



Article Title: Experimental Study on the Performance of Concrete Structural Elements Using Calcined Clay and Basalt Aggregates

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ABSTRACT

The term ‘Sustainable’ environmentally means “green”. The deteriorating environment is driving the worldwide focus on sustainable development. It is to be noted that the largest impact on nature and environment is by the construction industry. Previously, the concern on environment formed a small part of construction development. We know that cement is the main constituent of concrete. Production of large quantity of cement results in increasing CO₂ emissions and the consequence being Greenhouse Effect. The purpose of this paper is to investigate the feasibility of using basalt aggregates in concrete mixes. Concrete is the most important engineering material and the addition or replacement of some of the materials may change the properties of the concrete. In recent years a lot of research been carried out in order to obtain more durable and long term performance of concrete structures in the dynamic environment. An experimental program is set up to test the effect of basalt aggregate content and its combinations with calcined clay with variation of percentages in concrete mixes. Different aggregate percentage combinations were used in this study for basalt and calcined clay respectively. The laboratory investigation included measurement of compressive strength, tensile strength and flexural strength. In addition the source aggregate properties were considered in this study: specific gravity and absorption for coarse aggregates and fine aggregate. The result of this investigation indicates a general improvement in mix properties with the introduction of basalt aggregates in the mix.

1 Introduction

Now a days concrete is widely used in various type of construction industries, because of high strength, durability, workability so that presently many structures are constructed by concrete. The materials used for normal conventional concrete cement, coarse aggregate, fine aggregate. Portland cement is an important building material which supports the concrete industry for infrastructural and residential development. Concrete is the second most widely consumed material after water. Research has shown that not only Portland cement is used to prepare durable concrete but also mixture between Portland cement and supplementary cementitious materials (SCMs) is possible. SCMs that have been used in concrete include pozzolanic materials such as fly ash, slag, silica fume, and metakaolin, calcined clay etc. Also environmental concerns the damage caused by extraction of raw materials and CO₂ emission during cement manufacture have brought about pressures to reduce cement consumption by the use of supplementary materials. Calcined clay consists basically of a pozzolanic



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properties. Coarse aggregates normally possesses more than 33% of the volume of cement. Concrete durability is one of the most important parameter while designing a new structure or assessing the condition of any existing structure. Basalt is that type of volcanic rocks, grey to black in color, contains less than 20% quartz, 10% feldspathoid and at least 65% of the feldspar of its volume. Basalt is considered an igneous rock with fine grains due to the rapid cooling of lava. The durability of concrete is increased by using Basalt as coarse aggregate. The other materials are available from the market. The strength of concrete can be increased by Calcined clay and basalt as coarse aggregate.

2 Literature Survey

Swati Jha, Prakhar Duggal and Chiku Agarwal “To Study the Durability Aspects of Concrete using Basalt Aggregate”. From this paper to analyze and study the durability aspects of concrete using Basalt Aggregate with that of convention concrete. The cubes were being tested for compressive strength, flexural strength, fire resistance and water permeability of concrete by using basalt as aggregate as per the mix design. The tests were carried out with 50%, 30% basalt as aggregate. Comparative analysis between concrete with normal aggregate and concrete with basalt aggregate was performed for durability aspects. There results showed considerable increase in compressive strength, flexural strength, fire resistance value and water permeability value with 50% and 30% basalt as aggregate. The study suggests that basalt aggregate is better in terms of mechanical properties and more economical alternative for aggregate in terms of durability as compared to normal aggregate. The intent of this project has been fulfilled with significant improvement of concrete properties in compression, tension and flexure.

P. Ramteja “Basalt Aggregate as Coarse Aggregate in High Strength Concrete Mixes”. The aim of this study the way toward selecting appropriate elements of concrete and deciding their relative sums with the goal of delivering a concrete of the required, quality, durability, and workability as monetarily as could reasonably be expected is termed the solid blend outline. The extent of this work is constrained to the improvement of an appropriate blend configuration to fulfill the necessities of workability and quality of the solid blend utilizing basalt aggregates as a coarse aggregate. To assess the workability of concrete blend utilizing basalt total as coarse total. To assess the quality of solidified cement utilizing basalt total as coarse total. The consequences of the compressive quality.

3 Calcined Clay

Calcined clay is an anhydrous aluminium silicate produced by heating ultra-fine natural kaol into high temperature in kiln. The calcinations process increases whiteness and hardness. usually 20-40% (by weight) of Portland cement replaced by calcined clay. Such a concrete exhibits favorable engineering properties.



