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A Survey on Effect of Recycled Aggregate on Standard Concrete Incorporate with Micro Silica

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ABSTRACT- The continuous global demand for infrastructure due to persistent increase in population growth implies that more aggregate and cement would be required in concrete production. This would eventually lead to more extraction and depletion of natural resources. Now days many structures were demolished and rebuilt, so the disposal of waste produced during demolishing process has become a severe social and environmental problem in the territory. The possibility of recycling of waste from the construction industry is thus of increasing importance. In addition to the environmental benefits it reduces the demand of land for disposing the waste, the recycling of construction & demolition wastes can also help to conserve natural materials and to reduce the cost of waste treatment prior to disposal.

Several research studies had made on the reuse of recycled aggregates. The findings indicated that recycled aggregate derived from demolished concrete or masonry can be extensively used in civil infrastructure projects including the production of Portland cement concrete, sub-base materials in road construction projects. But in practice, recycled aggregate is not commonly used in the production of concrete. One of the reasons is that Portland cement concrete is produced to form structural elements which have to meet strict strength and durability requirements. Extensive research is required to verify the properties of recycled aggregate concrete before it can be confidently adopted by the concrete industry.

The aim of this research work is to develop standard concrete using recycled coarse aggregate incorporating with microsilica, with the object to boost higher use of recycled coarse aggregate in the construction industry. Concrete was designed for 28-day compressive cube strength of 30MPa, a constant water-cement ratio of 0.45. Microsilica was incorporated up to 15% of cement content at 5% intervals, while the natural coarse aggregate substitution by recycled coarse aggregate ranges between 25 - 75% at 25% interval. Workability, compressive cube strength, tensile splitting strength and flexural strength these test were taken on fresh and hardened concrete. Results confirmed that, the incorporation of 10% microsilica with 25%, 50% and 75% recycled coarse aggregate fraction produced 28-day compressive cube strength, which required the characteristics and target mean compressive cube strength of the control mix which are 39.37MPa, 36.72MPa and 34.18MPa respectively. The result suggests that there is a potential to increase the optimum fraction of recycled aggregate from 25-75% in concrete, as result shows more strength for mix design of M30 grade concrete.

KEYWORDS- Recycled Aggregate, Concrete, Micro Silica.

I. INTRODUCTION

- **Background**

Concrete does a heterogeneous material comprise fine aggregate, coarse aggregate, potable water, and the binder known as cement and the presence of coarse aggregates in concrete contributes more to the heterogeneity. As compare to other ingredients of concrete, requirement of coarse aggregate is more. Generally, aggregates account for a huge proportion (60-75%) of the overall volume of concrete. concrete is characterized by very advantageous features ranging from cost effectiveness, durability, outstanding compressive strength, and availability these make it very useful. The increasing demand of infrastructure due to continuous rise in population, and high rate of urban drift. Concrete has more consumed because of industrialization and urbanization. Concrete is the most widely consumed resource in construction industry. The continuous global demand for concrete implies that, more aggregate and cement would be required in the production of concrete, thereby leading to more extraction and depletion of deposits of natural gravel,

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and increased CO_2 emission from quarrying activities. Also the continuous use of conventional concrete, (that is concrete produced with virgin aggregates and ordinary Portland cement) has proved to be very unfriendly to the environment.

This implies that, partial substitution of natural aggregate with recycled aggregate would lead to reduction in construction cost and carbon emission of the construction industry. Coarse aggregate as partial substitute for virgin coarse aggregate in concrete is not new to the construction industry, and significant progress has been made over the past years since recycled aggregate properties were first investigated by Gluzhge in 1946. This eventually lead to the current use of recycled coarse aggregate for non-structural concrete applications such as embankment fills, low-grade concrete production, coarse materials for road sub-base, paving blocks, drainage etc. In spite of many research studies and findings, there is urgent need to improve the engineering properties of recycled coarse aggregate concrete. This would help to reduce the current high level of uncertainty associated with the structural use of the material in concrete production.

