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Impact Of Target Strength On RCA Using Concrete Mix Design

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***Abstract*:** The construction industry is increasingly embracing sustainable practices, and recycled aggregate concrete (RAC) presents a promising avenue for reducing environmental impact. This research delves into the intricate relationship between target strength and the mix design of RAC, adopting an integrated approach. Understanding the nuanced influence of target strength is crucial for optimizing the performance and durability of recycled aggregate concrete structures.

The study begins by reviewing existing literature on recycled aggregate concrete
And fresh materials. emphasizing the need for tailored mix designs to accommodate the unique properties of recycled materials and fresh material of M20 grade concrete Subsequently, an experimental investigation is conducted, systematically varying the target strength parameters in concrete mix design included the statical analysis of recycled aggregates as per IS 10262:2009 The Study mainly focus on statical parameters of mix design like Standard deviation, target strength analysis encompasses mechanical properties, and environmental considerations, providing a holistic understanding of the interplay between target strength and concrete performance.

Index Terms – Concrete mix design, Recycled Aggregate, Statistical parameters, Target Strength, Construction demolition waste

I.INTRODUCTION

As per the general statement of concrete mix design. The Selection of suitable ingredients with respect to appropriate proportion is called as concrete mix design. Today number of methods availablefor mix design. According to the grade of concrete material proportions are different this proportion also vary in place to place due to effects of physical properties of material. Even with best mix design failures occurs in concrete some of the design and quality of material equality responsible for final strength of concrete. However, most often the reason for failure are due to neglect and neglect of quality on site during construction. The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of the required, strength, durability, and workability as economically as possible, is termed the concrete mix design. The proportioning of ingredient of concrete is governed by the required performance of concrete in 2 states, namely the plastic and the hardened states. If the plastic concrete is not workable, it cannot be properly placed and compacted. The property of workability, therefore, becomes of vital importance. The compressive strength of hardened concrete which is generally considered to be an index of its other properties, depends upon many factors, e.g. quality and quantity of cement, water and aggregates; batching and mixing; placing, compaction and curing.

The cost of concrete is made up of the cost of materials, plant and labor. The variations in the cost of materials arise from the fact that the cement is several times costly than the aggregate, thus the aim is to produce as lean a mix as possible. From technical point of view the rich mixes may lead to high shrinkage and cracking in the structural concrete, and to evolution of high heat of hydration in mass concretewhich may cause cracking.

The actual cost of concrete is related to the cost of materials required for producing a minimum mean strength called characteristic strength that is specified by the designer of the structure. This depends on the quality control measures, but there is no doubt that the quality control addsto the cost of concrete. The extent of quality control is often an economic compromise, and depends on the size and type of job. The cost of labor depends on the workability of mix, e.g., a concrete mix of inadequateworkability may result in a high cost of labor to obtain a degree of compaction with available equipment.

