recycled concrete materials with different sizes (recycled coarse aggregate (RCA) with a size of 4.75–25 mm, recycled fine aggregate (RFA) of 0.15–4.75 mm, and recycled powder (RP) smaller than 0.15(mm) produced from concrete waste on the fresh and hardened mechanical properties of concrete were evaluated. The replacement ratios of natural coarse and fine aggregates by RCA and RFA were 30, 60, and 100%, and those of ordinary Portland cement for RP were 10, 20, and 30%.The results showed that the concrete properties deteriorated with increasing replacement ratio regardless of the type of recycled materials. The properties were reduced in the order of the use of RFA, RCA, and the simultaneous use of RCA and RFA. In addition, concrete with 30% RP showed lower mechanical strength than concrete with 100% RCA and 100% RFA. Results stated that upto 30% replacement of recycled aggregate with natural aggregate there was a slight decrease in strength when compared with conventional concrete. The compressive strength stated that the use of RCA up to 40% affect the functional requirements of concrete structure. Slump test showed there was continuous decrease in workability of concrete mix, as the cement mortar paste is attached to RCA.

Hasan Jasim Mohammed and Zeina saad Sabir (2021)

Objective of the research paper was to investigate the properties of Recycled Demolition Aggregate (RDA) concrete. Five RDA concrete ratios were prepared experimentally by substituting, 0%, 25%, 50%, 75% and 100% of the gravel weight with RDA. The 10% of cement is substituted by silica fume (Si). Adding steel fibres (SF) (0.5 %, 1.0 % and 1.5 %). Treated RDA with cement mortar and superplasticizer (SP) admixture added to (1%) of total cementitious materials (TCM). The concrete properties exams performed such as; density, compressive strength, splitting tensile strength, and modulus of rupture.

Results concluded that the compressive strength, splitting tensile strength and rupture modulus values of RDA concretes are reduced with an increased RDA ratio relative to normal concrete. Density of RDA concrete reduces around 9% of normal concrete. RDA in the concrete mix as a partial substitute of gravel decreases the compressive strength about 27 %, 29 % at RDA75, RDA100, respectively, compared with the normal concrete. However, at (RDA50-Si-SP-SF1) (Mixing additives together), the compressive strength is increase up to 112 %. RDA content has a little influence on the concrete tensile strength, displaying a reduction of about 11 % at RDA100. But, when

Mixing additives together (RDA50-Si-SP-SF1) displaying an increase of up to 124 %, while the modulus of rupture is increase up to 34 % under the same conditions all concretes could be applicable for structural purposes under different environmental exposure conditions. In particular, concretes with 10% RP and 20% RP showed better cost-benefits compared to natural aggregate concrete with 100% ordinary Portland cement.

Sandanaveni sai sindhu and v. Akhil siddhartha (2022)
Research paper dealt with the analysis of workability, compressive strength, split tensile strength, flexural strength and durability of concrete by replacing coarse aggregates with demolished concrete waste aggregates. The percentage replacement of demolished aggregated was 0%, 10%, 20%, 30%, 40% and 50% results stated that demolished concrete density was less as compared with the conventional concrete which reduces the cost of the concrete and produces the light weight concrete structure. Compressive strength, split tensile strength and flexural strength of the concrete increased with increase in the percentage of demolished material from 0% to 30% after 30% demolished aggregates the value of strength decreases. The percentage loss of weight due to acid attack and alkaline attack increases with increasing the percentage of demolished aggregates.

Shahiron Shahidana (2017)
Research paper discussed recycled aggregates (RA) produced from C&D waste and their use in concrete construction. A summary of the effect of recycled aggregates on the properties of fresh and hardened concrete. Recycled aggregates was treated with epoxy resin to reduce the water absorption. The influence of aggregates of varying sizes on the compressive strength, split tensile and water absorption of concrete was presented. The optimum results for the split tensile test, compressive strength test and water absorption test were obtained for the aggregates measuring 10mm. The aggregate size of 10mm was taken as the optimum result because the highest figures were recorded for the split tensile test and the compressive strength test after a curing period of 28 days. The rate of water absorption was also among the least compared to larger size aggregates.

Yogendra. S et.al (2022)
author investigated the feasibility and reprocessing of demolished concrete waste for new project construction. Control mix was designed as per IS 10262:1986 to reach a target compressive strength of 30 MPa. The casted cubes were tested for 7, 14, 28 days compressive strength, Split tensile strength and 14, 21, 28 days flexural strength test. The design mix for concrete grade M30 was used and several replacement ratios of recycled aggregate by natural aggregate. The water cement ratio remained stable and the super plasticizer considered was Conplast SP 430.