In the process of crushing of aggregate because of impact CA have micro cracks on its surface. As the recycled aggregates have micro cracks on its surface this tends to have low strength of concrete, so there is a need to add some mineral admixture to improve the properties of RA concrete. The use of mineral admixture (i.e. microsilica) can enhance the physical and engineering properties of recycled aggregate concrete. These interactions would be investigated with a view to evaluate the potential to increase the optimum fraction of recycled coarse aggregate in concrete, from the currently recommended 30% level of replacement.

Microsilica contributes both physically and chemically in concrete mix. The physical contribution occurs through its action as nucleation sites, which reduces the average size of pores present in cement paste thereby enhancing concrete properties. While the chemical contribution takes place mainly by acting as an efficient pozzolanic material, which enables even distribution and higher volume of hydration products.

Most researchers incorporated micro silica as partial replacement for cement in concrete mix, while this research work incorporates micro silica as an addition with the intent to evaluate the optimum required addition that would produce the best significant result in terms of strength, durability and workability.

1.2 Research aim and objectives

1.2.1 Aim

The major aim of this research is to develop conventional standard concrete using recycled coarse aggregates as substitute for natural coarse aggregate and mineral admixture (micro silica), in order to improve the properties of recycled aggregate concrete. With an additional goal to boost the potential of increasing its uses from the recommended 30% level from some past researchers. Adequate factual scientific information is thereby required to establish the mechanical and physical characteristics of concrete incorporating above-mentioned materials.

1.2.2 Objectives

The objectives are to;

1) To study the durability, compressive, split tensile strength and flexural stress of the

concrete with the use of recycled aggregate along with micro silica.

2) To determine the flexural stress in recycled aggregate concrete along with micro

silica.

3) To evaluate the effect and optimal use of micro silica required to achieve good

strength concrete.

The outcome of this research will provide better understanding about the properties of recycled aggregate concrete produced from the aforementioned materials, and contribute greatly in ensuring that the construction sector increases the use of recycled coarse aggregate beyond the current recommendation. This research is also limited to the use of recycled coarse aggregate as a replacement for natural coarse aggregate, microsilica as an addition to cement respectively.

- **Significance of Research**

The following listed are potential benefits from this research work to the construction industry and the environment. These are;

- Reduction of pressure on landfills from construction and demolition debris;

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- Potential to increase the use of recycled coarse aggregate beyond the maximum recommended 30%;
- Conservation of natural resources through reduction in the use of natural coarse aggregate for concrete work;
- Mitigation of performance issue like low strength associated with recycled aggregate by incorporating micro silica (mineral admixture) in the concrete mix;
- Potential application of recycled coarse aggregate in structural concrete.

II. LITERATURE REVIEW

2.1 Introduction

The review of past related studies is presented and discussed in this chapter with the focus lying on the effect of recycled coarse aggregate and micro silica on fresh and hardened concrete properties. Although research has been undertaken to assess the suitability of recycled coarse aggregate (RCA) as a substitute for virgin coarse aggregate in concrete, few attempts have only been made to investigate the synergy between microsilica in addition of recycled aggregate concrete for high strength structural concrete application. Most of the researchers incorporated microsilica as a partial substitute for cement in the concrete mix. Various findings and contributions by previous researchers are reviewed with a view to summarize the latest development and identify the knowledge gap.

Concrete is a heterogeneous material comprising fine aggregate, coarse aggregate, potable water, and the binder known as cement), and the presence of coarse aggregates contributes more to the heterogeneity. While the process of crushing of recycled aggregate due to the impact aggregates have micro cracks on its surface, so the interface between the surfaces of aggregate and cement is weak and this is responsible for the low concrete strength.

