International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Research on the Strength and Durability Characteristics of Concrete with Ternary Blend

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ABSTRACT

The research aims to meet the demands of sustainable construction by using a multi-blended cement system of OPC (Ordinary Portland Cement) and different mineral admixtures in concrete. In this study, a concrete mix of M20 grade with a water-binder ratio of 0.48 is used. Glass powder and sugarcane bagasse ash are utilized as partial replacements for cement.

Glass powder, being an inert material, is a potential recycling material that can otherwise occupy landfill space for a long time. Crushed glass waste can be effectively utilized in the infrastructure industry. On the other hand, sugarcane bagasse ash is a by-product of sugar factories. The study explores the replacement of cement by glass powder ranging from 30% to 0% in increments of 5% and bagasse ash with a range of replacement from 0% to 30% in increments of 5%.

Seven different combinations of concrete mixes are studied at two different ages of concrete, specifically 7 and 28 days. The compressive strength of concrete cubes for various percentages of replacement is investigated and compared with conventional concrete to determine the optimum mix ratio. Furthermore, the flexural strength of concrete for the optimum mix ratio is analyzed, and certain durability parameters are studied in the research.

Keywords: sugarcane bagasse ash, glass powder, compressive, flexural, durability.

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INTRODUCTION

Coarse and fine aggregate, commonly known as gravel and sand, are chemically inert materials that, when combined with cement and water, form concrete, a composite material used in various civil engineering projects, including railroads, airports, and defense installations. The ancient civilizations used clay as a binding agent, and later, lime and gypsum were mixed by the Egyptians, leading to lime being recognized as a primary building material. In 1824, Joseph Aspdin created Portland cement by burning and grinding clay and limestone.

The selection of aggregates is crucial as they are inert materials that can react with other concrete constituents. Aggregates smaller than 4.75mm are classified as fine aggregates, while those larger than 4.75mm are classified as coarse aggregate. Adequate water is required for the full hydration of concrete, and curing is a significant consideration during this process. The formation of the Calcium-Silicate-Hydrate gel, also known as C-S-H gel, occurs during the hydration process.

The process of concrete hydration occurs in three stages. The first stage takes approximately 6-7 hours and involves rapid strength development. In the second stage, the pace of strength development is faster than in the first stage. The third stage, which completes hydration, produces less heat and has a slower rate of strength development.

India ranks third in terms of E-Waste output, following the US and China, with 3.2 million tonnes of E-Waste production. Between 2017–18 and 2019–20, India's e-waste production increased by over 43%, resulting in an increase of more than one million tonnes in just three years, surpassing Supriyo's (2020) prediction of 0.7 million tonnes.

OBJECTIVE OF THEWORK

The main goal of this study is to investigate the structural behavior of concrete by partially replacing cement with sugarcane bagasse ash and glass powder. The experimental work involves evaluating the compressive strength of concrete with varying percentages of these materials and

determining the flexural strength of concrete for the optimum mix ratio. Additionally, various durability parameters will be studied as part of the research.

NEED OF THE STUDY

The use of admixtures for the replacement of cement is increased nowadays, due to the shortage in the supply of cement.

The use of admixtures helps to obtain durable high strength concrete with minimum cost.

The use of mineral admixtures not only extends technical advantages to the properties of concrete but also contributes to environmental pollution control.

