

EXPERIMENTAL STUDY ON REPLACEMENT OF COARSE AGGREGATE BY BASALT AGGREGATE AND LIME STONE

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ABSTRACT

The purpose of this research is to investigate the feasibility of using basalt aggregates in concrete mixes. An elaborate experimental program that included a variation of basalt percentages in concrete mixes. The laboratory investigation included measurements of compressive strength, indirect tensile strength, flexural strength, thermal conductivity, permeability, shear strength and modulus of rupture. A conventional limestone mix was used as a control mix. The results of this investigation indicate a general improvement in mix properties with the introduction of basalt aggregates in the mix.

INTRODUCTION

Construction companies are using natural resources from long decades as raw materials directly. Due to the continuous usage of natural resources such as Coarse Aggregate, the demand increased inevitably regardless of usage. Coarse Aggregate, which is one of the constituents, has become highly expensive and also scarce. It is an attempt to study the effect of replacement of Coarse aggregates by basalt Aggregates and Limestone Aggregates on cement concrete.

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. In crushed form, basalt also finds use as aggregate in concrete.

The basalt aggregates are higher in specific gravity, and lower in absorption and

abrasion loss values. Based on this comparison, it is clearly obvious that basalt is likely to be suitable for use in concrete mixes and this research will investigate this matter.

Objective

1. The preliminary objective of the project is to find out the impact strength, water absorption test, specific gravity test.
2. To find out Mix Design for M20 Concrete.
3. The main objective of the project is to find out the compression test of concrete cubes, which is with the replacement of normal coarse aggregate as basalt & limestone aggregate of 10%, 20%, 30%, 40%, 50% & 60%

Scope of Study

- To provide a most economical concrete.
- It should be easily adopted in field
- To reduce the cost of the construction.
- To promote the low cost housing to the E.W.S group people.

METHODOLOGY

Materials Used in Concrete

- Cement.
- Fine aggregate
- Water
- Coarse aggregate
 - Basalt
 - Lime stone

- Preliminary tests for concrete such as impact test and water absorption test for aggregate, specific gravity test for sand and fineness for cement are tested at the beginning of the project.
- Making the concrete cubes by replacing the coarse aggregate as basalt & limestone aggregate (12.5mm to 20mm sieve) in M₂₀ grade .
- Cube samples are prepared in the way of different trial aggregates:
 - 90% limestone + 10% basalt
 - 80% limestone + 20% basalt
 - 70% limestone + 30% basalt
 - 60% limestone + 40% basalt
 - 50% limestone + 50% basalt
 - 40% limestone + 60% basalt

Table-1: Estimated Quantities of Materials Per Cubic Meter of M₂₀

Sl. no	Materials	Quantities In Kg/m ³	Proportion
1	Cement	383	1
2	Fine aggregate	614.01	1.574
3	Coarse aggregate	1241.75	3.242
4	Water	191.6	0.5