The use of mineral admixture (i.e. microsilica) could enhance the physical and engineering properties of recycled aggregate concrete. This interaction is investigated with a view to evaluate the potential to increase the optimum fraction of recycled coarse aggregate in concrete from the currently recommended 30% level of replacement. Concrete will be highlighted and an attempt will be made to investigate whether performance issues such as workability, and low strength associated with recycled coarse aggregate can be mitigated by incorporating microsilica in recycled aggregate concrete. Microsilica contributes both physically and chemically in concrete mix. The physical contribution occurs through its action as nucleation sites, which reduces the average size of pores present in cement paste thereby enhancing concrete properties while the chemical contribution takes place mainly by acting as an efficient pozzolanic material which enables even distribution and higher volume of hydration products. Although the initial cost of concrete made with micro silica is higher than the cost of conventional concrete, the long term cost-benefits balances higher cost at initial procurement. Most researchers incorporated micro silica as partial replacement for cement in concrete mix while this research work incorporates micro silica as an addition with the intent to evaluate the optimum required addition that would produce the best significant result in terms of strength, durability, and workability.

2.2 Literature Review

Claudio Javier Zega and Angel Antonio Di Maio has done research on recycled concretes made with waste ready-mix concrete as coarse aggregate.In this paper they have prepared cubes and cylinders for 17Mpa & 30Mpa grade. For low-grade concrete (17Mpa), the objective was to produce recycled concrete with characteristics similar to those of the source concrete. For M30 concrete, the goal was to manufacture a recycled concrete with a satisfactory strength level and acceptable durability properties. They were used recycled coarse aggregates obtained by crushing waste ready-mix concrete. The mechanical and durability properties of recycled concretes has checked for concrete made by using 25, 50, and 75% of replacement of recycled aggregates.

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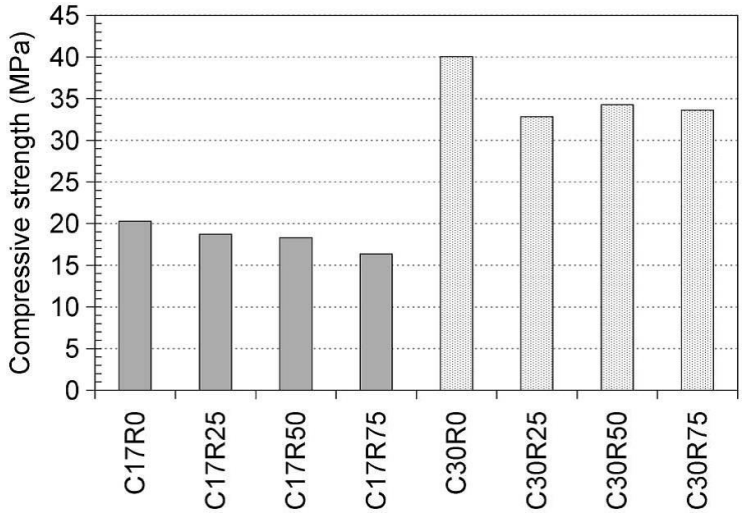

Fig. No. 2.1

The compressive strength up to 50% replacement of aggregate gave 10% lower strength and 75% replacement of aggregate gave 19% lower strength. Split tensile test was also shown low result.

De-jianYANG ,Ya-han HAO and Tie-cheng W, has done experimental Research on Recycled Aggregate Concrete for Highway Pavement 2010**;** This research paper uses recycled aggregate replacements for 30%, 50%, 70% and 100% were investigated. They prepared M25 grade concrete.

Table No. 2.1: specimen and compressive strength.

specimen	Compressive strength (MPa)
RAC0	33.7
RAC30	28.7
RAC50	27.2
RAC70	24.5
RAC100	23.8

From obtained results they conclude that the replacement ratio of recycled aggregate gives less results for compressive strength of concrete.

