Abstract

This study investigates the effects of incorporating waste glass powder, ceramic waste, and fly ash as partial replacements for natural fine aggregate in mortar. The aim is to assess the feasibility of using these industrial and post-consumer by-products as sustainable alternatives in construction materials. Mortar specimens were prepared with 10%, 20%, and 30% replacement levels for each material, and their performance was compared with a conventional control mix.

Experimental evaluations focused on key properties including workability, compressive strength, bulk density, water absorption, and ultrasonic pulse velocity (UPV). Results indicated that the inclusion of glass powder and fly ash up to 30% enhanced the compressive strength and durability of mortar due to their pozzolanic activity and particle packing effect. In contrast, ceramic waste showed reduced mechanical performance at higher replacement levels, primarily due to its inert nature and porous structure. Workability was generally improved with glass powder and fly ash, while ceramic waste reduced workability due to its high water absorption.

Overall, the findings support the potential use of glass powder and fly ash as partial replacements for fine aggregate in mortar, contributing to environmental sustainability and resource conservation. Ceramic waste, although less effective in strength, can still be utilized in non-structural applications, especially when optimized with supplementary materials.