EVALUATING THE STRUCTURAL PERFORMANCE OF MASONRY WALL PANELS CONSTRUCTED WITH GLASS WASTE AGGREGATE BLOCKS

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The construction industry faces a significant challenge in the form of high costs associated with construction materials. As a means of addressing this challenge, the industry has explored various alternatives to reduce costs. One such effort includes the use of alternative or waste materials in construction. The adoption of waste materials in the construction industry offers a viable solution to natural resource depletion while providing an opportunity for proper solid waste management.

The construction industry relies heavily on the use of bricks and blocks, which require significant quantities of natural resources. As a result, considerable research has focused on the introduction of waste materials into the bricks and blocks manufacturing process, such as Glass Waste, waste tea, rice husk ash, crumb rubber, and cement kiln dust, as a substitute for sand. Among these materials, glass waste plays a particularly prominent role in increasing municipal solid waste.

According to current literature, the compressive strength of masonry units is dependent on the percentage of glass waste used, with peak strength observed at 20%-25% replacement. Beyond this threshold, subsidence becomes noticeable. The maximum replacement percentage that can be used without significantly reducing the compressive strength of general masonry units is 50%. However, it is essential to evaluate masonry strengths, rather than just masonry unit strengths, when designing walls within the framework of construction quality. This research aims to evaluate the compressive and flexural strength of wall panels cast from masonry units in which 50% of the fine aggregate has been replaced with glass waste. The study will compare the results obtained with that of the strength requirement specified in the BS EN 1996-1-1.

The compressive strength of GWAB is observed to be higher than that of CSB, as reported in the literature. However, experimental values indicate a significant reduction in compressive strength as compared to the values calculated from BS EN 1996-1-1. In light of this, $K_{GWAB} = 0.48$ factor has been defined for the design of wall panels according to equation 3.1 in BS EN 1996-1-1 using general-purpose mortar and GWAB. Furthermore, the equation 3.1 in BS EN 1996-1-1 can be redefined as follows with the K_{GWAB} factor. $f_k = K_{GWAB} K f_b^{\alpha} f_m^{\beta}$, definitions of other parameters in the equation defined in BS EN 1996-1-1. This factor is crucial for ensuring optimal performance and durability of the wall panels.

The characteristic flexural strength of GWAB wall panels perpendicular to the bed joint and parallel to the bed joint was compared with the theoretical and experimental values of CSB wall panels and graphically represented in the charts.

Keywords: Compressive strength of wall panels, Flexural strength of wall panels, Glass waste, Wall panel testing

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Evaluating the Structural Performance of Masonry Wall Panels constructed with Glass Waste Aggregate Blocks (GWAB)

Background

Strength properties and accordance to the design codes of masonry units which constructed using Glass Waste Aggregate Blocks were evaluated in the research

Objectives

Evaluating the compressive and flexural strength of wall panels constructed using Glass Waste Aggregate Blocks

Methodology

- Literature review
- Resource gathering and GWAB manufacturing



- Material testing
  - Sieve analysis test
  - Water absorption test
  - Compressive strength test for GWAB
- Casting the required number of wall panels using mix design in Table 2
  - 3 panels For compressive strength testing
  - 5 panels for flexural strength testing in directions of parallel to the bed joint
  - 5 panels for flexural strength testing in perpendicular to the bed joint
- GWAB wall panel testing
  - Compressive strength test
  - Flexural strength test in directions of parallel to the bed joint
  - Flexural strength test in directions of perpendicular to the bed joint
- Comparison of strength properties with reference material properties
  - Characteristic compressive strength
  - Characteristic flexural strength in directions of parallel to the bed joint
  - Characteristic flexural strength in directions of perpendicular to the bed joint

Summary of the strength properties of GWAB wall panels