A STUDY ON BASALT AGGREGATE AS COARSE AGGREGATE IN HIGH STRENGTH MIXES

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Abstract *Concrete technology has been changing rapidly and constantly since its discovery. The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete Of the required, strength, durability, and workability as economically as possible, is termed the concrete mix design. The scope of this work is limited to the development of a suitable mix design to satisfy the requirements of workability and strength of the concrete mix using basalt aggregate as a coarse aggregate. To evaluate the workability of concrete mixes using basalt aggregate as coarse aggregate. To evaluate the strength of hardened concrete using basalt aggregate as coarse aggregate*

The results of the compressive strength tests will be conducted on the trial mixes containing 0%,25%, 50%,75% and 100% basalt, respectively. The compressive strength will be tested as the percentage of basalt content in the mix is increased. Five mixes were prepared; namely 0% basalt (as a control mix), 25% basalt, 50% basalt, 75% basalt and 100% basalt for each set of design mix. The composition of each mix was 60% coarse aggregate of 20 mm size and 40%coarse aggregate of 10mm size. Fine aggregate confines to zone-I.

1. INTRODUCTION

Concrete is the most commonly used material in various types of construction, from the flooring of a hut to a multi storied high rise structure from pathway to an airport runway, from an underground tunnel and deep sea platform to high-rise chimneys and TV Towers. In the last millennium concrete has demanding requirements both in terms of technical performance and economy while greatly varying from architectural masterpieces to the simplest of utilities. It is difficult to point out another material of construction which is as versatile as concrete.

Concrete is one of the versatile heterogeneous materials, civil engineering has ever known. With the advent of concrete civil engineering has touched highest peak of technology. Concrete is a material with which any shape can be cast and with any strength. It is the material of choice where strength, performance, durability, impermeability, fire resistance and abrasion resistance are required. It is well recognized that coarse aggregate plays an important role in concrete.

Coarse aggregate typically occupies over one-third of the volume of concrete, and research indicates that changes in coarse aggregate can change the strength and fracture properties of concrete. To predict the behavior of concrete under general loading requires an understanding of the effects of aggregate type, aggregate size, and aggregate content. This understanding can only be gained through extensive testing and observation.

Some research (Strange and Bryant 1979, Nallathambi, Karihaloo, and Heaton 1984) has shown that there is an increase in fracture toughness with an increase in aggregate size. However, Gettu and Shah (1994) have stated that, in some high-strength concretes where the coarse aggregates rupture during fracture, size is not expected to influence the fracture\2parameters.Tests by Zhou, Barr, and Lydon (1995) show that compressive strength increases with an increase in coarse aggregate size. However, most other studiesdisagree. Walker and Bloem (1960) and Bloem and Gaynor (1963) concluded that an increase in aggregate size results in a decrease in the compressive strength of concrete. Cook (1989) showed that, for compressive strengths in excess of 69MPa (10,000 psi),smaller sized coarse aggregate produces higher strengths for a given water-cement ratio. In fact, it is generally agreed that, although larger coarse aggregates can be used to make high-strength concrete, it is easier to do so with coarse aggregates below 12.5 mm *(Y,* in.) (ACI 363-95).There has not been much research on the effects of coarse aggregate content on the fracture energy of concrete.

Literature studies

Asi et al. 2009, studied the use of basalt in asphalt concrete mixes. Their study focused on skid resistance and stripping and how to reduce them using the optimum replacement percentage of the limestone aggregate by basalt. The Marshall Mix design was used to prepare the asphalt mixes. These mixes were evaluated using Marshals stability, indirect tensile strength, stripping resistance, resilient modulus, creep, fatigue, and permanent deformation.

Masad et al. 2003 was evaluated the aggregate characteristics affecting HMA concrete performance. The study assessed the HMA sensitivity to aggregate shape characteristics. Aggregate shape was characterized through detailed measurements of angularity, form, and texture using the Aggregate Imaging System (AIMS). The shape characteristics were presented in terms of the distribution of the property in an aggregate sample rather than an average index of this property.

Materials and methods

Cement

The Locally available cement like Bharathi Ordinary Portland Cement (OPC) of 53 grade of Cement Brand conforming to ISI standards has been procured and various tests have been carried out according IS 8112-1989.

Fine aggregates

The locally available natural river sand is procured and is found to be conformed to grading zone-II.

Coarse aggregates (Granite)

The Machine Crushed granite aggregate confirming to IS 383-1970 consisting 20 mm maximum size of aggregate has been obtained from the near or local quarry.

Basalt aggregate

Basalt is a hard, dense volcanic igneous rock that can be found in most countries across the globe. For many years, basalt has been used in casting processes to make tiles and slabs for architectural applications. Additionally, cast basalt liners for steel tubing exhibit very high abrasion resistance in industrial applications. In crushed form, basalt also finds use as aggregate in concrete. Crushed basalt aggregates are dense fine-grained rocks that are of very dark color- green or black and are formed when molten lava from deep in the earth's crust rises up and solidifies. Slightly coarser old sheets of basalt, now partially altered but still dark in color, are extensively quarried, crushed and sold as "trap rock.