II.LITERATURE REVIEW

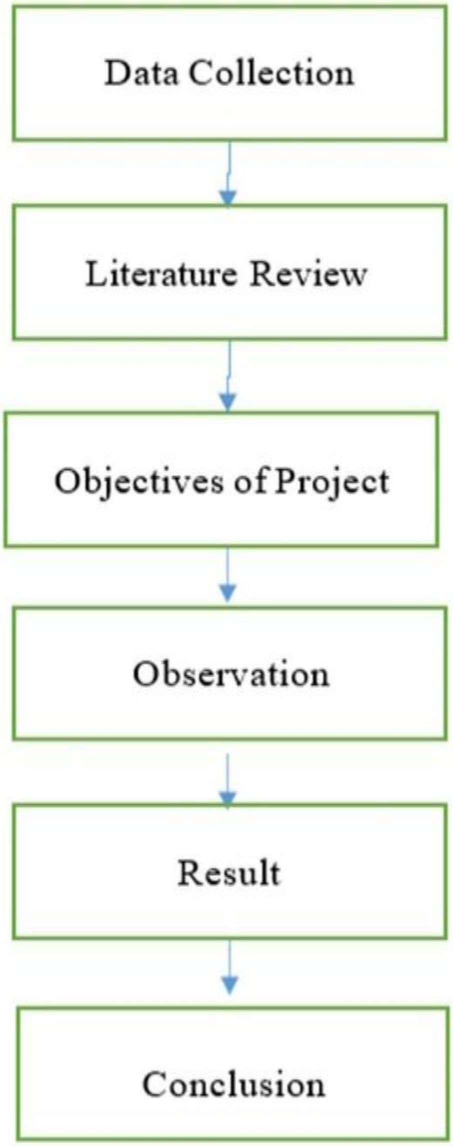
G.V. Tapkire: Concrete mix design involves the process of selecting ingredients with appropriate proportions. Creates the required strength and durability of the concrete structure. Material having different properties. Not easy to create a great mix of concrete. It is Imperative all ingredients be tested determine their physical properties then prepare the mix as per guidelines. But guidelines available for fresh raw or the natural material used in the mix design. Various steps include in mix design for this paper mainly focus on Target strength of concrete (Fck) Value variation. In case of recycled concrete material used in the mixed design. For the study casting the M25 grade. Recycled aggregate used up to 30 % by weight. Compare the statistical analysis variations used for mix design.[1] **Hi Sun Poon et.al.:** Concrete specimens were prepared with a recycled normal- strength concrete (NC) aggregate, a recycled high performance concrete (HPC) aggregate and a natural aggregate (NA) as control. The influence of these aggregates (recycled and natural) on the microstructure and compressive strength of the new concrete were studied. SEM observations revealed that the NC aggregate–cement interfacial zone consisted mainly of loose and porous hydrates whereas the HPC aggregate–cement interfacial zone consisted mainly of dense hydrates. The compressive strength results that the concrete prepared with natural aggregates was higher than that of the recycled aggregate concrete. Also, the strength development of the HPC recycled aggregate concrete was faster than that of the NC recycled aggregate concrete. At 90 days, the HPC recycled aggregates concrete achieved similar strength values to the natural aggregate concrete. The results are explained by the differences in porosity and pore structure of the two types of aggregates, and possible interactions between the aggregates and the cementpaste.[2] **Sameeluh Bhat et.al.:** the current study an effort has been made to investigate the impact of cupola slag inclusion, on the mechanical and durability properties of concrete. Different percentages (10%, 20%, 30%, 50%, and 80%) of cupola slag were used to substitute fine aggregate and corresponding results have been observed. Also, different mechanical and durability tests were carried out to check the suitability of replacing natural fine aggregate by cupola slag. Compressive strength was found to be increased by cupola slag inclusion up to a percentage replacement of fine aggregates of 30%, after which further cupola slag addition resulted in a loss of strength. For flexural and tensile strength similar trends were observed. On the other hand, as the amount of cupola inclusion increased from 0% to 80%, a decreasing trend in both water penetration depth and water absorption was observed. Likewise, for all the aforementioned criteria a notable improvement in chloride penetration was observed due to the inclusion of cupola slag. The study basically focuses on present concern regarding industrial waste whichposes a risk to the environment. Industrial waste has been utilized in a sustainable manner, as it has shown improvement in properties as compared to ordinary concrete mix. Such type of modified concretecan be employed in harsh exposure conditions as can be found from durability tests. The findings of this study show that cupola slag is a sustainable matter that works well as a partial replacement for natural sand.[3] **Nasriin Mohemmed et.al.:** Use of Recycled Coarse Aggregate (RCA) in concrete can be described in terms of environmental protection and economy. This paper deals with the mechanical properties of concrete compressive strength, splitting tensile strength, modulus of elasticity, and modulus of rupture. Three kinds of concrete mixtures were tested, concrete made with Natural Coarse Aggregate (NCA) asa control concrete and two types of concrete made with recycled coarse aggregate (50% and 100% replacement level of coarse recycled aggregate). These kinds of concrete were made with different targets of compressive strength of concrete f 'c (35MPa) and (70 MPa). Fifty specimens were tested of the fresh and hardened properties of concrete. The waste concrete from laboratory test cubes was crushedto produce the Recycled Coarse Aggregate used in recycled concrete. A comparative between the experimental results of the properties for fresh and hardened concrete is presented in the paper. Recycledaggregate concrete (RCA) had a satisfactory performance despite the replacement ratios. It was found using the size of Recycled Coarse Aggregate (RCA) of (5-14) mm has quite similar in performance withthe same size of Natural Coarse Aggregate (NCA), it is necessary to use high quality of recycled concrete(with low levels of impurities). Recycled aggregate as an alternative to natural aggregates -seems quite.