Conclusion stated that the recycled aggregate concrete though has slower strength development than the natural aggregate concrete, it can still be used in construction by choosing the best possible replacement ratio. The split tensile strength similarly follows the same tendency of reduction in strength with increased replacement. But they still lie within the range needed to be used in structural concrete and hence are acceptable.

A.U. Maheswari et.al (2021)
Objective of the research paper was to assess the effect of recycled concrete aggregates on the strength of nominal concrete mix. The properties of recycled aggregate was used as a coarse aggregate for M25 grade of concrete and determined. The percentages of recycled aggregate that partially replaced natural aggregate by weight was 0%, 10%, 20%, 30% and 40%. Concrete cubes were casted and tested in

laboratory. Properties of natural aggregates and recycled aggregates were investigated and workability tests and compressive strength tests were performed.
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Zidan Ahmed (2021)
In the research paper, an experimental study was carried out to investigate the recycling of demolished waste concrete for new contraction. This research included a collecting a Demolished Concrete from waste and was separated with different sizes using sieve analysis. Various sizes of aggregate were treated with heating process. The demolished concrete aggregate DCA was replaced by various percentage of 10%, 20%, 30%, 50%, 100% and test can be conducted and compared with nominal concrete.

With the same w/c ratio, the slump value decreases if percentage of demolished aggregates is increased. The compressive strength of Recycled Aggregate Concrete was lower than that of Natural Aggregate Concrete but if 20% demolished waste is used then it will give more characteristics strength to that of natural aggregate used concrete. Strength decreases with 30% replacement and with 10% and 20% of demolished waste it gives more result as compared to normal aggregate concrete. Recycled concrete can be effectively used in low cost housing.

Results stated that concrete patches were stronger compared to bituminous patches and the life span of concrete patches was more than bituminous patches. Patches made from demolished concrete provide a smooth ride, more durable and gives better appearance in terms of economical and durability.

Basha Fayissa and Anteneh Geremew (2018)
Author investigated the use of recycled concrete aggregate in the concrete and the effects on its compressive strength by progressively replacing the natural concrete aggregate (NCA) with recycled aggregate. It was the experimental study of recycled concrete aggregate (RCA) when it was compared with the natural concrete aggregate on account of its physical properties. Cubes having dimension 150x150x150mm3 were casted using recycled aggregate by replacing the natural aggregate by 0%, 25%, 50% and 75% and corresponding results of compressive strengths were recorded. The compressive strengths were recorded by crushing the cube at 7, 14, 21 and 28 days.

Results stated that performance of concrete with 0% and 25% replacement of natural aggregate by recycled aggregate were quite similar to concrete without replacement but with 50% and 75% replacement, the strength of concrete was decreased.

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.

Md. Habibur Rahman Sobuz (2020)
In the research paper, four concrete mixes were prepared having 0%, 15%, 30%, and 45% DCA replacement of normal coarse aggregate (NCA). By preparing the concrete mix, slump test, and compaction factor test were carried to evaluate the influence of DCA aggregate on fresh state properties. Besides, uniaxial compressive strength, splitting tensile strength, and digital rebound hammer tests were examined after 7 and 28-days of curing ages.

Results stated that the slump and compaction factor of the DAC decreases with the increment percentage replacement. The compressive strength and splitting tensile strength reduces around 9% and 5% on average respectively due to pores in the interfacial transition zone (ITZ). Moreover, the NDT assessment of the specimen helps to predict the compressive strength at the various stage of the specimen. This trend of the utilization of DCA and NDT assessment is

the key towards the problem of a surplus of waste materials and enhancing the parallel option of final product quality assessment regularly.

Abdulsamee M. Halahla (2019)
Objective of the research paper was to investigate the possibility of using old recycled concrete as coarse aggregate to make new concrete mixes, and its effect on the evolution of the compressive strength of the new concrete mixes. Core samples for demolished concrete were tested to determine its compressive strength. The core test results can be thought of as aggregate properties for the new concrete. Then, the compressive strength and splitting tensile strength of the new recycled aggregate concrete (RAC) were determined experimentally by casting a cubes and cylinders, respectively.

Results stated that the evolution of compressive strength of recycled aggregate concrete is similar in behavior to the concrete with natural aggregate, except that it was about 10% lower in values. It was also seen that water absorption for recycled aggregate is noticeably higher than that for natural aggregate, and should be substituted for in the mix design.