Water

Potable water has been used in this experimental program for mixing and curing. Water should be free from acids, oils, alkalis, vegetables or other organic Impurities. Soft waters also produce weaker concrete. Water has two functions in a concrete mix.

Mix Design for M50 Grade of Concrete

Grade Designation	M50
Type of Cement	OPC 43 Grade
Maximum Nominal size of Aggregate	20 mm
Minimum content of Cement	430 Kg/m^3
Maximum Water Cement ratio	0.35
Specific Gravity of Cement	3.15
Specific Gravity of Coarse Aggregate	2.61
Specific Gravity of Fine Aggregate	2.66

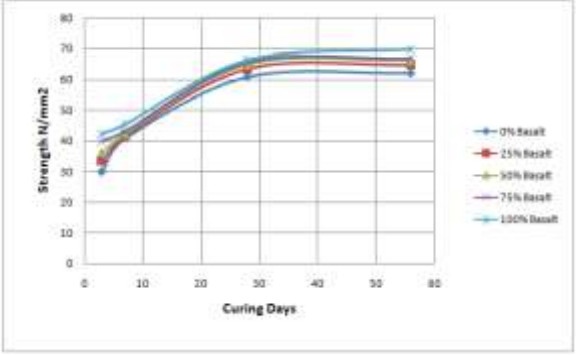
Mix Design for M60 Grade of Concrete

Grade Designation	M60
Type of Cement	OPC 53 Grade
Maximum Nominal size of Aggregate	20 mm
Minimum content of Cement	450 Kg/m^3
Maximum Water Cement ratio	0.30

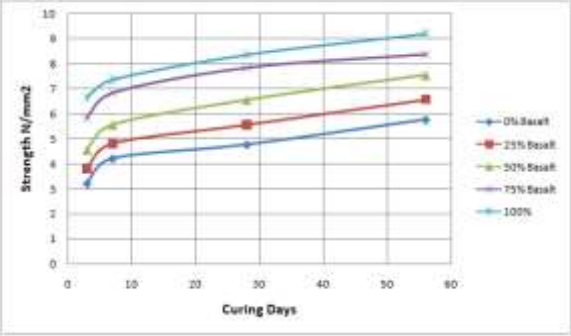
Specific Gravity of Cement	3.15
Specific Gravity of Coarse Aggregate	2.61
Specific Gravity of Fine Aggregate	2.66

RESULTS AND ANALYSIS

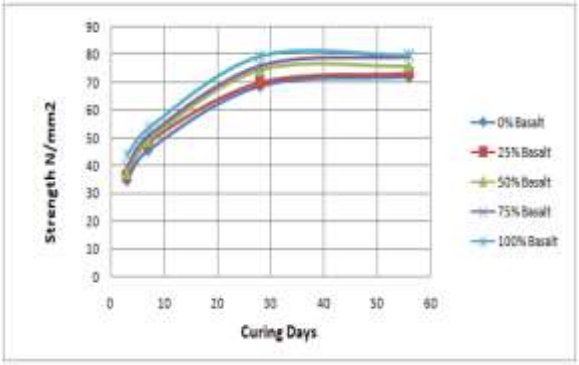
Compressive strength (M50 grade)



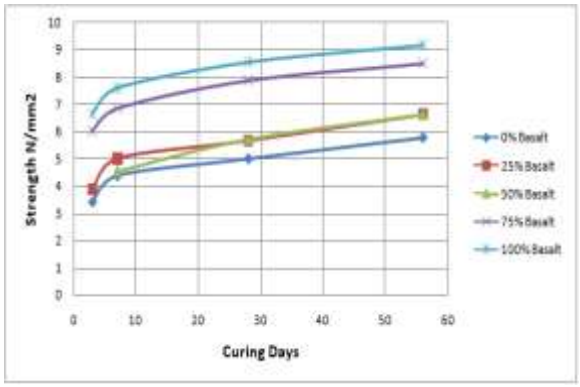
Split tensile strength (M50 grade)



Compressive strength (M60 grade)



Split tensile strength (M60 grade)



CONCLUSIONS

1. While using the basalt in concrete the original water cement ratio of concrete mix is to be corrected by the amount of water available in basalt aggregate.
2. The laboratory test results in compressive strength, seems to indicate that the increase in basalt percentage enhances the mix strength. This is due to the factthat basalt is denser and more durable and less water absorbing than limestone. Also higher workability is obtained for more basalt aggregate content mix which reduces the cost of labor.
3. As basalt aggregate is a natural aggregate also available in plenty at low cost, an economical and relatively high strength concrete is obtained by using basalt aggregate as coarse aggregate in concrete mixes.
4. Coarse aggregate replacement with 25% basalt to increase in Compressive Strength, Split Tensile Strength
5. For M50 Grade with basalt 25%, 50% 75%, 100% the percentage increase in Compressive Strength, Split Tensile Strength are 25.21%,10.5%.
6. For M60 Grade with basalt aggregate25%, 50% 75%, 100% the percentage increase in Compressive Strength, Split Tensile Strength are 6.46%, 4.62 % respectively.
7. There is an increase in Compressive Strength of Cylinders for M50 & M60 with basalt100% is 27.12 % and 24.91 % respectively higher than Conventional Concrete

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