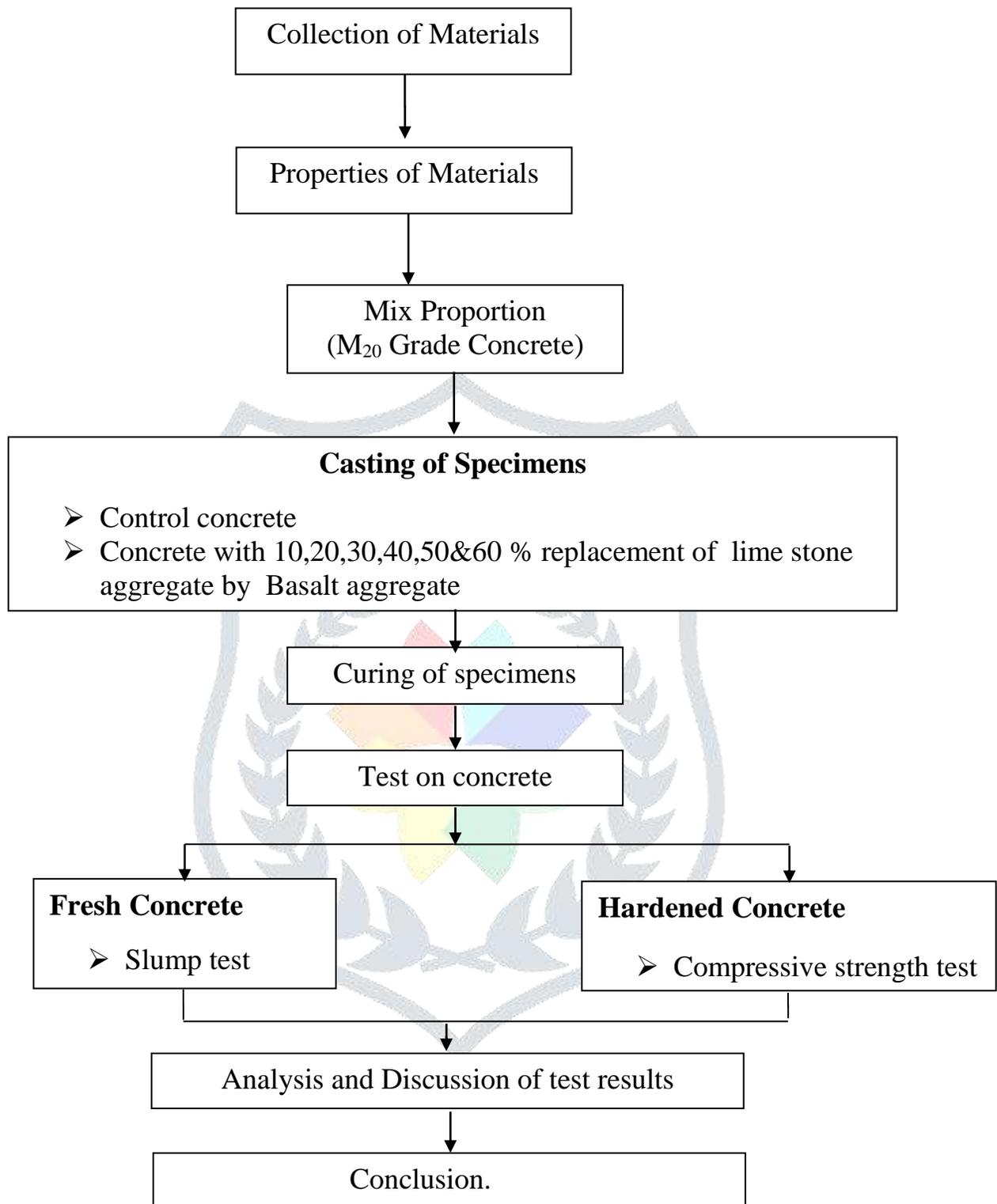
Coarse Aggregate

M20 mix, the sieve sizes 12 – 20 mm. The physical properties were tested.

These are chemically inert, solid bodies held together by the cement. Aggregates come in various shapes, sizes, and materials ranging from fine particles of sand to large, coarse rocks. Because cement is the most expensive gradient in making concrete, it is desirable to minimize the amount of cement to use. 70 to 80% of the volume of concrete is aggregate keeping the cost of the concrete low. The selection of an aggregate is determined, in part, by the desired characteristics of the concrete.

Although some variation in aggregate properties is expected, characteristics that are considered when selecting aggregate include:

- Grading
- Durability
- Particle shape and surface texture
- Abrasion and skid resistance
- Unit weights and voids
- Absorption and surface moisture

Figure 1: Methodology of Study

Testing Results

Table-2: Compressive Strength of Basalt Concrete Cube for 7 Days Curing In M₂₀ Grade

S.No	% of Basalt	% of Limestone	Load (kn)	Compressive Strength (n/mm ²)
1.	10	90	222.45	9.886667
2.	20	80	259.05	11.51333
3.	30	70	284.55	12.64667
4.	40	60	321.225	14.27667
5.	50	50	369.15	16.40667
6.	60	40	434.625	19.31667