[4] **Anike Saidani et.al :** This research investigates the impact of mix design methods on the mechanical characteristics of steel fibre-reinforced concrete (SFRC) made with recycled aggregates (RA) obtained from a precast waste concrete. The experimental campaign was carried out in two phases. In phase I, three types of steel fibre (SF) differing only in shape were examined. Then, eight mixes were formulated,considering a range of SF volume ratios from 0.125% to 1.5%, using both normal and the Equivalent Mortar Volume (EMV) mix design methods. In phase II, a reference mix and two recycled aggregate concrete mixes were developed, one designed with normal method and the other with the EMV technique and incorporating their associated optimum SF content obtained in phase I. The results show that the mechanical properties of SFRC proportioned with the EMV approach is not adversely affected and that water absorption capacity of the concrete is improved with this method compared to the traditional method. Also, mix design method adopted for recycled concrete affects the optimum SF volume ratio.[5] **Songpu Gao et.al.:**The influence of four factors (water-binder ratio, recycled coarse aggregate replacement rate, fly ash substitution rate, and superplasticizer content) on the workabilities and mechanical properties of recycled coarse aggregate self-compacting concrete (RCASCC) was studied using the orthogonal test method. Based on the orthogonal test design and range analysis method of the fresh and hardened properties of RCASCC, the optimal mix is as follows: water-binder ratio of 0.269, recycled coarse aggregate replacement rate of 30%, fly ash substitution rate of 40%, and superplasticizercontent of 0.50%. Then, the porosity and aperture size distribution of nine groups of RCASCC were tested by mercury intrusion porosimetry (MIP) at the microlevel. The macroscopic and microscopic relationship was established by combining the results of mechanical property tests and MIP. Fractal dimension D of the B.B. Mandelbrot model was used to study the fractal characteristics of pore volume of RCASCC. Results showed that porosity and strengths are negatively correlated, and the relative strength can be roughly judged according to the porosity. The pore structure of nine groups of RCASCCmaterials has evident fractal characteristics of irregular shape. The complex pore structure adversely affects strength.[6] **Andrea Piccanali et.al.:** This review aims to present and discuss the mechanical and environmental properties of two different type of recycled aggregates obtain from construction and demolition waste (CDW): (1) Recycled Concrete Aggregates (RCA) and (2) Mixed Recycled Aggregates (MRA). In addition, the properties of the concrete in the fresh (workability, water/cement ratio) and hardened state (mechanical and durability properties), as well as the environmental impact of the concrete produced with the two types of recycled aggregates, are presented and discussed. Due to the heterogeneous composition of recycled aggregates, the concrete properties can be significantly variable. The systematicreview concerns scientific papers published from 2010 to 2020 and it shows the importance of the selection process in order to obtain high quality CDW as well as of the type of recycled aggregates on concrete properties. In particular, recycled concrete aggregates show a better quality and homogeneity than mixed recycled aggregates that make them more suitable for concrete. This work presents an overview on the influence of recycled aggregate quality on the physical, mechanical and environmental properties of concrete. [7] **Dang meng:** This paper puts forward a strength-based mix design method for recycled aggregate concrete using a modified empirical formula. A total of 30 mixes, the amount of cement varies from 300kg/m³ to 500 kg/m³ and the proportion of recycled coarse aggregate ranges from 0% to 100%, were prepared for the regression analysis of relationships between multiple parameters. Then for a defined workability and specified value of recycled coarse aggregate replacement ratio, and known natural waterabsorption of recycled coarse aggregate to be used in a mixture, two mixture design parameters, cement–water ratio and cement content, are generated from the proposed method after determining the water consumption. Moreover, the confirmatory experiments show that the test results of 26 validation mixes, designed strength ranges from 30 MPa to 50 MPa and recycled coarse aggregate replacement ratio variedfrom 20% to 100%, were in satisfactory agreement with the target compressive strength. Recycled aggregate concrete durability performances corresponding to this method were also evaluated, and results show that the increasing of recycled coarse aggregate, degrades the freeze–thaw resistance, drying shrinkage, chloride penetration and carbonization. [8] **Tereza Pavlu**: The utilization of recycled materials is one of the seven principles of sustainableconstruction. These principles based on the efficient use of resources were defined by the International Council of Building in 1994.Recycled materials such as recycled concrete aggregate or recycled brick aggregate from construction and demolition waste, waste glass from municipal waste or recycled waste gypsum from gypsum boards are able to use as replacement of primary raw materials in cement and concrete production. Concrete and cement production totally depends on the natural resources. The worldproduction of concrete has been twelve times increased during last six decades. Nowadays, nearly one ton of concrete is produced each year for every human being in the world on average. On one hand, the use of recycled materials in cement and