RattaponSomna; Chai Jaturapitakkul, A.M.ASCE; WichianChalee; and PokpongRattanachu did research on the effect of the Water to Binder Ratio and Ground Fly Ash on Properties of Recycled Aggregate Concrete.This research paper gives results for the mix proportions of normal concretes and recycled aggregate concretes, which had W/C (water to cement ratio) of 0.45, 0.55, and 0.65. For normal concrete, the mix proportion was designed by using ACI method. Recycled aggregate concrete was made with the same mix proportion of normal concrete, except that the recycled coarse aggregate was fully used to replace the crushed limestone. In addition, ground fly ash was also used to replace the OPC at 20, 35, and 50% by weight of cement in the recycled aggregate concretes. From this replacement & W/C ratio the maximum compressive result obtained was 42.7Mpa at 0.45 ratios with 20 % replacement of ground fly ash. Latter increasing W/C ratio and replacement of ground fly ash will decrease the compressive strength.

Verma Ajay, Chandak Rajeev and Yadav R.K. have explained the effect of microsilica on The strength of concrete with ordinary portland cement 2012)**ISCA[4]** *Vol. 1(3), 1-4, Sept. (2v 012);*
In this they prepared M30 concrete with different % of micro silica like 5%, 10%, 15% & 20%, they found following results.

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Table No. 2.2: Replacement level and compressive strength (Mpa).

	Plain	5 SF	10 SF	15 SF	20 SF
28 Days	34.7	45.8	47.7	48.3	45.5

They conclude that silica fume increases the strength of concrete up to 25%. Silica fume is much cheaper then cement therefore it very important form economical point of view. Silica fume is a material which may be a reason of Air Pollution this is a byproduct of some Industries. Use of silica fume with concrete decrease the air pollution. Silica fume also decrease the voids in concrete. Addition of silica fume reduces capillary, Absorption and porosity because fine particles of silica fume reacts with lime present in cement. The results obtained are as below.

Table No. 2.3: Addition of silica fume and compressive strength.

Mix Description	Plain	5 SF	10 SF	15 SF	20 SF
% adding of silica fume	0 %	5 %	10%	15 %	20%
7 Days	23.2	28.4	32.1	33.2	32.1
14 Days	28.7	30.5	34.4	37.4	36.3
28 Days	34.7	43.8	45.7	48.3	45.5

Viviana Letelier , Ester Tarela, Pedro Munozb, Giacomo Moriconi done their research on combined effects of recycled hydrated cement and recycled aggregates on the mechanical properties of concrete.In This paper analyses of the mechanical properties of concrete manufactured replacing different amounts of cement and natural coarse aggregates with recycled hydrated cement and recycled aggregates respectively. The goal is to determine their optimal combination to maximize the reuse of recycled materials, and also maintaining the performance of the material and minimizing its environmental impact. The levels of the percentage of RA considered were 20%, 30% and 40%. The levels of the percentage of RHC replacing cement considered were 5%, 10% and 15%, chosen.
The strength of control specimen was 32.1, as the replacement of aggregate & recycled hydrated cement the compressive strength of concrete was reduced. The maximum results obtained after replacement was 28.6 at the replacement of 20% aggregate & 5% recycled hydrated cement. After that strength was reduced rapidly.
From this they conclude that the amount of cement replaced by the reused powder shows a low significance, but still perceptible. A loss of the strengths, both compressive and flexural, takes place when the amount of the RA increases, due to the low quality of the aggregates used.