Shakti Sagar and Deepak Juneja (2019)
Objective of the research paper was to examine the feasibility of construction demolished waste for improving the performance of patches. The research was conducted in two phases: experimental work and visual inspection. The standard tests such as Aggregate Impact value Test, crushing value test, Specific Gravity test, Water Absorption test, and Los Angeles Abrasion test, flow value test and Marshall Apparatus test are performed. The results were compared by attaining values such as using bituminous patches, lime patches and concrete patches.

Dalinaidu.M (2018)
The autor conducted an experimental investigation on the effect of replacement of natural aggregate by recycled concrete aggregate in the production of concrete and the strength of concrete. Natural coarse aggregates in concrete were replaced with 0%, 20%, 40%, 60%, 80% and 100% of crushed concrete coarse aggregates.

Result showed a gradual decrease in compressive strength, split tensile strength, flexural strength and modulus of elasticity as the percentage of recycled aggregate is increased. However up to 20% replacement of recycled aggregate concrete does nor loose significant strength and hence can be used as upper limit.

M. Anjaneyulu Naik and A. Ramakrishnaiah (2018)
Research paper focused on utilizing the Demolished Concrete waste and reducing the generation of construction waste, and collecting Demolished Concrete from the demolition of building at site, Crushing Demolished Concrete waste and separating different sizes using sieve analysis, by collecting various sizes of Aggregate were treated with heating and chemical process. Feasibility analysis was done for recycling of demolished waste concrete for new construction.

Results stated that the compressive strength of the concrete is increases with increasing the percentage of demolished material upto 30%. The split tensile and flexural strength of demolished concrete also increases with increasing the percentage of demolished material.

The use of dismantled aggregate in making fresh concrete will also help in reduction of solid waste dumping on existing landfill sites. Demolished aggregate possesses relatively lower bulk crushing, density and impact standards and higher water

absorption as compared to natural aggregate. Using demolished aggregate concrete as a base material for roadways reduce the pollution involved in trucking material.

Jyoti Choudhary and Honey Gaur (2018)
Research was conducted on the partial replacement of Recycled Coarse Aggregate in making high strength concrete M20. Compressive Strength results stated that 80% replacement of 20 mm aggregates in RCA mixing attains more than the conventional concrete and attains more strength when compared to conventional mix at 28 days. Compressive strength of 80% Replacement of 20 mm aggregates in RCA mix cubes were attain strength closer to the compressive strength results of conventional concrete at 7 days,14 days, 21days, 28 days. Construction and demolition waste can be used as recycled aggregate in construction. The more thoroughly the waste is treated, the higher the quality of the aggregate. However, high-quality aggregate is expensive, and thus, economically unavailable in countries where natural aggregate is cheaply obtained. Recycled concrete aggregates are different from natural aggregates and concrete made from these materials has specific properties.

Bhagyashree S. Katkar and Dr. N. K. Gupta (2017)
Author evaluated the properties of DWA considering pervious concrete mix design proportions for 0%, 10%, 20% and 30% DWA replacements and evaluate the properties like density and compressive strengths (at 7 days, 14 days and 28 days) of hardened pervious concrete using demolished waste aggregate.

The water absorption of NCA is less as compared to DWA this shows that pervious concrete using DWA are more porous as compared to NCA but have less strength. Density and compressive strength of pervious concrete was observed to be decreasing with increase in percentage of building demolished waste aggregates. The strength of pervious concrete with 0% DWA replacements at 7 days and 14 days was 11.11 MPa and 10.27 MPa and the strength of pervious concrete with 10% DWA replacements at 7 days and 14 days was 9.15 MPa and 9.51 MPa.

Ibtisam Kamal (2017)
Research paper dealt with using demolishing concrete waste as coarse aggregate in concrete for the purpose of reduction the natural resource exploitation and associated costs, as well as minimization waste landfill. A 2-operating parameter central composite design (with 2*2=4 factorial points, 2*2 star-points and 2 repetitions of central point) was adopted to optimize and model the impact of demolition aggregate content (8.6-86.4) wt.%, and water/cement ratio (0.43-0.57) for concrete contain demolishing components as coarse aggregate on compressive strength and density. Water absorption characteristics were further investigated. Conventional concrete specimens were prepared and tested for comparison purposes.

Conclusion confirmed that the incorporation of the demolition aggregate resulted in decreasing concrete density and water absorption capacity. The model analysis results approved that concrete with lower density and water absorption, and superior compressive strength of 49.70MPa could be manufactured using demolishing concrete as coarse aggregate up to 49.3 (wt. %) atwater/cement ratio 0.49.

III.CONCLUSION

In the above review it is observed that authors in past applied various methods and resources to modify concrete and its characteristics.

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