concrete production helps to reduce raw materials and urban land occupation. However, on the other hand, the recycled materials used as partial replacement of raw materials influence properties of final product. This paper reviews the different uses of recycled materialsin cement and concrete production and the effect of the properties of these materials to the cement and concrete. [9] **Danying Gao:** Steel fibre reinforced recycled coarse aggregate concrete (SFRCAC) is an impact minimization building material. Mixture proportion design method of SFRCAC is developed in this paper to obtain concrete with target strength and workability, which can be used in structural members. Four key parameters of mixture proportioning, steel fibre content, water-cement ratio, water content and sand ratio are discussed through the mixture design tests. The formula for calculating the four key parameters of mixture proportions for SFRCAC are established through the statistical analysis of test results, which mainly consider the influences of recycled coarse aggregate (RCA) replacement ratio and steel fiber characteristic coefficient. The detailed procedure by using the new mixture proportion design method is illustrated with examples. The formulas established have the simple form, reflect the properties of RCA and steel fibres, enhance the mixture proportion design accuracy, and provide the reference for the mix proportion design of SFRCAC. [10] **Narasimha Raj et.al.:** Packing density is new kind of mix design method used to design different types of concrete. To optimize the particle packing density of concrete, the particles should be selected to fill up the voids between large particles with smaller particles and so on, in order to obtain a dense and stiff particle structure. Higher degree of particle packing leads to minimum voids, maximum density and requirement of cement and water will be less. In this work the co-relation curves are developed for packing density method between compression strength and water cement ratio, paste content to reduce the time involved in trial to decide water cement ratio and paste content for a particular grade of concrete.Results obtained by packing density method are compared with IS code method. The optimum bulk density was obtained at proportion of 42% coarse aggregates (20mm downsize), 18% coarse aggregates (12.5mm downsize) and 40% fine aggregates. Large number of trial casting were carried out for each grade of concrete (i.e., M20, M25, M30, M35 and M40) with different water cement ratio and three paste contents in excess of void content. To finalise mix proportions using packing density method flow table tests were carried out to decide water cement ratio and paste content in excess of void content for each grade of concrete. The finalised mix proportion for each grade of concrete was used to cast the cube specimens for 7 days and 28 days curing age. The cube compressive strength results obtained by packing density and IS code method are nearly same. The co-relation curves were plotted for packing density results alone and also combining the results of packing density and IS code methods. The co- relation curves were plotted between compressive strength vs water cement ratio at 7 and 28 days curingage and compressive strength vs paste content at 7 and 28 days curing age. Very good co-relation is obtained with a co-relation coefficient of 0.953 (minimum) to 0.998 (maximum). These curves can be used to decide the water cement ratio and paste content for the specified grade of concrete incase of packing density method thus reducing the material and time involved in trial testing.[11] **Atish Bharadwaj:** The need of concrete is increasing every year as the population of humans are increasing as per their demands i.e. infrastructure developments and shifting composition etc. Due to rising demands and fight to produce good quality of concrete, construction industries have overused the natural materials used in concrete, leads us to extinction in natural materials and results in rising pricesof materials. Thus, the environmental problems related with excessive extraction and mining from natural sources have been reported in many countries. Due to finite availability of natural materials, and involvement of economy, it has now become very important to look as for the alternative source for natural materials used in concrete i.e. gravels and natural sand. Waste foundry sand (WFS) is a propitiousmaterial that can be used as an alternative for the natural sand i.e. (fine aggregates) in concrete. The thesis demonstrates the potential of re-use for waste foundry sand i.e. industrial by-product as a substituteof a fine aggregate in concrete. The fine aggregates i.e. (natural sand) are replaced with WFS in six different substitution rates i.e. (2.5%, 5%, 7.5%, 10%, 12.5% and 15%). Several tests were performedto examine the mechanical properties i.e. (compressive strength, flexural strength and splitting tensile strength) as well as the durability of concrete i.e. (sulphate resistance). The results indicate that the compressive strength was increased from 3.93%–9.3%, splitting tensile strength increased from 4.8%-11.37%, flexural strength increased from 3.81% -12.27% for 2.5%-5% replacement levels of waste foundry sand with fine aggregates in concrete and after that there is a systematic decrement in strengthas the percentage goes on increasing at curing age of 28 days. The strength in Sulphate resistance test was increased up to percentage level of 10% with natural sand as a fine aggregate in concrete and after that there is a systematic decrement in strength. From following results, it was concluded that 10% WFSreplacement level of WFS with fine aggregate in concrete can be effectively used to make concrete and various application of concrete i.e. (concrete paver blocks) and beyond 10% WFS replacement level is not beneficial.