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## A Review on Standard Recycled Aggregate 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 and increased carbon emission. This leads to more extraction, depletion of deposits of natural gravel, and increased CO<sub>2</sub> emission from quarrying activities. Concrete is a heterogeneous material comprising fine aggregate, coarse aggregate, water and the binder known as cement. The presence of coarse aggregates contributes more to the heterogeneity. An aggregate consumes about 60% to 75% of the overall volume of concrete. The aim of this research work was to develop high performance concrete using recycled aggregate, microsilica, and synthetic macro fibre with the object to boost higher use of recycled coarse aggregate in the construction industry. An important aspect of sustainable construction is recycling or reuse of the construction material and demolition waste. It will maintain a friendly green environment. Recycled aggregates has micro cracks on its surface causes low strength, low workability of concrete. This draw back can be avoided by using micro silica. In this paper experimental results were shown for recycled aggregate incorporating with micro silica.

**KEYWORDS:** -Micro silica; Recycled aggregate; Natural aggregate; Construction and demolition waste; Recycled concrete.

### I. INTRODUCTION

Concrete is a heterogeneous material comprising fine aggregate, coarse aggregate, potable water and the binder known as cement. The presence of coarse aggregates contributes more to the heterogeneity. An aggregate consumes about 60% to 75% of the overall volume of concrete. Although, concrete is characterized by very advantageous features ranging from cost effectiveness, durability, outstanding compressive strength, and availability, 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, as a result of depletion of the natural resources. Growing disposal problems and huge energy consumption in quarrying activities, has affects the nature. The increasing demand for infrastructure, As a result of industrialization and urbanization has lead to more consumption of concrete. Concrete is the most widely consumed resource in the world after water and also the most widely used construction material in the last few decades.

#### 1.1 Background

During the crushing process and due to having loose mortar cover on surface of aggregate, Recycled aggregate has micro cracks on it. As a result of this, bond between cement and aggregate is weak. This is responsible for the low concrete strength and low workability.

By using recycled aggregate compressive strength of concrete get reduced as compare to the concrete from natural aggregate Researchers found that the replacement up to 30% [2], but this replacement gives lower strength than virgin aggregate. The use of mineral admixture (i.e. micro silica) could enhance the physical and engineering properties of recycled aggregate concrete. Micro silica contributes both physically and chemically in concrete mix. The size of micro silica particles is smaller than that of cement. This will results in reduction of the average size of pores present in

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cement paste. While the chemical contribution takes place mainly by acting as an efficient pozzolanic material, which enables even distribution and higher volume of hydration products.

## 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) Determination of fresh and hardened properties of concrete incorporating various percentage of recycled coarse aggregate content;
- 2) Evaluate the effect of addition of mineral admixture (micro silica) on concrete produced in (1) above;
- 3) Determine the optimal use of micro silica required to achieve good strength concrete produced in (2) above;
- 4) Evaluate the flexural performance of nominal reinforced concrete incorporating micro silica which produced the optimal effect in above.

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.

## 1.3 Significance of Research

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

- 1) Reduction of pressure on landfills from construction and demolition debris;
- 2) Potential to increase the use of recycled coarse aggregate beyond the maximum recommended 30%;
- 3) Conservation of natural resources through reduction in the use of natural coarse aggregate for concrete work;
- 4) Mitigation of performance issue like low strength associated with recycled aggregate by incorporating micro silica (mineral admixture) in the concrete mix;
- 5) Potential application of recycled coarse aggregate in structural concrete.

## II. LITERATURE SURVEY

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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De-jian YANG, 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.

Rattapon Somna; Chai Jaturapitakkul, A.M.ASCE; Wichian Chalee; and Pokpong Rattanachu 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 42.7 Mpa 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. (2012);

In this they prepared M30 concrete with different % of micro silica like 5%, 10%, 15% & 20%, they found following results.

They conclude that silica fume increases the strength of concrete up to 25%. Silica fume is much cheaper than cement therefore it very important from 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.

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, Bohumil Kasal 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 X 600, 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

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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.

NwzadAbduljabarAbdulla explain 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.

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.

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

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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.

## IV. CONCLUSION

The graph plotted using the results are shows results with addition of microsilica. Hence from the results we can conclude that Micro silica improves the strength as discussed before.

1. The water absorption of recycled aggregate is more as compare to the natural aggregate.
2. As the percentage of microsilica increases workability of concrete get decreases.
3. The incorporation of microsilica, significantly improves properties of recycled aggregate concrete up to 10% beyond which it get declines.
4. The outcome of research suggests potential to increase current recommended fraction of recycled aggregate in concrete.

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