Partially Replacement of Aggregate in Concrete with Granite

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Abstract—This research aims to investigate the effects of partially replacing traditional coarse aggregate with granite in concrete mixes. The study will explore the influence of varying replacement percentages on concrete properties, including compressive strength, flexural strength, durability, and workability. In developing countries where concrete is widely used, the high and steadily increasing cost of concrete has made construction very expensive. This coupled with deleterious effect of concrete production on the environment has led to s tudies on various materials which could be used as partial replacement for coarseaggregate. This project is experimented to reduce the cost of concrete. The only way to reduce and tackle these problems is reuse and recycles.

The water cement ratio is maintained for this mix design is 0.45. The granite wastes were properly cut down to the size of coarse aggregate and then they were mixed with the concrete in 10%, 20%, 40%, 60%,80%. Cubes were casted with these concrete mixes and subjected to curing of 7 days, 28 days and their strength is determined. Thedetermined compressive strength was compared with the conventional concretecube's stre ngth. Of the above percentage mixes, the perfect percentage mix of granite withcoarse aggregateis found and can be brought to use.

Keywords: coarse aggregate, granitewaste, partial replacement, compressive strength, durability,workability, sustainability.

I. INTRODUCTION

Concrete is one of the most widely used construction materials globally, with coarse aggregate being a crucial component in its composition. However, the depletion of natural resources and environmental concern s associated with traditional coarse aggregates have led to the exploration of alternative materials. Granite, areadily available natural resource, presents itself as a potential substitute for traditional coarse aggregate du e to its mechanical properties and aesthetic appeal. Stone-like material that has many uses. Often additives like pozzolans and superplasticizers are included into the mixture to improve the physical properties of wet mix or the finished material. Most concrete is poured withreinforcing material such as rebar embedded to provide tensile strength, yielding reinforced concrete. Today, large concrete structures like dams and multi-store buildings are usually madewith reinforced concrete. There are many types of concrete available, created by varying the proportionsof main ingredients. The cement concrete has attained the status of major buil ding material in all branchesof modern construction.

The granite stone industries in India produces vast amount of by-product rock waste and as a result, many residential and agricultural areas are settled over the landfills whic h are basically composed of these wastematerials. As the physical and chemical properties of granite are suit able, the by-product rock wastes couldbe used for the preparation of concrete as a partial replacement for fine or coarse aggregates. The aim of this project is to explore the feasibility and effectiveness of utilization granite waste, a by- product of granite stone industries in India, as a partial replacement of traditional aggregate in concrete pro duction.

II. EXPERIMENTAL SETUP

In this stage collection of materials required and data required for the mix design are obtained by sieve an alysis and specific gravity. Sieve analysis is carried out from various fine aggregate (FA) and coarse aggreg ate (CA) samples and the samples which suits the requirement is selected. Specific gravity tests arec arried o ut for fine and coarse aggregate. The various materials used were tested as per Indian standard specification.

III. MATERIALS

Raw materials required for the concreting operations of present work are cement, fine aggregate, coarseaggregate, granite waste and water.

IV. CEMENT

Cement is used as binding material in the concrete where the strength and durability re significant important. The ordinary

Portland cement of 53 grades conforming to IS: 12269-1987 is usedto manufacturethe concrete. Also some tests were conducted such as consistency test, setting ti me test, specific gravity test. The choice of the cement content depends on the strength requirements, expos ure class for durability and the minimum amount of fines requires in the mix. The cement used for this study is ordinary Portlandcement.

V. AGGREGATE

Aggregate are the important constituent in the concrete reduces shrinkage and economy. These are the chemically inert material which form the bulk of the cement concrete. Theses aggregate are bound together by means of cement. These aggregates are classified into two categories as coarse aggregate and fine aggregate

V.I. FINE AGGREGATE

It consists of small angular or grounded grains of silica (SiO_2) and is formed by decomposition of sand st one under the effect weathering agencies. The size which is less than 4.75mm is called as fine aggregate.Riv er sand is used as fine aggregate conforming to the requirements of IS 383. Before using that, it can beprope rly cleaned by sieving and washing to eliminate the impurities.

V.II. COARSE AGGREGATE

Coarse aggregate may be in the form of irregular broken stones or naturally occurring rounded gravel. M aterials which are large to be retained on 4.75mm sieve size called as coarse aggregate. It acts as a mainfiller, and forms the main bulk of concrete. Of which the materials adhere in the form of film. Aggregates balance the shrinkage and volume changes of concrete conforming to IS: 383 are used.

Property	Fine a ggregate	Coarse aggregate
Fineness modulus	2.345	2.93
Specific gravity	2.71	2.66
Moisture content (%)	42.38%	4.6%

Physical properties of fine aggregate and coarse aggregate

VI. WATER

Water plays an important role in mixing, laying, and compaction, setting and hardening of concrete. When partial replacement of coarse aggregate with granite is carried out, it's important to ensure that thewater is used in the concrete mix meets the required quality standard. Any impurities in the water can potentially inter act with granite aggregate and affect the overall performance of concrete.