[12] **Panel Mehran Shirani Bidabadi et.al :** Due to the finite sources of natural aggregates, recycled concrete aggregates can be used as a suitable and economic material for the production of recycled concrete. Use of the recycled aggregates in concrete may undermine some mechanical properties of concrete. The aim of this study is to determine an optimum mix design made with the recycledaggregates, so that the environmental and economic aspects and also the fresh and hardened propertiesof concrete are taken into account. In the first phase of this research, different recycled concrete mixes with different levels of replacement of the recycled fine and recycled coarse aggregates are tested respectively instead of the natural fine and natural coarse aggregates. The results show the replacement of fine aggregates at the level of 30% has no significant negative effect on the expected common fresh and hardened properties of concrete such as fresh density, workability and compressive strength, and so this mix design can be selected as the optimum recycled mix design. In order to extend the applicationof the recycled concrete for the structures that tensile and flexural strengths may be demanded too, in the second phase of the research, the effect of the adding of polypropylene and steel fibers on the tensile and flexural strengths of the optimum mix design of the recycled concrete is investigated. The results show that the use of the fibers as the partial replacement of cement has no significant effect on the fresh properties of concrete, while effectively increases the tensile and flexural strengths of the recycled concrete and improve crack resistance and brittle behaviour of the concrete when failure occurs. [13] **Mirjana Malesev et.al.:** world's great powers that developed the recycling industry after natural disasters and wars, the paper points to the possibility of using large quantities of construction and demolition waste, generated as a result of the recent floods in the B&H and Serbia. Based on the yearsof extensive experimental research, and the research conducted by eminent experts, an overview is provided of the most basic properties and application of recycled aggregate concrete. It has been shown that the application of coarse recycled concrete aggregate, as the component materials in the concrete mixtures, it is possible to produce structural concrete that can be satisfactory and even with high quality,which primarily depends on the characteristics of crushed demolished concrete.[14] **Said Kenai**: Construction industry generates huge amounts of debris that needs to be recycled and reused as recycled aggregates (RAs) for partial or total substitution of natural aggregates. Recycling reduces waste and reduces energy consumption and hence contributes to a more sustainable constructionindustry. In this chapter the need for recycling and the current situation worldwide are highlighted. RA properties are discussed. RAs have a relative density lower than that of virgin materials and higher waterabsorption. A state of the art RA concrete performance at the fresh and hardened state is summarized. RA concrete presents lower compressive and flexural strengths as well as lower modulus of elasticity and lower fracture because of the porous nature of the RA and the old adhered cement mortar on the surface of the aggregates. Bond strength and abrasion resistance are little affected. Shrinkage, water permeability and water absorption by capillary increase with increase in RA content. However, the lower performance can be mitigated by a good mix design using supplementary cementitious materials. Successful applications of RA in producing self-compacting and roller-compacted concrete are also discussed.[15] **Rui Vasco Silva**: In light of the proven technical feasibility of using recycled aggregates (RAs) in the production of concrete and its several value-added potential applications, this chapter presents a set of case studies wherein RA has been successfully used in construction. A description concerning the difference that can be observed in small and even large-scale laboratory experiments is made in comparison to full-scale pilot studies. Case studies are presented on the use of RA concrete in full-scale structural elements and in non-structural components for the construction of buildings. For road pavement construction, apart from the use of the material in the manufacture of non-structural precast elements, RA were also used in the production of rigid pavements. [16] **Abbaas I. Kareem** : Inclusion of recycled aggregates (RAs) in asphalt mixtures can reduce the depletion of natural aggregates (NAs) by providing an alternative material for hot-mix asphalt (HMA). Given the effects of cement mortar attached to the RA surface and other impurities, the performance of RA-asphalt mixtures was widely documented to be less than that of mixtures containing fresh NA. This chapter summarizes the research results in the field of RA-asphalt mixtures. The chapter also explains why RAs remain unpopular as acceptable materials in HMA production, discussing various treatments previously suggested for RA-mixtures and also identifying current and future trends in the research of RA-asphalt pavements.