Replacement of Cement in Concrete by Fly Ash & Waste Brick Powder

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Abstract— This study explores the feasibility of utilizing waste brick powder (WBP) and fly ash as substitutes for cement in concrete, addressing growing environmental concerns and waste accumulation from demolition activities in India. Partial replacements of cement with 10%, 15%, and 12.5% fly ash, alongside 10%, 15%, and 12.5% WBP in M25 Grade concrete, are investigated over a 7-day curing period. Compressive strength is evaluated as the primary parameter, while specific gravity tests are conducted to analyze material properties. The study aims to assess the sustainability and cost-effectiveness of incorporating fly ash and WBP in concrete production. Results reveal the influence of varying fly ash and WBP proportions on concrete strength, with the optimized mix of 12.5% Fly Ash + 12.5% Waste Brick Powder demonstrating superior strength properties compared to conventional concrete. This blend demonstrates practical feasibility and potential for widespread adoption in construction applications. The study underscores the sustainable utilization of industrial by-products, aligning with eco-conscious construction practices and contributing to reduced carbon emissions. This research provides valuable insights for the construction industry in India, offering a solution to waste management challenges while enhancing the sustainability and cost-effectiveness of concrete production. It advocates for the integration of fly ash and WBP into cement mixes, facilitating a transition towards a more environmentally friendly and resilient construction sector.

Index Terms— Waste Brick Powder, Fly Ash, Compressive Strength Test, Strength.

I. INTRODUCTION

In India, there is a mass production of cement from which CO2 is emitted, which causes air pollution and effects the environment. It is very essential to reduce the use of cement as much as one can, as the world is heading towards sustainability and taking a step closer to reducing the carbon footprint. Aim is to examine the feasibility of using waste brick powder and fly ash in concrete as alternative to cement. The replacement of concrete is done. Fly ash, which is a natural Pozzolana, is a by-product of Coal and petroleum cokecombustio, which is generated from the thermal power plant. The utilization of brick dust is justified by its dual benefits: economic advantages and a reduction in overall cement consumption within concrete formulations. Empirical findings suggest that brick dust exhibits potential as a viable substitute for cement in concrete, as indicated by experimental results highlighting its efficacy in partial cement replacement. Fly ash and wasted brick powder are used as sustainable options in our research. Many researchers have conducted investigation to study behavior of cement in concrete as a replacing agent.

II. OBJECTIVE

To achieve the compressive strength of M-25-grade concrete by using sustainable materials.

The experiment points to utilizing fly ash and waste brick powder in a cost-effective manner in concrete.

Study the outturn of swapping in the replacement percent of fly ash and waste brick powder as a partial replacement of cement in concrete.

To determine the compressive strength and workability of the concrete mix over 7 days.

III. LITERATURE REVIEW

A. Rehan Arif [Published on 18 October 2021

The aim was to interrogate the feasibility of using waste brick powder successfully in concrete as a substitute of cement. According to the study it was found that 11 billion metric tons of concrete is produced annually. In which aggregate cover 70-75%,

water cover 15% & cementitious binder 10-15% of volume of the concrete. 1 ton of CO2 is emitted from the production of 1 ton of cement. The concrete prepared by 20% of replacement of cement by waste brick powder. The study reveal that the powder possesses pozzolanic character & can be used as substitute of cement in fine powder. The replacement level was chosen to 5% & 10% respectively. Various test was performed, the different tests were slump, density, compressive strength, flexural & splitting tensile strength, Schmidt hammer, ultra sonic pulse velocity test, microscope analysis. The round edge & smooth surface result in the increase in workability. the increase in compressive strength, flexure & splitting tensile strength indicate the improvement of the concrete quality. The rebound hammer & ultra sonic pulse velocity test enhance the quality of concrete. The observation indicated that the rich mixes provided lower value of bulk density & improved strength till 40% replacement. The waste brick powder possesses strong pozzolanic property & can be used in partial replacement of cement. The material used was waste brock powder having a density of 1250 kg/m^3 & specific gravity of 2.17, Ordinary Portland cement with grade c-53 was used, Sand, Coarse aggregate. The gradation test was performed on the sample of cement & brick powder. Sieve 200 was used for particle size distribution, which represent 0%,5%,10% partial substituent of cement with brick powder. The conclusion came out to be was that the addition of brick powder in concrete increase workability. the slump can increase as 30% by replacing 10% of OPC by waste brick powder. The total cost of cement can be saved by brick powder, by replacing 10% of cement by waste brick powder one bag out of 10 can be saved in concrete construction. The unit weight of concrete with brick powder (10% replacement) is reduced as much as 1.7% in fresh & 1% approx. in hardened state. 10% replacement increase compressive strength, tensile strength, flexure strength by 18% ,17%, 3.5% in fresh state & 10%, 24%, 12% in hardened state.

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[Published on 3 June 2019]

It has been come to light that fly ash may substitute cement in concrete industry. It may be mentioned here that fly ash amounting to 15% to 25% by mass has been used as cementitious material in concrete. The compressive strength of concrete was examined by replacing different proportions of cement with fly ash. The compressive strength of concrete was measured by 7, 28,60 days. The replacement was done for lower grade of concrete. The replacement level taken / chosen was 0%, 15%, 25%, 35%, 45%, 55% and 65%. The material used in the experiment was Ordinary Portland cement of grade 53 with specific gravity of 3.10 and compressive strength of 53Mpa. Fly ash obtained from thermal power station. Fine aggregate which is natural sand with maximum size of 4.75mm and with a specific gravity of 2.55. it is found that for all mix increased in compressive strength is not the same with passage optimum. The concrete grade taken was M25 N/mm^2, M35 N/mm^2, M50 N/mm^2. The compressive strength of concrete mix decreases with increase percent of fly ash. The optimum limit is 45% & more than that may not be safe for different concrete mix. There was steep increase in strength from 7 to 28 days indicative that early strength of concrete is reduced with increase in proportion of fly ash. Fly ash has an adverse effect on early strength of concrete.

CONCLUSION

The preliminary result of this indicates favorable prospective for utilizing waste brick powder and fly ash as partial replacements for cement in concrete production. The compressive strength results indicate improvements, while workability shows reactivity to replacement percentages. Further analysis of specific gravity and consistency will provide a comprehensive understanding of the feasibility, sustainability, and cost-effectiveness of this alternative approach.

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