VII. GRANITE WASTE

In granite quarries, the granites were dig until the quality granite stones were obtained. The former granitedi g were wastes and hence they were piled and put up. Due to piling of such granite wastes more lands wereacquired. These heaped granites are called granite wastes. In this project these granite wastes were crushedand us ed in the place of 20mm coarse aggregate. Granite are indeed light plutonic igneous rocks, composed mainly quartz, feldspar, and mica. Granite can beused as a partial replacement for coarse aggregate in concrete mixes. This substitution can offer various benefits,includingincreasedstrength,du rability, andresistance to weathering.

Fig 1 - Granite waste

VIII. DESIGN MIX PROPORTIONS

The concrete is designed for M20 grade by using the procedure as per Indian standard (IS10262:2009).

a) Standard Proportion of M**20** grade of concrete. **(1:1.5:3)**

b) Maximum nominal size of aggregate- **20mm**

c) Type of cement- **PPC 53 grade**

d) Specific gravity of cement- **3.1**

e) Fine Aggregate (specific gravity)- **2.71**

f) Moisture content of course aggregate- **4.6%**

g) Specific gravity of fine aggregate- **2.71**

h) Water absorption of fine aggregate- **42.38%**

i) **Quantity for cubes-**Size of Cube-150x150x150mm

j) **No of cubes – 15**

Fig2-Casting of cubes

IX. EXPERIMENTAL METHODOLOGY

The evaluation and replacement of granite waste for coarse aggregate are done by using concrete testing.150mm*150mm*150mm are casted for each percentage of replaced concrete and normal concrete. The cubes are prepared in the proportions of 1:1.5:3 and the water cement ratio of 0.5. After 24 hours the cu bes are remoulded and they are cured in the curing tank for 7, 14 and 28 days. Totally three set of cubesare p repared for each proportion of replacement. First set is taken for compressive test after 7, 14 days curing andsecond set is for 28 days curing.

