

Strength Characteristics Analysis of Autoclave Cellular Concrete Block (A.C.C.) with Quarry Dust as Fine Aggregate

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Concrete is the most widely used construction material today. The basic ingredients of conventional concrete are cement, sand and aggregate. Properties of aggregate affect the durability and performance of concrete. Therefore, fine aggregates are considered as an essential component of concrete. The most commonly used fine aggregate is sand derived from river banks. This can be expensive due to the excessive cost of transportation from natural sources, and creates environmental problems. The interest of the construction community in using waste or recycled materials in concrete is increasing because of the emphasis placed on the need of sustainable construction. As environmental, transportation and other constraints make the availability and use of river sand less attractive, a substitute or replacement product for concrete industry needs to be found. To reach this endeavor, one way is to go green by using sustainable materials that are non-toxic, reusable, renewable, and recyclable. Study the performance of A.C.C. with quarry dust as a fine aggregate. Landfills are commonly used for disposal of quarry dust in many parts of world. Rapid urbanization has made it increasingly difficult to find suitable landfill sites. The ability to use natural sand in concrete mix declines gradually. Replacing sand with quarry dust as fine aggregate in concrete mix would result in the low cost and eco-friendly construction without compromising strength and performance.

This research experiment was divided into three phases as follows. Phase I: Collect required ingredients of the autoclave cellular concrete (A.C.C.) for the experimental investigations. The primary raw materials required for the preparation of concrete include fine aggregate (river sand and quarry dust), course aggregate, mixing water and cement. Phase II: Determine and compare properties of fine aggregate and quarry dust including: specific gravity, shape, size, texture, density, color, occurrence, soundness, permeability, porosity & voids ratio, durability, modulus of elasticity, thickness, water absorption, binding capacity, organic impurities, strength, bulk density and grading by sieve analysis. Phase III: A.C.C. mix design was made for preparation of testing specimens as per the standard specifications. The process used river sand and quarry dust as fine aggregate. After the mix design proportion, the concrete is mixed under controlled condition using standard cast iron cubic molds with proper compaction through tamping or vibrators. These casted specimens are de-molded and kept for strength development (hydration), with proper curing. The cubes are tested for their variation in strength after the required curing. Obtained results were analyzed and prepared concrete cubes were tested as follows: 1. Finding workability by using following methods: slump test, compaction factor test, compressive strength, tensile strength. 2. Analysis of material characteristics of blocks: stress strain relationship, thermal conductivity, durability properties and functional properties. 3. The overall properties of both river sand and quarry dust as fine aggregate were then prepared, concluding whether fine aggregate and quarry dust had similar properties and roles in the A.C.C. blocks.
Physical and chemical properties of quarry fines and river sand are the same. It is expected that the full or partial replacement of river sand by quarry fines in autoclave cellular concrete gives maximum strength and durability.
The river sand usage as fine aggregates in concrete has increased the cost of construction in some parts of the world. This is due to dwindling natural resources coupled with supply and demands. The increase in the cost and restrictions imposed by the state governments on sand quarrying, as well as the concern to prevent further environmental degradation and ground water contamination. These problems have led to the search for alternative materials that are ecofriendly and inexpensive. Quarry dust, readily available and abundant from crusher units proved economical in many areas. This provides a viable alternative for conventional river sand. Crusher dust from quarries are considered a waste product and will have a positive outcome with the environmental impact if consumed by construction industry.

Keywords: Autoclave Cellular Concrete, Quarry Dust, Eco-friendly Construction, Environmental Impact