Result:-

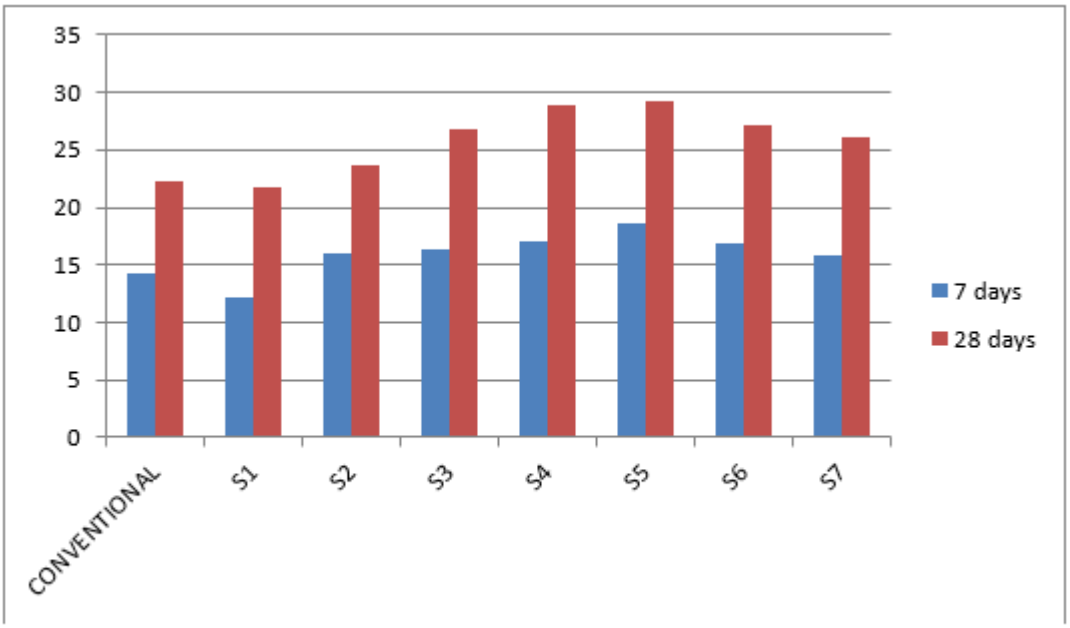

Fig.1 : Graphical representation for compressive strength

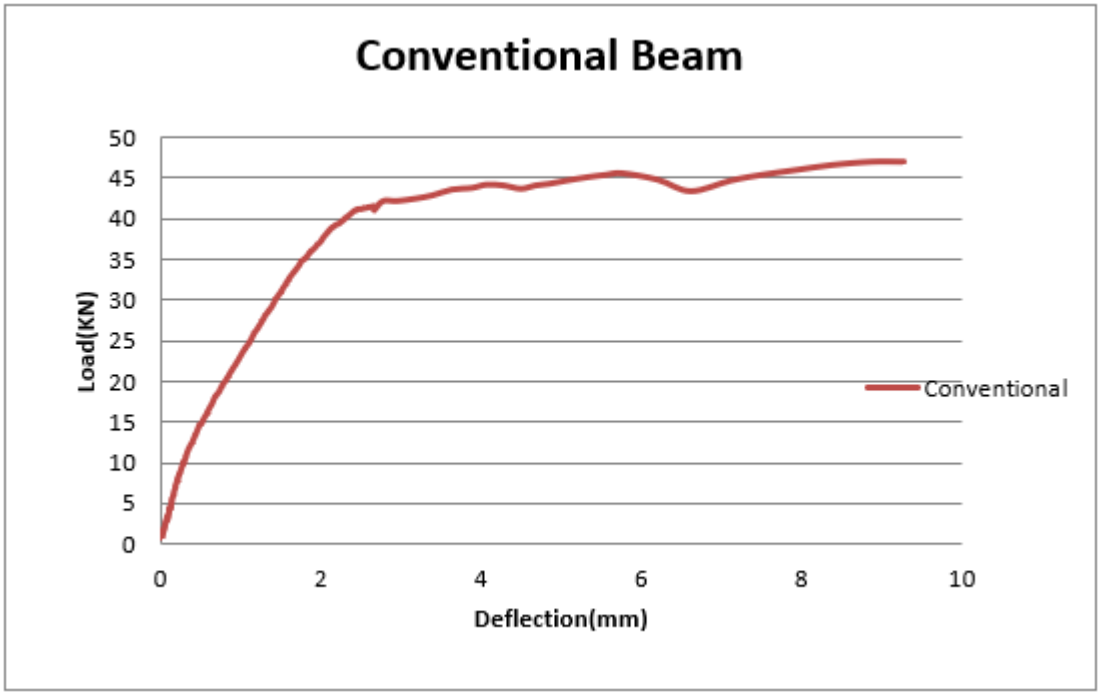

Fig.2 : Load vs Deflection curve (conventional)

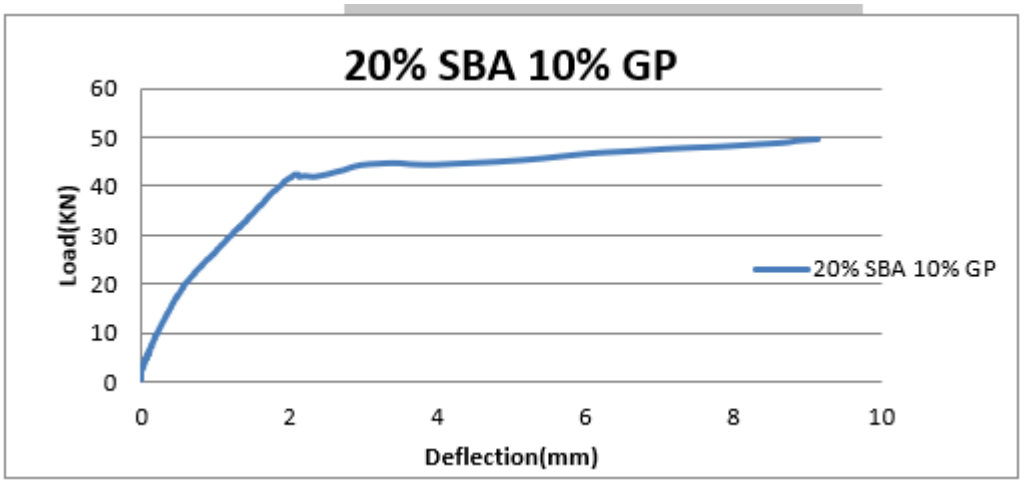

Fig.3: Load vs Deflection curve (20%SBA 10% GP)

Conclusion-

Based on the experimental results, the maximum mix ratio percentage was determined to be 25% for sugarcane bagasse ash and 10% for glass powder. In this research, 70% of the cement content was kept constant, and the remaining 30% was replaced with a range of 0% to 30% in increments of 5% for sugarcane bagasse ash, and for glass powder, the replacement ranged from 30% to 0% in increments of 5%. A total of seven different combinations of mix ratios were studied at ages of 7 days and 28 days.

The compressive strength was measured for all mix ratios and conventional concrete. Among the various mix ratios, the 20% sugarcane bagasse ash and 10% glass powder replacement showed the highest compressive strength, reaching 18.63 MPa at 7 days and 29.18 MPa at 28 days. This mix ratio exhibited a significant increase of 30.18% in compressive strength compared to the conventional concrete. The peak load for the conventional beam was 46.9 kN, while the maximum mix ratio achieved 49.6 kN.

Water absorption and Sorptivity test results revealed that the 20% sugarcane bagasse ash and 10% glass powder mix absorbed less water compared to the conventional mix ratio.

The research demonstrated that both sugarcane bagasse ash and glass powder, with their pozzolanic properties, contributed to the improvement of mechanical properties and durability of concrete without the need for additional chemicals or superplasticizers. Consequently, these waste materials can effectively enhance the durability and strength of concrete, thus contributing to sustainability in construction.

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