[17] **Ammar Younes et.al** : Concrete waste (CW) recycling stands as a promising strategy to promote sustainable construction practices. This research aims to assess the feasibility of using recycled concrete aggregates (RCA) as a surrogate for natural aggregates (NA) in concrete applications and reduce the environmental impact associated with the depletion of natural resources and landfill space. To achieve these objectives, CW was segregated from debris mixes of construction and demolition waste (CDW), collected, crushed, and graded to generate RCA. Thirty-two concrete samples were prepared and categorized into four distinct groups with 0% (reference), 50%, 75%, and 100% substitution levels for both coarse RCA (CRCA) and fine RCA (FRCA), all utilized simultaneously. Concurrently, the environmental impacts of producing 1 m^3 of concrete were evaluated using a life cycle assessment (LCA) approach, (cradle-to-gate) covering three phases, the raw material supply (A1), transportation (A2) and concrete production (A3). At the 50% replacement level, the mechanical properties of recycled aggregate concrete (RAC) demonstrated a 20.0% increase in splitting tensile strength, accompanied by marginal decrease in workability (15.0%) and compressive strength (6.0%). In addition, at that percentage, the average environmental effects were reduced by 31.3%, with specific reductions of 34.7% for A1, 40.3% for A2, and no change in A3.[18] **Sumit Arora et.al :** The results of the present research study offer the twofold applications in concrete sector. Primarily it shows the results of strength performance of concrete containing partial to full replacement of Coarse Recycled Concrete Aggregates (RCA) and its substantial improvement by the addition of 5%–15% Mineral Admixtures/Supplementary Cementitious Materials (SCMs) as partial replacement of total powder material. Secondly, Artificial Neural Network (ANN).[19] **Mir Kashif Billal** : Concrete is one of the most widely used construction materials in the world, mainly due to its favorable features such as durability, versatility, satisfactory compressive strength, cost effectiveness. But with the depleting natural resources and the huge amount of concrete waste produced, it becomes essential to identify an effective way to solve the need of the moment. In this rapid industrialized world, recycling construction material plays an important role to preserve the natural resources. In this research, Recycled Coarse Aggregates (RCA) from demolished slab pieces was used. These demolished slab pieces are crushed to suitable size and reused as recycled coarse aggregate. Natural sand used as fine aggregate. Concrete industry, uses 12.6 billion tons of raw materials each year, is the largest user of natural resources in the world. The environmental impact of production of raw ingredients of concrete (such as cement and coarse and fine aggregates) is considerable. In this paper The mix design has been done by trial and error method. The mix proportions are calculated as per IS code. The design procedure as per IS code and IRC: 44-2008 is used in mix design of M30 grade cement concrete. The w/c ratio is taken 0.5% for all the mixes. Hence, Coarse aggregates was replaced in percentages of 0%, 20%, 40 %, 60 %, 80 %, 100 % with recycled coarse aggregates 150 × 150 × 150mm, Beam and Cylinder moulds were used for casting. [20] **Sallehan Ismail et.al** : This paper presents a recycled aggregate concrete (RAC) mix that has been modified by adding treated recycled concrete aggregate (RCA) and various types of fiber-reinforced systems. The effectiveness of these modifications in terms of energy absorption and impact resistance was evaluated and compared with that of the corresponding regular concrete, as well as with unmodified RAC specimens. Results clearly indicate that although modification of the RAC mix with treated RCA significantly enhances the impact resistance of RAC, further diversification with additional fiber, particularly those in hybrid form, can optimize the results.[21] **Bachir Kebbali et.al** : Reusing concrete wastes as a secondary aggregate might be an efficient solution for long-term environmental protection and sustainable development. However, the different properties of waste concrete, particularly compressive strengths might have a negative impact on recycled concrete. The main purpose of this experimental investigation is to evaluate the influence of parent concrete quality on recycled concrete performance. Three categories of compressive strength (10 to 15 MPa), (20 to 25) MPa, and (30 to 40 MPa) are used to complete this assignment. As a random parameter, an unknown compressive strength was also incorporated. The experimental mix contains 40% secondary aggregates (both coarse and fine) and 60% natural aggregates.