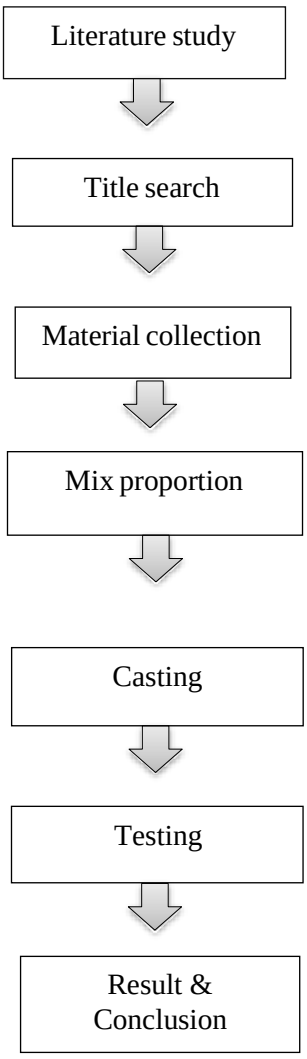


Fig4- Compressive testing machine

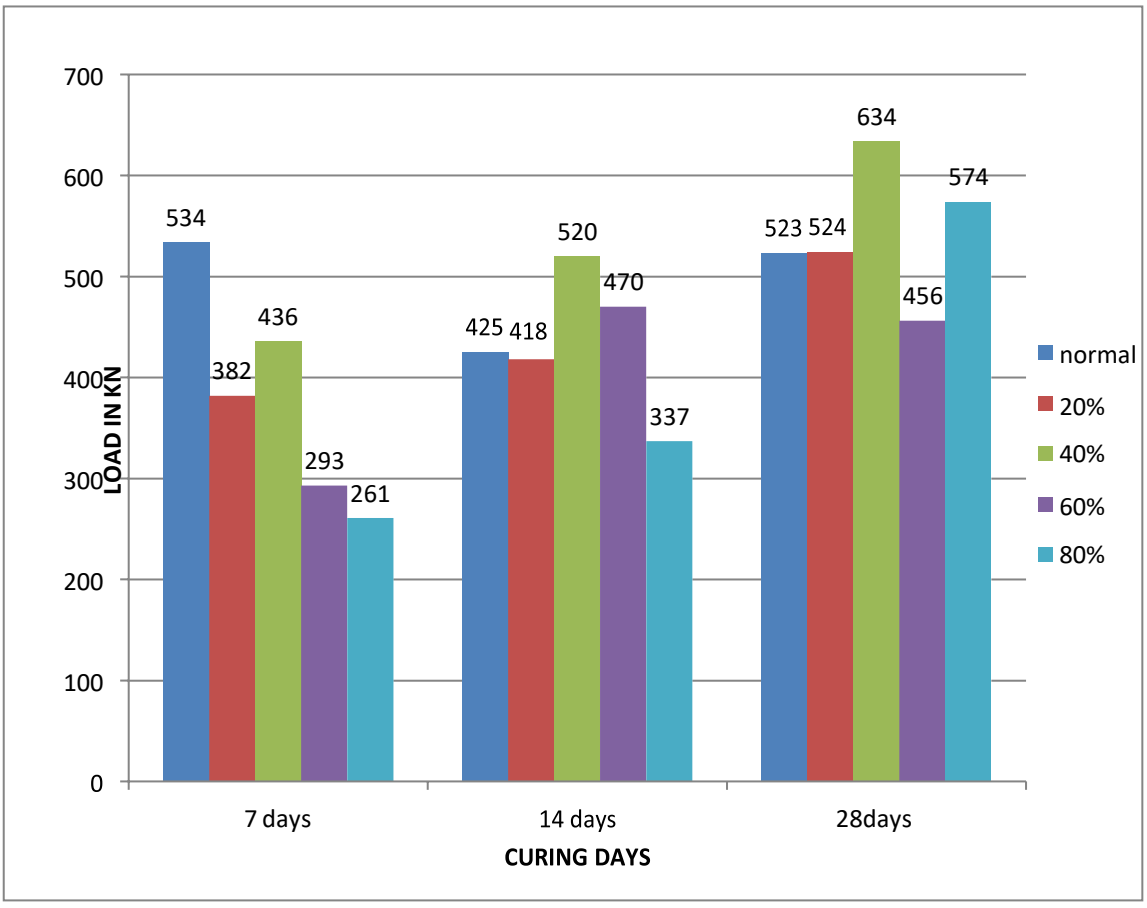
Fig 5- Concrete Vibrating table

X. TESTING AND RESULTS

Compressive strength test:

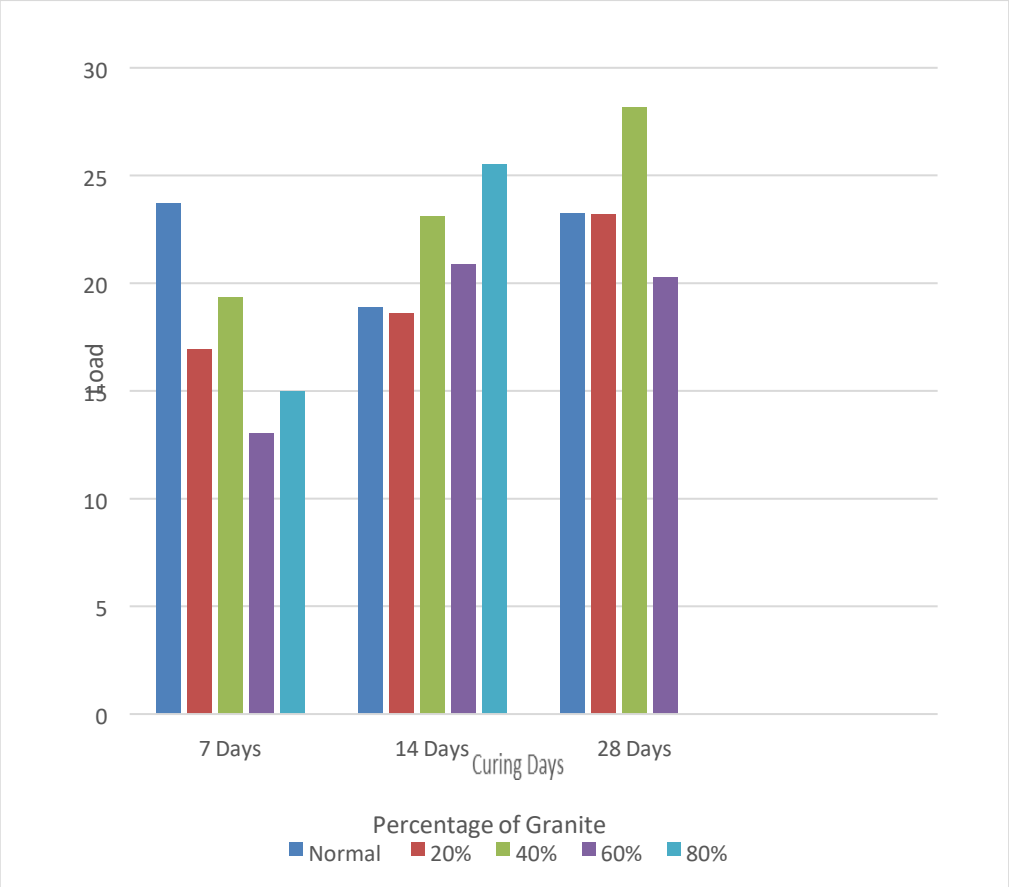
The compressive strength of cubes and cylinders are tested by using the compressive testing machine bya pplying the load at the rate of 30N/mm2 per minute. The average test result values are tabulated and comparative studies were made on the both normal and partially replaced concrete cubes of 10%, 20%, 40%, 60% and 80%.