Basalt Aggregate Average Compressive Strength for 7 Days Curing In M₂₀ Grade

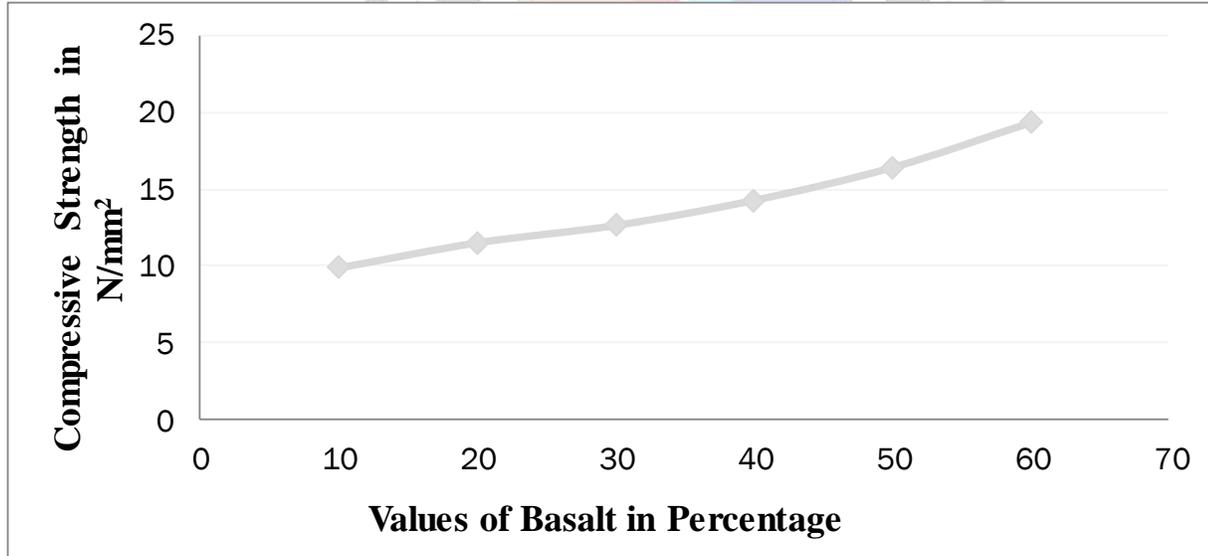


Table-3:Compressive Strength of Basalt Concrete Cube for 14 Days Curing In M₂₀ Grade

S.No	% of Basalt	% of Limestone	Load (kn)	Compressive Strength (n/mm ²)
1.	10	90	227	10.13
2.	20	80	285	12.68
3.	30	70	356	15.85
4.	40	60	413	18.39
5.	50	50	456	20.28
6.	60	40	524	23.21

