

ECO-FRIENDLY HOLLOW MASONRY BLOCKS WITH WASTE GLASS AGGREGATE

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The construction industry heavily depends on natural resources such as river sand and gravel, resulting in the rapid depletion of these materials and severe environmental impacts. At the same time, increasing volumes of non-degradable waste, especially waste glass, have continued to accumulate in landfills due to limited recycling. Although many studies have been conducted to explore the use of waste glass in concrete, limited research has focused specifically on its use in hollow masonry blocks, which are commonly used for both structural and non-structural wall applications.

This study investigates the potential of partially replacing fine aggregates with crushed waste glass in the production of hollow masonry blocks. The aim was to assess whether waste glass could be used as a sustainable and effective alternative material while meeting required engineering standards. An optimum mix design, previously developed for solid masonry blocks using 25% waste glass as a fine aggregate replacement, was selected and applied to hollow blocks for evaluation.

A series of laboratory tests was conducted to examine the mechanical and durability performance of the developed blocks. These included compressive strength tests of individual blocks at 7, 21, and 28 days, water absorption and moisture content tests, bulk, dry, and wet density tests, and compressive strength testing of full-scale wall panels at 28 days. The stress-deflection behaviour of the wall panels was also analysed using dial gauge measurements.

The results showed that the compressive strength of the waste glass-based hollow blocks met the minimum requirements for both load-bearing and non-load-bearing applications, as specified in Sri Lanka Standards (SLS 855: Part 1). Water absorption and moisture content were significantly reduced compared to conventional blocks, indicating improved moisture resistance and enhanced durability. The density was found to be slightly higher, which may improve stability but could also affect handling. The wall panel tests confirmed that the blocks performed adequately under compression, showing ductile failure modes and acceptable stress-deflection responses.

In conclusion, the study demonstrates that waste glass can be effectively used in hollow masonry block production, offering both environmental benefits and acceptable structural performance. The findings support the potential use of waste glass in sustainable construction; however, further research is recommended to optimise the mix design for hollow blocks and to evaluate long-term performance under real environmental conditions.

Keywords: Waste glass aggregate, Hollow masonry blocks, Compressive strength, Durability, Sustainable construction

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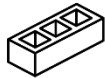
Problem

Depletion of natural sand
⇓
unsustainable mining & ecological damage

Glass waste accumulation
⇓
low recycling rates & landfill issues

Aim

Investigate the feasibility of developing eco-friendly hollow masonry blocks with **25% replacement** of fine aggregate with waste glass.

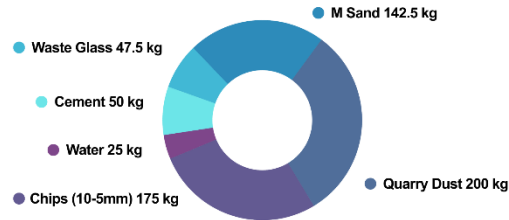


Conclusion

- Waste glass hollow blocks are **structurally reliable and durable**.
- Offer **dual environmental benefits** → reduce sand use + recycle waste glass.
- Suitable for **load and non-load-bearing applications**.

Methodology

Modified Mix Design



Process

Mixing » Casting » Curing » Testing

Tests Conducted

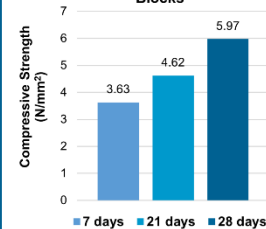
- Compressive strength on individual blocks (7, 21, 28 days)
- Water absorption & moisture content
- Density (bulk, dry, wet)
- Wall panel compressive strength & stress-deflection

Future Studies

- Optimize mix design** for better workability.
- Explore the **effect of different glass types and colors**.
- Study **long-term durability** (wet-dry cycles, exposure to chemicals, and thermal effects)
- Conduct **economic & life cycle assessment**.

Key Findings

Compressive Strength Test Results for WG Based Hollow Masonry Blocks

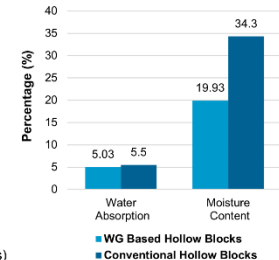


- Compressive strength** (28 days) → 5.97 N/mm² (blocks) and 4.33 N/mm² (wall panels)
- Satisfied SLS 855:1989 requirements which is 2.8 N/mm²

	Bulk density (kg/m³)	Dry density (kg/m³)	Wet density (kg/m³)
WG-Based Hollow Blocks	1478.99	1456.65	1542.65
Conventional Hollow Blocks	1452.94	1426.2	1504.17

- Stress vs. Deflection** graphs indicate,
 - Progressive cracking without sudden drops
 - Maintains strength despite internal damage

Comparison of Water Absorption and Moisture Content of Conventional and WG Based Hollow Masonry Blocks



- Water absorption & moisture content** → lower than conventional hollow masonry blocks
- Density** → Slightly higher than conventional hollow masonry blocks

Stress Vs Deflection Graph