To achieve the necessary workability, the significant water absorption properties of recycled concrete aggregate necessitate water content adjustment. As a result, the compressive strength of recycled concrete decreases by 14 to 23.7 percent when compared to conventional concrete. To compensate for this loss, a quantity of cement content deemed to be absorbed by porous attached mortar equal to 4% of the weight of the recycled aggregate was added. The results show that the strength qualities of the original concrete have only a little impact on the compressive strength of the recycled concrete. When crushed, low compressive strength parent concrete produces a considerable volume of fine aggregate and a high proportion of clean recycled coarse aggregates with less attached mortar and has the same compressive strength as excellent parent concrete. In comparison, cement content adjustment does not enhance flexural strength; This appears to be due to a weak interface zone between the aggregate and the old adhering mortar.[22] **Mohammed Seddik Meddah et.al** The collection and recovery of building rubbles from old, demolished and damaged concrete structures is a crucial matter and an environmental concern worldwide. After collecting, screening and crushing, these solid wastes can serve as secondary aggregates or recycled aggregates in concrete production. Test results [18] showed, through a proper treatment process, many building rubbles with various solid waste compositions could be transformed into valuable recycled aggregates for concrete production. In fact, recycled aggregates, including RCA, could be incorporated in concrete mix as washed or unwashed aggregates. The usage of unwashed RCA in concrete may affect its strength characteristics, especially at low water-to-cement ratios. Washed recycled aggregates (WRA) have less negative impacts and the concrete strength characteristics were significantly enhanced especially flexural strength. Similar to the washing process, Tang et al. (2019) [16] proposed a surface treatment by lithium silicate solution. The authors observed a neat improvement in the overall performance of the self-compacting concrete (SCC) made with the treated RCA compared to the non-treated RCA. Particular improvement was in the mechanical properties including compressive and tensile strengths, and elastic modulus as well as an improvement in the bond strength at the interfacial transition zone through densification. RCA derived from an old concrete with a 28 MPa compressive strength at 28 days were used as aggregates to produce new concretes with nearly 100% of natural aggregates replaced with the RCA.[23] **Dr.V. Mallikarjuna Reddy et.al** Concrete is the most important construction material used throughout the world in different types of civil engineering activities. Day by day scarcity of quality coarse aggregate and fine aggregate is taking place. Restrictions on mining of aggregates is increasing day by day due to greater awareness of environmental protection. This leads to search for substitute material. It forces to reuse aggregate extracted from the construction and demolition waste (C&D waste) in new concrete. C&D waste generally contains Concrete rubble as major share. This concrete rubble can be crushed and sorted out for recycled coarse aggregate and fine aggregate. These can be used as a replacement material for natural aggregates in concrete or as a sub-base or a base layer in pavements. The material which is extracted from Construction and Demolition waste and used again in making concrete is called as recycled aggregate. The natural aggregate can be replaced with reused aggregate up to 25%. Beyond this percentage the strength starts to reduce [1]. Based on the quantity and size of recycled aggregate, a regression model has been modified appropriately by test results.[24] **Chander Bhan, Manjit Kaur** The recycled concrete aggregate has some properties like the natural aggregates but the strength is less than the natural aggregates. We can use the industrial by-product to some extent, which does not affect the fresh and hardened properties of the concrete and gives the similar result as normal concrete. A large number of researches have been directed toward the utilization of waste materials. To increase the durability of the concrete made with recycled concrete aggregates, admixture & fiber can be used, the admixture increases the workability of the concrete at the same water-cement ratio, whereas the fiber increase compressive, tensile & flexural strength of the concrete. The required durability characteristics are more difficult to define than the strength characteristics, specification often uses a combination of performance & prescriptive requirements, such as workability, compressive strength, Split tensile strength, flexural strength, and water-cement material ratio to achieve a durable concrete. The end result may be a high strength concrete, but this only comes as a construction & demolition waste of requiring a durable concrete.[25] **V. P. Kukadia et.al** Due to development process the demand for new buildings increase that is the reason for Development in the concrete industry. After useful life of structure this concrete generates the waste material largely known as C&D waste. The management of waste create major environmental effect on the agricultural land and hinders natural resource preservation. There has found the scarcity of dumping grounds which is made worse by the occupation and rising value of urban areas, high social costs of waste management and public sanitation. [1]. the depletion of natural sand and natural aggregate encourage to use alternative raw material which deposits close to large urban centers. Waste materials produced from either demolished concrete Structures or from industrial precasting of concrete members, are the potential sources for Recycled Concrete Aggregates (RCAs), and can possibly be employed for producing new cement-based composites, such as ecological concretes or mortars [2] Recycled concrete Aggregate (RCA) is a material; where in natural aggregates (65–70%) are coated by cement mortar (30–35%) and can be produced from the crushing of concrete into smaller pieces [3]. This attached mortar has higher porosity and lower density than the natural crushed stone, which is known to be the major area for concerned for effective use in Concrete.[26] **Jitender Sharma, Sandeep Singla** the Research work on there cycling of waste construction materials is very important since the materials waste is gradually increasing with the increase of population and increasing of urban development. Sustainable construction has become one of the key requirements of today's concrete. A wide range of recycled aggregate has been steadily introduced in range of civil engineering and construction applications as partial replacement of natural aggregates in concrete[2]. The reasons that many investigations and analysis had been made on recycled aggregate are because recycled aggregate is easy to obtain and the cost is cheaper than virgin aggregate. In recent years, concrete made with recycled aggregate is considered to be one of the most promising solution store duce the amount of construction and demolition waste (CDW)that may end up in landfills. Over the last decades, the amount of CDW has increased considerably in line with increased construction activities and due to the demolition and restoration of old buildings. [27] **Sami W. Tabsh , Akmal S. Abdelfatah** In recycled concrete, the reclaimed concrete used to make coarse aggregate for new concrete may come from different sources. It can be obtained through the demolition of concrete elements of roads, bridges, buildings and other structures, or it can come from the residue of fresh and hardened rejected units in precast concrete plants. The quality of the recycled concrete aggregate will normally vary depending on the properties of the recovered concrete. Variations between concrete types result from differences in aggregate quality, aggregate size and texture, concrete compressive strength, and uniformity [12]. Therefore, there is a need to investigate the effect of the origin of the recycled concrete aggregate on the strength properties of the new concrete. Specifically, it is desired to quantify the consequences of using recycled concrete coarse aggregate with lower, equal, or higher strength than the target strength of the new concrete.[28] **Suraya Hani Adnan et.al** Recycled Aggregate Concrete (RAC) is concrete that using Recycled Aggregate (RA) as partially or fully replacement in coarse and fine aggregate. It is believed RA have been used from 1945 in concrete producing and started when World War II damaged a large quantity of concrete structures and the high demand of aggregate to rebuild the structures. They recognize the factors like depletion of natural aggregates, tightly environmental law and waste disposal problems which influenced the application of RA. RA had such a possible application in certain area and Masood et. al. (2002) have summarized it. They have conducted some experimental investigations and found that RA had a potential functioning as aggregate that can be applied in concrete roads, drainage work, shallow storage tanks, culverts and sewage or treatment plants. RAC has attracted many researchers to study its performance. [29] **Idi Priyono , Meiske Widyarti** The use of RCA (Recycled Concrete Aggregate) as coarse aggregate could decrease compressive strength by 40%. The other effect of RCA as coarse aggregate are decreased tensile strength by 24% and modulus of elasticity by 45% with a higher long-term deformation. RCA as fine aggregate has higher amount of cement pasta than RCA as coarse aggregate with a consequence of increase water absorption and decrease density [10]. The negative effect of RCA as fine aggregate, makes it very limited and even prohibited to use [11]. Because of that makes only few literature studying about RCA as fine aggregate [12]. Substitution of whole RCA as fine aggregate to standard aggregate resulting decreased of compressive strength, tensile strength, and flexural strength by 14%, 6%, and 23% [13]. The recycled aggregate which studied use material from recycle concrete waste, paving block, and red bricks that can be reused for building construction material. The aim of this study is to obtain recycled aggregate concrete compressive strength and to examine recycled aggregate concrete quality in days 3, 7, 28, 35, and 90 along with a proposal of the use of recycled aggregate concrete as a building construction material.[30]