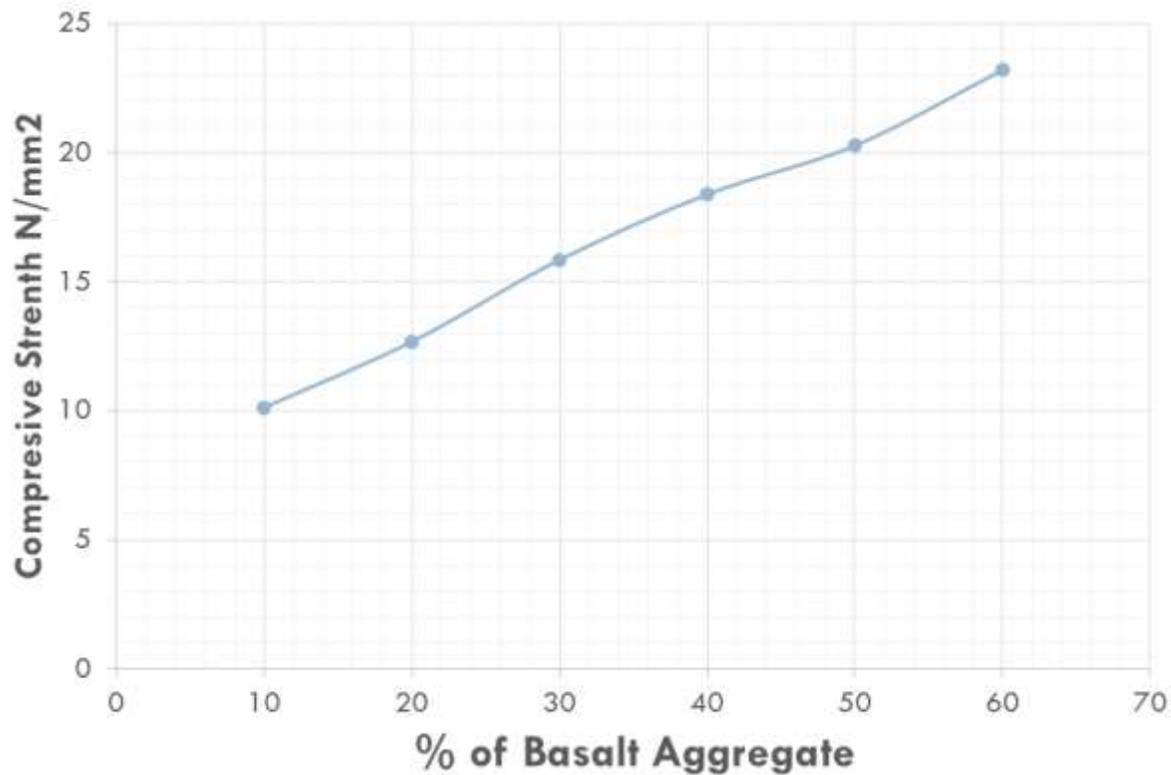
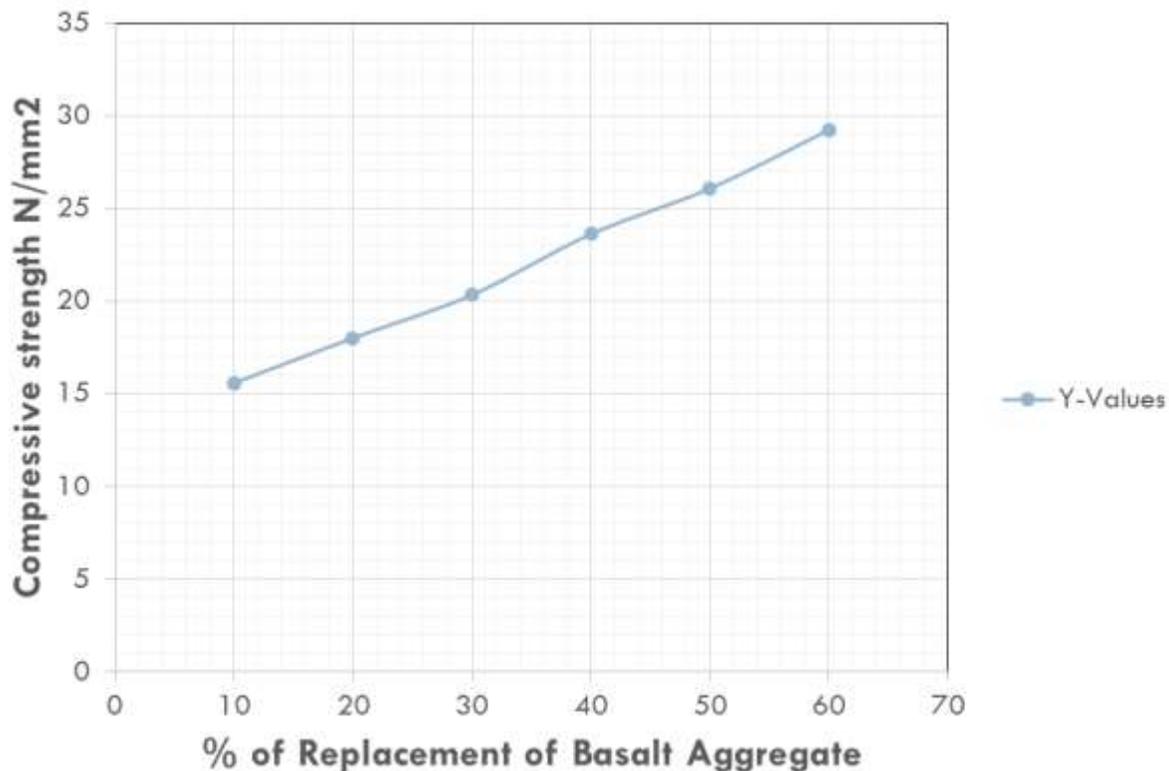
Basalt Aggregate Average Compressive Strength for 14 Days Curing In M₂₀ Grade