Bin Yan, Liang Huang, Libo Yan, Chang Gao, BohumilKasal has gave behaviour of flax FRP tube encased recycled aggregate concrete with clay brick aggregate. In researcher use recycled aggregates mainly came from concrete rubble, but the use of RAs from masonry rubble for recycled aggregate concrete is very rare. This study reported the compressive behaviour of flax FRP tube encased recycled aggregate concrete containing partially clay brick aggregate which was termed as FFRP- recycled aggregate concrete - clay brick aggregate. For the recycled aggregate concrete, up to 70% of natural coarse aggregates were replaced by recycled aggregates. The recycled aggregate consisted mainly of 60% of recycled clay brick aggregates and 40% of recycled concrete and mortar aggregates. A total of 36 cylindrical specimens including 24 FFRP-RAC-CBA and 12 unconfined RAC-CBA were tested under uni-axial compression. The testing variables included: (i) strength of RAC-CBA (i.e. 27.5 MPa and 32.8 MPa); (ii) thickness of FFRP tube (i.e. 3, 6, 9 and 12 FRP layers); and (iii) size of cylinder (i.e. 75 X 150, 150 X 300 and 300 X600, unit of mm). Tests results indicated that the natural FFRP tube enhanced the ultimate strength and ductility of the confined RAC-CBA remarkably, the enhancement was more pronounced in specimens with higher concrete strength. Increasing FFRP thickness led to higher compressive stress and strain of the FFRP-RAC-CBA. Compared with natural aggregate concrete, the RAC-CBA had reduced compressive strength.

FFRP tube confinement had significantly enhancement on both strength and ductility of the tube confined RAC-CBA cylinders, i.e. for medium-sized FFRP-RAC-CBA, the ultimate compressive strength increased by 51% due to 9-layer FFRP tube confinement. With an increase in FFRP tube thickness, the ultimate compressive strength of the confined RAC-CBA increased.

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NwzadAbduljabarAbdullaexplain the effect of recycled coarse aggregate type on concrete. In this research paper they promote the use of local waste as 100% alternative coarse aggregate in construction industry, an experimental program was carried out using samples of main Iraqi building waste. The types of aggregate used represent the three main constituents within recycled aggregates: unbound stone, crushed concrete and crushed brick. Tests for mechanical properties of different types of recycled aggregate included crushing value and abrasion resistance. Using multilinear correlation analysis, the influences of these aggregate characteristics and other parameters on the properties of recycled aggregate concrete were evaluated.
In this they have taken different test on recycled aggregate like size & shape, water absorption strength. The particle shape was determined by the EI and FI index. These values affected the strength of the particles and were higher for RA because of the crushing process, which resulted in less equidimensional, rough-surface, angular particles when compared with the rounded, smooth-surface, uncrushed Natural Aggregate. The strength of different types of aggregates was measured by the crushing value and abrasion test (Los Angeles). All types of RA exhibited lower resistance to crushing under gradual compressive load than that of NA. The open structure bricks and limestone were more brittle and resulted in CV values higher than that of NA by 92, 120, and 89%.

In the slump testing they observed that The shape and texture of recycled aggregate affected the workability, yielding higher water absorption values over that of natural aggregate, which affects the slump values (40, 50, and 45 mm) compared with the 55-mm target for natural aggregate concrete. The density for replaced aggregate concrete was less than that of natural aggregate by 8, 9, and 5%, despite originating from the same parent aggregates.
From this they conclude that recycled aggregate have low density so it can be used for light weight concrete.
The concrete which is made by using recycled aggregate cannot be used for road & pavement purpose it can only be used for normal concreting work.

2.3 Summary of Existing development

There is consent among researchers with respect to low workability of recycled aggregate concrete with increasing amount of recycled coarse aggregate and mineral admixture in the concrete mix. However, there are different reports on the impact of slag, fly ash and higher content of recycled aggregate in concrete. Some researchers held that compressive strength, tensile splitting strength and flexural strength, reduces as the aforementioned materials increases in concrete mix while other researchers reported increase in mechanical properties and insignificant effect respectively. The majority of researchers reported decreasing strength with increasing recycled coarse aggregate content decreasing weight of concrete as well as increasing permeability and increasing strength and decreasing permeability with inclusion of admixture.