Sr No.	% Mix	Compressive Strength (KN)		
		7 Days	14 Days	28 Days
1.	Normal	534	425	523
2.	20%	382	418	524
3.	40%	436	520	634
4.	60%	293	470	456
5.	80%	261	337	574



XI. COMPARATIVE TESTING BASED ON COMPRESSION STRESS

Sr No.	% Mix	Compressive Stress (Mpa)		
		7 Days	14 Days	28 Days
1.	Normal	23.73	18.89	23.24
2.	20%	16.9	18.57	23.2
3.	40%	19.33	23.11	23.17
4.	60%	13.02	20.88	20.26
5.	80%	11.6	14.97	25.51



XII. CONCLUSION

Based on these research investigations the following observations were made-The compressive strength of concrete is same with the conventional concrete only at 10%, 20%, 40%replacement of granite waste. The development of concrete with granite waste as coarse aggregate has been successfully completed and the results were presented and analyzed in the previous chapter. B ased on the test results of M20 grade concrete the following conclusions are given below.

- Depending upon the percentages of replacement of coarse aggregate with granite waste is found to be increase strength compared to ordinary concrete.

- In 20% replacement of granite aggregates, the compressive strength of concrete is decreasedby at 7 day 152 KN, at 14 day 7 KN and 28 Day increased by **1 KN** when compared to normal cube.
- In 40% replacement of granite aggregates, the compressive strength of concrete is decreasedb y at 7 day 98 KN, at 14 Day increased by **95 KN** and 28 Day increased by **111 KN** when compared to normal cube.
- In 60% replacement of granite aggregates, the compressive strength of concrete is decreased by at 7day 241KN, at 14 Day increased by **45 KN** and 28 Day decreased by 67 KN when compared to normal cube.
- In 80% replacement of granite aggregates, the compressive strength of concrete is decreased by at 7day 273KN, at 14 Day decreased by 88 KN and 28 Day increased by **51 KN** when compared to normal cube.

More over by using granite waste and its applications reduces the solid waste dumping and increases thesustainable development of the construction industry in the most efficient way and also address the high value of usage of such waste. So we conclude that the coarse replaced with granite waste at 40% in concrete is suitable for construction.

REFERENCES

1) R. Sri Ravindrarajah, C.T. Tam November 1987 "Recycling Concrete as a Fine Aggregate in concrete".

2) Jaseem AC. Muhammed Shuhail MC. Muhammed Mirshad P Mubeen TP. Vidyadhar N. 2004 "Partailly replacement of course aggregate by using crushed granite in concrete".

3) T. Felixkala and P. Partheeban 2006 "granite powder concrete".

4) Manasseh JOEL24 December 2010 "use of crushed granite fine aggregate in manufacturing of concrete".

5) S.A. Abukersh, C.A. Fairfield October 2011 "recycled aggregate concrete produced with red granite dust as a partial cement replacement".

6) M Vijayalakshmi, A.S.S. Sekar, G. Ganesh prabhu. September (2013) "strength and durability ofconcrete made with granite industry waste".

7) Telma Ramos, Ana Mafalda Matos, Bruno Schmidt, João Rio, Joana Sousa-Coutinho October (2013).

8) L. O. Ettu, O. M. Ibearug bulem, J. C. Ezeh, and U. C. Anya march 2013 "strength of binary blended cement composite containing saw dust ash".

9) C. B. Echeta, E. E. Ikponmwosa and A. O. Fadipe NOVEMBER 201 "effect of ceramic waste ascoarse aggregate on strength property on concrete".

10) Arivumangai, T. Felixkala 2014strength and durability properties of granite powder concrete".

11) Y. Yaswanth Kumar, C.M. Vivek Vardhan, A. Anithaapril 2015 "use of granite waste as a partialsubstitute to cement in concrete".

12) Sarbjeet Singh, Ravindra Nagar, Vinay Agrawal, Aditya Rana, March (2016) "sustainable utilization cutting waste in high strength concrete".

13) Markandeya Raju Ponnada*, S Siva Prasad & Harish Dharmala 2016 "check strength of concreteby replacement of aggregate of course aggregate".

14) Mr. G. Raja Mr. K. M. Ramalingam May 2016 "to study the effect of granite powder on concrete".

15) NarendraKumar Sharma, Praveen Kumar, Sanjeev Kumar, Blessen Skariah Thomas 1 October (2017) "properties of concrete containing polished granite waste as partial a substitution as coarseaggregate".