III. Objective Of Study

- To study the different parameters for concrete mix design.
- To check the standard deviation and coefficient of variance value for mix design.
- Check the physical properties of RCA, by IS method, IS 10262-2009
- Prepare mix design for recycled concrete aggregate.
- To check RCA strength.

IV. Methodology



V. EXPERIMENTAL WORK

(A) Material testing

Crushing of materials

Weighing Of Crushed Material

Separation Of Material

(B) Testing

Testing By Sieve Shaker

(C) After Testing

Fineness modulus of aggregate is an index number which gives an idea about the coarseness or fineness of an aggregate.

This test method covers the determination of the particle size distribution of fine and coarse aggregates by sieving. A weighed sample of dry aggregate is separated through a series of sieves of progressively smaller openings for determination of particle size distribution.

For Fine Aggregate

Total weight of the Fine Aggregate = 1 kg.

Observation Table-1

Sr No.	IS Sieve	Retaining(gm)	% ret.	% age.
1	4.	5	0.5	0.5
2	2.	39 0	39	39.5
3	1.	30	3	42.5
4	60	49 0	49	91.5
5	30	40	4	95.5
6	15	25	2.5	98
7	90	15	1.5	99.5
8	75	5	0.5	100
9	Retain		Total	367
				3.67

Result:

The Fineness modulus of fine aggregate is found as:

$$\text{F.M.} = \frac{\Sigma\text{Cumulative \% weight retained up to } 150\mu}{100} = 3.67$$

VI. Sample Preparation

Regular Materials Required

We casted 10 cubes consisting of ratio 1: 1: 2 for M25 grade of concrete.

a. Cement = 19 kg

b. Water = 9 litre

c. Sand = 18.098 (approx. 19 kg)

d. Aggregate = 36 kg

This cube are casted by using regular materials.

Cube Casting (Regular Materials)

Curing (Regular Materials)

Testing (Regular Materials)

Observation Table No – 2

SAMPLE NO	STREES N\MM	$(\bar{x}-x)$	$(\bar{x}-x)^2$
1	10.6	1.19	1.4161
2	9.8	1.99	3.9601
3	6.2	5.59	31.2481
4	11.3	0.49	0.2401
5	11.6	0.19	0.0361
6	17	-5.21	27.1441
7	16	-4.21	17.7241
8	12.6	-0.81	0.6561
9	12.6	-0.81	0.6561
10	10.2	1.59	2.5281
	$\bar{x} = 11.79$		85.609

$$S = \sqrt{\frac{\sum[\bar{x}-x]^2}{n-1}}$$

$= \frac{\sqrt{85.609}}{9}$

= 3.08

Recycled Material (RCA)

We casted 10 cubes consisting of ratio 1:2.04:3.74 for M25 grade of concrete.

a. Cement = 15kg

b. Regular Sand = 10 kg

c. Recycled Sand = 15 kg

d. Aggregate = 40 kg

e. Recycled Sand passing through 2.36 Sieve.

Cube Casting (Recycled Materials)

Curing (Recycled Materials)

Testing (Recycled Materials)

Observation table No – 3

Sample No	Load (KN)	STRESS	$\overline{x} - x$	$(\overline{x} - x)^2$
1	450	20	-1.48	2.1904
2	330.9	14.7	3.82	14.5924
3	344.6	15.3	3.22	10.3684
4	424.3	18.8	-0.28	0.0784
5	218.1	9.6	8.92	79.5664
6	490.1	21.7	-3.18	10.1124
7	446.2	19.8	-1.28	1.6384
8	386.7	17.1	1.42	2.0164
9	439.5	19.5	-0.98	0.9604
10	646.7	28.7	-10.18	103.632
		$\overline{x} = 18.52$		225.156

$$S = \sqrt{\frac{\sum(\bar{x} - x)^2}{n - 1}}$$

$$S = 5$$

VII. Conclusion

- From the above studies observe that Characteristics of recycled aggregate largely rely on the duration of material dismantling. Material properties exhibit notable changes over a five-year period, and significant variations are observed in material properties over span.
- Experimental studies indicate favourable outcomes, with a Statistical Analysis score of 3.08 for Natural Material and 5.0 for Recycled Fine Aggregate
- As per IS Code 10262:2009 mix design. From above study conclude that Target strength value also Increases.
- Utilizing RCA as a substitute for natural fine aggregate has a positive impact on environmental concerns.
- The quality and properties of recycled aggregate are mostly dependent onquantity and quality of materials used.
- The RCA (recycled concrete aggregate) is a major ingredient in this method.
- The use of RCA as a replacement of natural aggregate impacts positively to environmental concerns.
- This method particularly covers the size distribution of fine and coarse aggregateby sieving.
- Statistical approach is being carried out in this work.
- Types of test can be carried out on RCA are Sieve Analysis test, Crushing Value test etc.
- Due to recycled aggregate in construction industry, energy & cost transportation and quarrying is significantly saved. This in turn reduces the impact of waste material on environment.

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