Table-4:Compressive Strength of Basalt Concrete Cube for 28 Days Curing In M₂₀ Grade

S.No	% of Basalt	% of Limestone	Load (kn)	Compressive Strength (n/mm ²)
1.	10	90	350	15.58
2.	20	80	405	18.01
3.	30	70	457	20.34
4.	40	60	531	23.62
5.	50	50	586	26.08
6.	60	40	657	29.24

Basalt Aggregate Average Compressive Strength for 28 Days Curing In M₂₀ Grade



RECOMMENDATIONS FOR FURTHER RESEARCH

In future, the research incorporates the performance based observations on existing elements of structures containing basalt

aggregates. This can be done in a manner similar to that of this research. Also, it is observed that the deflection behavior in the laboratory testing of shear failure and flexural strength seems to

indicate minimum deflection values occurring for mixes with less than 50% basalt content.

REFERENCES

1. Al-Baijat, H.M.O. 1993, Lightweight Concrete Structure Using Perlite and Pumice. Master Thesis, University of Jordan, Amman, Jordan.
2. Al-Dalou, A., Al-Sbaie, I. and Mahmud, S. 1997 Geochemical Prospecting for Minerals for Basalt and Dolorite Dyke, Along El-Qwaira-Mudawwara Area. NRA.
3. Alfred, T.A. 2002, Citing Online Sources: Basalt [online]. Available from Access Science@McGraw-Hill, <http://www.accessscience.com>, DOI 10.1036/1097-8542.073600, [cited 20 March 2006].
4. Al-Shweily, H. 2002. Effect of Bituminous Mixtures Stripping on Creep Behavior, Master Thesis, Jordan University for Science and Technology, Irbid, Jordan.
5. Asi, I.M. 2005. Evaluating Skid Resistance of Different Asphalt Concrete Mixes. *Building and Environment Journal*, Scotland, Scheduled for Publication.
6. Boom, G. Van Den and Suwvan, O. 1966 Report on the Geological and Petrological Studies of the Plateau Basalt in NE Jordan. Hannover, Bundes. F. Boden. Rep., 42p.
7. Buchanan, M. 2000. Evaluation of the Effect of Flat and Elongated Particles on the Performance of Hot Mix Asphalt Mixtures. National Center for Asphalt Technology, Report No. 2000-03, Auburn University, Alabama.
8. Cominsky, R., Huber, G., Kennedy, T. and Anderson, M. 1994. *The Superpave Mix Design Manual for New Construction and Overlay*, National Research Council, Report No. SHRP-A-407, Washington, D.C.
9. Ibrahim, K., Rabba, I. and Tarawneh, K. 2001. Geological and Mineral Occurrences Map of the Northeastern Badia Region, Jordan, The Higher Council for Science and Technology and Natural Resources Authority, Jordan.
10. P. D. Kumbhar and P. B. Murnal ,A New Mix Design Method For High Performance Concrete Under Tropical Concrete, ,Asian Journal of Civil Engineering (BHRC) Vol. 15, No. 3 (2014).