An Experimental Study on Use of Demolished Concrete Waste, Industrial Ceramic Waste, and Fly Ash as a Partial Replacement of Fresh Concrete

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Abstract — In Many areas of the developing world sources of good quality aggregates are very limited or practically not available and therefore it has become necessary to study alternative materials. The rapid growth in construction and depleting natural resources demands the recycling and reusing technology to be adopted in construction field. In this experimental study the natural coarse aggregate (NCA) is replaced with recycled coarse aggregate (RCA), coarse industrial ceramic waste with fly ash at different percentage and the mechanical strength of concrete is tested. The objective of present study is to determine the sustainability of RCA, coarse industrial ceramic waste as an alternate material to NCA, and to compare the workability, density and compressive strength result using fly ash, For this mix design take water cement ratio 0.5 Cubes are casted by replacing virgin aggregate and cement with 10%, 20%, 30%, 40% RCA, ceramic waste and FA and compressive strength is checked. Results shows that RCA, ceramic waste and FA up to 40% can be used for making concrete.

Keywords: Compressive Strength, Concrete, Fly Ash (FA), Natural Coarse Aggregate (NCA), Recycled Coarse Aggregate (RCA), Coarse Industrial Ceramic Waste

I. INTRODUCTION

The Recycling System for concrete being demanded now a day due to the rapid economic growth is leading to urbanization and industrialization generating waste which is adversely affect the environment. The course towards this involves mainly minimizing the environmental impact of concrete production by substituting virgin mineral materials by recycled ones as well as reducing the global CO2 emissions. The aim of this research is to assess the feasibility of inclusion of flyash (as replacement of cement) for RCA based concrete to improve its quality and secondly, to evaluate the effect of various percentage flyash, RCA, on compressive strength and split rensile strength of concrete. Y of concrete with RCA is very dependent on the quality of the recycled material used. In the process of manufacturing such recycled aggregate, the manufacturing cost and amount of CO2 emissions is likely to rise sharply, consequently limiting the extent to which recycled aggregate concrete is used. Due to their bonded mortar, RCA have a lower specific gravity and a higher water absorption capacity compared to NCA, In this study it is try to prove that to manufacture structural concrete by partly substituting natural with recycled aggregates by up to 30 % perecent is indeed feasible in India, 2009 delhi government have initiated a program to manage the construction and demolition waste.

II. LITERATURE REVIEW:

It Involve examining existing research and scholarly works related to this topic.

1) Introduction- The utilization of waste materials in construction has gained significant attention in recent years due to environmental concerns and the need for sustainable development. This literature review aims to analyze and summarize the existing research on the experimental study conducted on the partial replacements for fresh concrete.
2) Demolished concrete Waste: - Demolished concrete waste, commonly known as recycled concrete aggregate (RCA), is generated from the demolition of old structures. The use of RCA in concrete production offers several benefits, including reduce landfill waste, conservation of natural resources, and lower carbon footprint, previous studies have investigated the effects of incorporating RCA in fresh concrete mixes, considering aspects such as mechanical properties, durability, and workability.
3) Industrial Ceramic Waste: Industrial ceramic waste refers to the by-products generated from ceramic manufacturing processes. This waste material possesses pozzolanic properties, which can contribute to the strength and durability of concrete when used as a partial replacement for cement. Literature suggests that incorporating industrial ceramic waste in concrete can enhance the compressive strength, reduce permeability and improve the overall performance of the concrete.
4) Fly Ash: Fly, a by-product of coal combustion in power plants, is a widely used supplementary cementitious material in concrete production. It possesses pozzolanic properties and can enhance the workability, durability, and long-term strength of concrete. Numerous studies have investigated the effects of incorporating fly ash as a partial replacement for cement in fresh concrete mixes, considering factors such as hydration characteristics, mechanical properties, and durability performance.
5) Experimental Study: The experimental study reviewed in this literature review focuses on the combined use of demolished concrete waste, industrial ceramic waste, and fly ash as partial replacements for fresh concrete. The research aims to investigate the influence of these waste materials on the mechanical properties, workability, and durability of concrete. Key parameters examined may include compressive strength, flexural strength, water absorption, chloride ion penetration resistance, and carbonation resistance.
6) Findings and Conclusion: Based on the reviewed literature, it can be concluded that the use of demolished concrete waste, industrial ceramic waste, and fly ash as partial replacements for fresh concrete shows promising results. The incorporation of these waste materials can enhance the mechanical and durability properties of concrete, while also contributing to sustainable construction practices and reducing environmental impact. However, it is important to consider the specific

characteristics of the waste materials, their optimal replacement percentages and any potential challenges associated with their use in concrete production.