2.4 Knowledge gap

From several research findings reviewed under this chapter, the influence of the combination of microsilica and recycled aggregate concrete is yet to be investigated. The contributions of microsilica as an addition to cement in concrete has not been widely investigated as only few researchers had studied the benefits of using microsilica in concrete as a percentage replacement. However, the majority of the researchers, conducted research on recycled aggregate concrete without incorporating microsilica. This research work aims to investigate the effect of incorporating microsilica as a percentage addition to recycled coarse aggregate concrete rather than as partial replacement for cement. Most researchers in a similar way suggests the use of about 30% recycled coarse aggregate as a replacement for conventional coarse aggregate in concrete, because findings have shown that there is no significant effect at such percentage replacement. However, it is one of the objectives of this research work to assess the potential of raising this recommended percentage utilization of recycled coarse aggregate in concrete mix beyond 30%. This research work would influence on the properties of micro silica and synergise these properties in order to achieve the set target thereby reducing the consumption of natural coarse aggregate which is about 60-75% in concrete mix.

III. PROBLEM STATEMENTS AND MATERIALS DISCRIPTION

3.1 Problem statement

From review of literature, it was found that much work was done on recycled aggregate concrete with natural aggregate, also the cement was replace with different admixture. As a result of this no any improvement in strength was obtained. Also no work was found on addition of admixture of micro silica. So in this research, the RCA was replaced to NCA in addition of micro silica for improving the properties of recycled aggregate concrete is carried out.

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3.2 Experimental Work

The experimental work is essential for the research work. In order to evaluate the physical and mechanical characteristics of the concrete produced from the aforementioned materials under theoretical work, some laboratory work is required. The percentage of natural coarse aggregate replacement by recycled coarse aggregate was chosen as 0%, 25%, 50% and 75% by weight of coarse aggregate respectively with 0% taken as the control or reference concrete. Laboratory testing was also performed on fresh and hardened concrete samples in order to determine their workability, compressive strength, tensile splitting strength and flexural strength respectively in accordance to Indian Standard. The impact of recycled coarse aggregate and microsilica on the properties of concrete were also investigated from the results of tests carried out, which enabled comparison to be made with control experiment.

3.2.1 Concrete materials

Concrete is a composite material composed of different ingredients like coarse aggregate, fine aggregate, cement, water etc., so the characteristics of concrete mainly depends on the characteristics of ingredients used to make concrete. Table no. 4 shows the essential concrete material that was used in experimental work. Mineral admixtures are becoming more popular in recent decades. The use of recycled materials as concrete ingredients has been gaining popularity because of increasingly stringent environmental legislation, and the discovery that such materials often have complementary and valuable properties.

Table No. 3.1: Concrete materials and description.

Material	Description
Cement	Birla Shakti 53-grade (Ordinary Portland pozzolona cement)
Microsilica	complies with ASTM C1240
Natural coarse aggregate	Crushed gravel
Recycled coarse aggregate	Maximum size of 20mm, Taken from SSP Technology Pune
fine aggregate	Artificial crushed sand

3.2.1.1 Cement

The cement used in this research was Ordinary Portland pozzolona cement (OPC). These cement were stored within the laboratory, numbered with dates and used according to date of delivery.

3.2.1.2 Microsilica

The microsilica used in the laboratory is complies with ASTM C1240 as shown in figure no.3.1 was obtained from Walter Pvt.Ltd. Mumbai.

Fig. No. 3.1: Microsilica Supplied by walter pvt.ltd.

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A typical property of microsilica is given in Table 3.2 & 3.3.

Table No. 3.2: Typical properties of microsilica.

Form		**Description**
Colour		Grey
Odour		Odourless
Solubility (Water):		Insoluble/Slightly soluble
Specific Gravity (water=1)		2.11
Bulk density (gm/cc)		0.416
Chemical property	**Test Method**	**Result**
Silicon Dioxide(SiO_2) % by mass	BS EN 196-2	92.0
Elemental Silicon % by mass	ISO 9286	0.12
Free Calcium Oxide %by mass	BS En 451-1	0.34
Sulphate (SO_2)	BS EN 196-2	0.14
Total Alkali (Na_2O_{eq}) %by mass		0.40
Chloride (Cl) %by mass		0.03
Loss on Ignition % by mass		2.10
Particle size, mean (μm)		25

Table No. 3.3: Chemical properties

There are 2 distinct ways in which microsilica enhances concrete strength and durability these are;

- By acting as filler to reduce the average size of pores present in cement paste and;
- By providing more even distribution and higher volume of hydration products while acting as a pozzolan.