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Figure 1: Analysis for the seven methods

Table 1: Chemical Composition of Calcined Clay

COMPOUND	PERCENTAGE
SiO ₂	59.7
Al ₂ O ₃	25.53
Fe ₂ O ₃	5.22
CaO	0.16
MgO	1.37
SO ₃	1.11
Na ₂ O+K ₂ O	2.41
Other minerals	4.5

4 Basalt Aggregate

Basaltic total might be quarried as an ordinary bed rock quarry (normally homogeneous rock type) or burrowed as rock from pits. Its arrangement can fluctuate both inside a quarry, apit and between pits. This influences the general



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Compressive Strength Comparison Chart

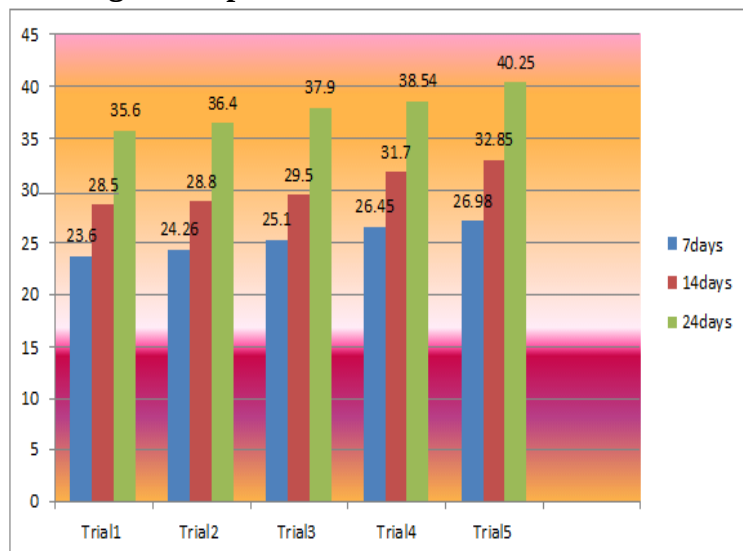


Figure 2: Comparison chart

Compressive Strength Comparison Graph

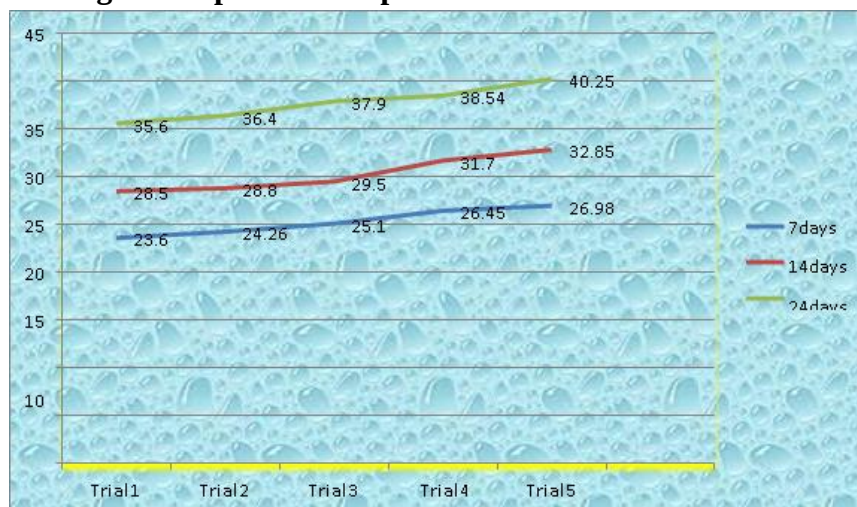


Figure 2: Comparison graph

Split Tensile Strength Test For M35 Concrete

Table 2: Split tensile strength of concrete

Sl.no	Split tensile strength	7 days N/mm ²	14 days N/mm ²	28 days N/mm ²
1.	Trial1	2.95	3.56	4.32
	Trial2			



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2.		3.09	3.69	4.61
3.	Trial3	3.23	3.73	4.67
4.	Trial4	3.36	4.10	4.85
5.	Trial5	3.52	4.59	5.20