7) Future Research: Further research in this area should focus on optimizing the mix design parameters, such as the proportion of waste materials, to achieve the desired strength and durability requirements. Additionally, long-term performance monitoring of structures incorporating these waste materials should be conducted to assess their behaviour over time. Exploring the economic viability and environmental benefits of using these waste materials on a larger scale could also be valuable for promoting their widespread adoption in the construction industry.

III. RESULT:

A. *Compression Test of Concrete Cube*

The compressive strength test is the test to determine the compressive strength. This test consist of set of 3 cube of dimension 150X150X150 mm at the age of 7 and 28 days. Theoretically, it is desirable to obtain the target compressive strength at the end of 28 days by using following formula:-

Target compressive strength (Ft = fck + 1.65 * s)

where, Ft: target characteristic strength

Fck: characteristic strength of concrete mix s: standard deviation

for M30: Ft = 30 + 1.65 *5 = 38.25 MPa

Hence, the target strength for M30 is 38.25 MPa.

Compression test result of cube specimen of M20 mix performed on the compression testing machine after 7 days and 28 days is:- 25MPa and 37MPa respectively.

SLUMP test (14)

From the results, it is also found that workability of concrete is decreased due to higher water absorption. Whenever recycled aggregate is applied, water content is monitored carefully in concrete mix as water absorption is increased due to presence of porous mortar. The slump test is performed to measure the workability of the concrete mis designed.

Slump value obtain for M20 mix is 32mm which is slightly less because of water absorption is increased due to presence of porous mortar.

Full replacement of NCA with RCA requires about 10% increase, in mixing free water to achieve the same workability without using superplasticizer. Using of superplasticizer decreased w/b ratio by an average of 12% and 15% with or without silica fume respectively.

B. *Bulk Density and water Absorption*

From the result it is studies that there is a correlation between the water absorption of coarse aggregates and their density because the higher the absorption, the lower the density. The results observed for recycled coarse aggregates were 14.50%, 12.50%, 12.44%, and 12.10% for water absorption, while for the bulk density, it was 2.05 kg/dm^3, 2.18 kg/dm^3 , 2.21 kg/dm^3, and 2.28 kg/dm^3, respectively. For natural coarse aggregates, the water absorption was 2.30%, 1.98%, and 1.70%, while the bulk density was 2.69 kg/dm^3, 2.74 kg/dm^3, respectively.

The results also shows that concrete with absorption of 2.48%, 5.1%, 7.49%, 10.2%, and 12.5% water have a saturated surface dry density of 2.59 kg/dm^3, 2.35 kg/dm^3, and 2.08 kg/dm^3, respectively.

IV. CONCLUSION: -

The following conclusion are drawn from the studies are as following:

- It is found in the study that the workability of concrete decrease as the percentage of fly ash replacement increases, In order to maintain the proper workable concrete, chemical admixture required. For the proper workable concrete, chemical admixture required. For the proper compaction of concrete mechanical machine required at such a workability like slump value of 10mm in RAC20 mix.
- After observing the strength parameter of various mix proportion of concrete, which is composed of recycled aggregates with fly ash as the replacement of cement in the variation of 0%, 5%, 10%, 15%, 20% and compared them with the conventional concrete. In the comparison it is found that the strength of conventional aggregates without addition of fly ash i.e. CAC0, is maximum at the age of 28 days. But the strength of recycled aggregates concrete with fly ash is sufficient enough to use, the target strength is differ more or less as compare to target strength of M30 i.e. 38.25.
- After comparing the strength parameter of recycled aggregate concrete mix proportion of different variation of fly ash i.e. 0%, 5%, 10%, 15%, 20%, it is found that concrete mix with 15% replacement of fly ash i.e.

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