3.2.1.3 Natural coarse aggregate (crushed aggregate) Crushed gravel with nominal maximum size of 20mm and 10mm and relative density of 2.79 and 2.72 was used as natural coarse aggregate in the research work. The impact value test and abrasion test for these aggregate were performed in the laboratory which gave result as 13.84% and 17.2% respectively. The materials were stored outside the laboratory at a designated area. Aggregate were obtained from the nearer dealer of construction material from college area.

3.2.1.4 Natural Fine Aggregates (crushed Sand)

Crushed sand with relative density of 2.65 was used as natural fine aggregate in the research. The materials were stored outside the laboratory at a designated area. Aggregate were obtained from the nearer dealer of construction material from college area.

3.2.1.5 Recycled Coarse Aggregates

Recycled aggregates are mainly crushed concrete obtained from materials that were previously used in construction activities and recovered from demolition debris. They may be grouped as either recycled concrete aggregate (RCA) when the components are largely from crushed concrete or generally referred to as recycled aggregates (RA) when they are made up of substantial amounts other than crushed concrete. The major difference between recycled coarse aggregate and natural coarse aggregate is that the former consists of two separate materials; natural aggregate and attached or adhered cement mortar. The recycled coarse aggregate used for the research has a nominal size of 20mm and 10mm and was obtained from SSP Technology Pune, Pune college campus area. These aggregates have low specific gravity 1.89. The impact value and abrasion value were evaluated as 20.7% and 26.4% respectively. Photo. No. 1 shows the sample of recycled coarse aggregate used for concrete work in the laboratory.

3.2.1.5.1 Impurities in Recycled Coarse Aggregate

The performance of recycled coarse aggregate can be reduced due to the presence of impurities, which emanated from demolition process including porous mortar and cement paste attached to the parent aggregate. The effect could also lead to general reduction in characteristics of recycled aggregate concrete. Some of the impurities identified through visual inspection from the recycled coarse aggregate.

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The average percentage impurities present in the recycled coarse aggregate amounted to about 5% of the total mass of the sample. Although there is visual evidence to show the presence of adhered mortar on the parent material, it was practically impossible to estimate their percentage. However, the adhered mortar does not seem to be of significant quantity but its impact on the characteristics of recycled coarse aggregate concrete cannot be neglected.

3.2.1.6 Water

The reaction between the mixture of water and cement results in hardening of concrete through the process known as hydration. In order to prevent any deleterious substance from interfering with the process of hydration, water for concreting is recommended to be from a potable source. This is because the role of water in water to cement ratio is the most critical factor in concrete. Excess water reduces the strength of concrete while inadequate water make concrete less workable. Due to desire to ensure concrete workability and of required strength, it is necessary to balance the water to cement ratio in concrete mix. In view of this, potable drinking water from the laboratory was used for concrete mixing in order to enhance hydration of cement and mineral admixture, and enable proper binding effect. The source of water is free from any form of contamination otherwise; it would affect the physical and mechanical characteristics of concrete.

3.2.1.7 Concrete Moulds

The dimension and types of concrete moulds used in the laboratory work are indicated in Table No.3.4 and photo2 respectively.

Table No. 3.4: Description of moulds.