Split Tensile Strength Comparison Bar chart

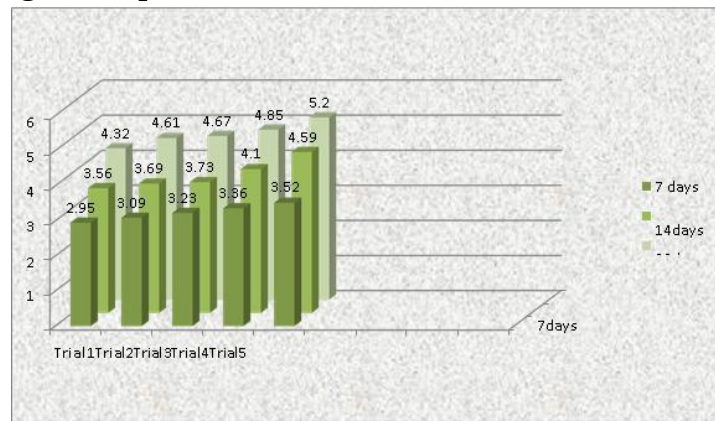


Figure 3: Split Tensile Strength Compression Bar Chart

Split Tensile Strength Compression Graph



Figure 4: Split Tensile Strength Compression graph



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Flexural Strength Test Form 35 concrete Beam

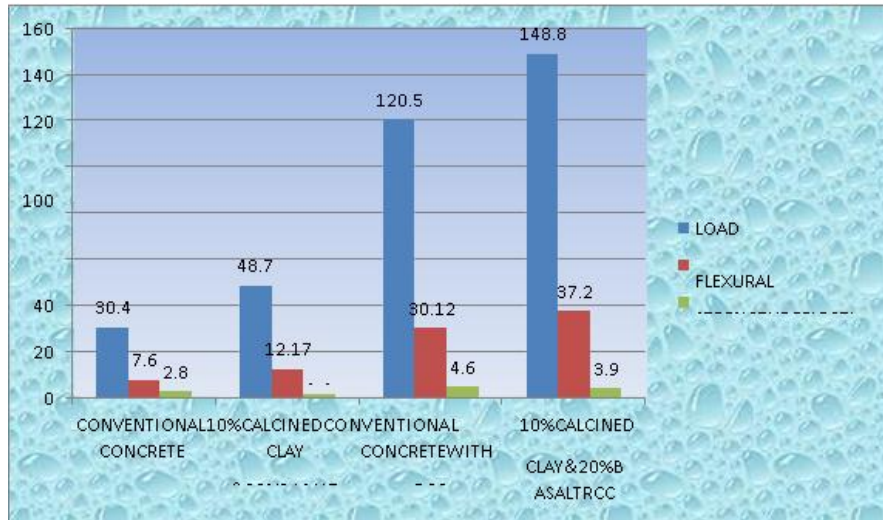


Figure 4: Flexural strength compression bar chart

Flexural Strength Test Form 35 concrete Beam

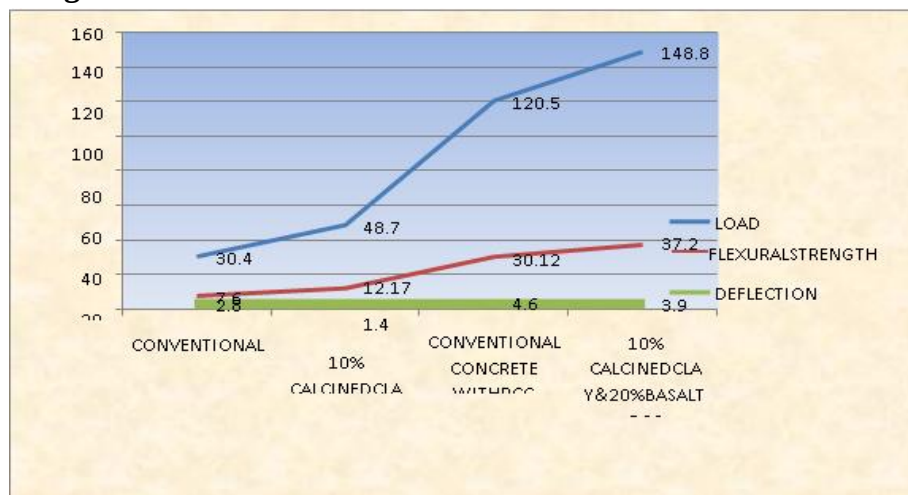


Figure 5: Flexural strength compression bar chart

5 Conclusion

From the experimental study the partial replacement of calcined clay for cement and Basalt for coarse aggregate is mixed with the concrete to compare the strength. Thus the experimental investigation the strength is determined by various test like compressive strength, split tensile strength, flexural strength test. The specimens are casted and the result is obtained. Here 20% replacement of basalt for coarse aggregate and 10% of Calcined clay for cement gives higher strength, when compared with other percentage. Since, they are naturally occurring material their will be nohazardness to the environment.



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