Concrete moulds	Dimensions (mm)	Volume (m^3)
Cube	150x 150 x 150	0.003375
Cylinder	150x 300	0.0053
Beam	150x 150 x 700	0.01575

IV. CONCLUSION

The experimental investigation has been carried on cubes, cylinders and beans to observe the compressive strength, split tensile strength and flexural strength. The obtained tests results are discussed above, which have recycled aggregates in different percentage incorporating with microsilica with vary in percentage. The tests were taken on the universal testing machine. The results of these tests are studied and following conclusions are drawn. The water absorption of recycled aggregate is more as compare to the natural aggregate, as they have mortar on its surface so it absorbs more water. Higher recycled coarse aggregate fraction in concrete mix results in a significant reduction in physical and mechanical properties of concrete. As the percentage of microsilica increases workability of concrete get decreases, as the micro silica requires additional water for chemical reaction that is for hydration. The incorporation of microsilica, significantly improves properties of recycled aggregate concrete up to 10% beyond which it get declines. The outcome of this research suggests a strong potential to increase the current recommended fraction of recycled coarse aggregate in concrete from 30% to 75% in terms of strength.

REFERENCES

1. Claudio Javier Zega and Angel Antonio Di Maio, “Recycled Concretes Made with Waste Ready-Mix Concrete as Coarse Aggregate”, ASCE 2011
2. De-jian YANG ,Ya-han HAO and Tie-cheng, “Experimental Research on Recycled Aggregate Concrete for Highway Pavement”, ASCE 2010
3. Rattapon Somna, Chai Jaturapitakkul, Wichian Chalee and Pokpong Rattanachu, “Effect of the Water to Binder Ratio and Ground Fly Ash on Properties of Recycled Aggregate Concrete”, ASCE 2012
4. Verma Ajay, Chandak Rajeev and Yadav R.K., “Effect of Micro Silica on The Strength of Concrete with Ordinary Portland Cement”, IJRCE Vol. 1(3), 1-4, Sept. (2012)
5. Viviana Letelier , Ester Tarela , Pedro Munozb, Giacomo Moriconi, “Combined effects of recycled hydrated cement and recycled aggregates on the mechanical properties of concrete”, Science Direct 2016
6. Nwzad Abduljabar Abdulla, “Effect of Recycled Coarse Aggregate Type on Concrete”, ASCE 2014

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.54|

| Volume 5, Issue 12, December 2022 |

| DOI:10.15680/IJMRSET.2022.0601005 |

7. IS 456:2000, Plain and Reinforced Concrete- code of practice (fourth revision), Bureau of Indian Standards, New Delhi- 110002
8. IS 10262, Recommended Guidelines for Concrete Mix Design (fifth revision), Bureau of Indian Standards, New Delhi- 110002
9. Shaikh Faiz Uddin Ahmed, "Existence of Dividing strength in Concrete Containing Recycled Coarse Aggregate", ASCE 2014
10. M. M. Y. Ali and A. Arulrajah, "Potential Use of Recycled Crushed Concrete – Recycled Crushed Glass Blends in Pavement Subbase Applications", ASCE 2012
11. Cameron, D. A., Azam, A.H. and Rahman, "Recycled Clay Masonary and Recycled Concrete Aggregate Blends in Pavement", ASCE 2012
12. E. Dapena, P. Alaejos, A. Lobet, and Perez, "Effecy of Recycled Sand Content on Characteristics of Mortars and Concretes", 2011 ASCE
13. Xiaoyan Ding,Wenkun Liu, Jihong Ye, Zhongfan Chen, and Ming Xu., "Research of Recycled Bearing Concrete Hollow Block", ASCE 2012
14. Jiusu Li , " Mix Design of Pervious Recycled Concrete", ASCE 2015
15. Kongrat Nokkaew1, James M. Tinjum, PhD, PE, M. ASCE2, and Craig H. Benson, PhD, PE, DGE, "Hydraulic Properties of Recycled Asphalt Pavement and Recycled Concrete", ASCE 2012
16. Weerachart Tangchirapat, Rak Buranasing and Chai Jaturapitakku, "Use of High Fineness of Fly Ash to Improve Properties of Recycled Aggregate Concrete", ASCE 2015
17. J. D. THOMPSON and H. H. BASHFORD, "Concrete Recycling and Utilization of Recycled Concrete: An Investigation of the Barriers and Drivers within the Phoenix Metropolitan Area", ASCE 2012

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