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"USE OF CRUSHED GRANITE STONE AS PARTIALLY REPLACEMENT OF COARSE AGGREGATE IN CONCRETE"

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ABSTRACT

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 studies on various materials which could be used as partial replacement for coarse aggregate. This project is experimented to reduce the cost of concrete. The only way to reduce and tackle these problems is reuse and recycles. In this project work, experiments have been conducted with the collection of materials required and data required for mix design are obtained. The M20 grade concrete is designed as per Indian standard code for conventional concrete. 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%, 30%, 40%. Cubes were casted with these concrete mixes and subjected to curing of 7 days, 14 days, 28 days and their strength is determined. The determined compressive strength was compared with the conventional concrete cube's strength. Of the above percentage mixes, the perfect percentage mix of granite with coarse aggregate is found and can be brought to use.

KEYWORDS: concrete, Granite Waste, Granite coarse aggregate, Ordinary Portland cement (OPC).

I. INTRODUCTION

Granite is a coarse-grained intrusive igneous rock composed mostly of quartz, alkali feldspar, and plagioclase. It forms from magma with a high content of silica and alkali metal oxides that slowly cools and solidifies underground. It is common in the continental crust of Earth, where it is found in igneous intrusions. These range in size from dikes only a few centimetres across to batholiths exposed over hundreds of square kilometres.

Aggregates form 70–80% of the total concrete volume. They significantly influence the strength, durability, and stability of concrete. Rapid urbanization has caused depletion of natural aggregates. Granite industries produce huge quantities of waste during cutting and polishing. These wastes can be recycled and used as coarse aggregate substitutes.

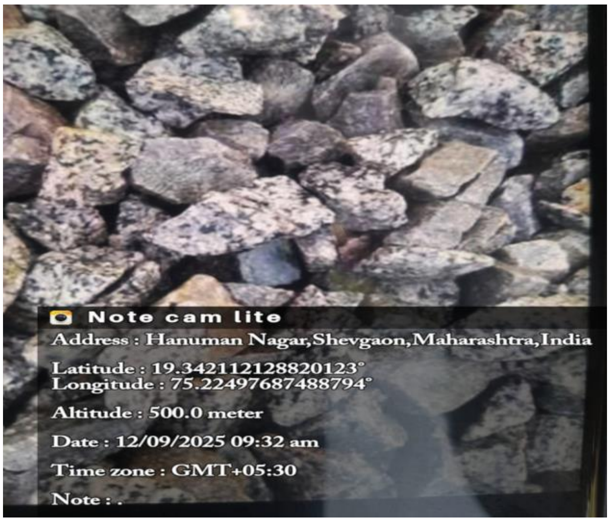


Photo 1- Granite waste photographs.

II. LITERATURE REVIEW

1. R. Siva Kumar, H. Mohammed Yousuff, et.al. (2016): "An Experimental study on partial replacement for coarse aggregate by Granite Waste"

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%, 30% replacement of granite waste. The strength is gradually decreasing at 40% and 50%.

More over by using granite waste and its applications reduces the solid waste dumping and increases the sustainable 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 course replaced with granite waste at 30% in concrete is suitable for construction.

2. Pooja Ahire Harish Khairnar, et.al. (2024): "Partially Replacement of Aggregate in Concrete with Granite."

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%re placement 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. Based on the test results ofiM20 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.

3. Samuel Gnaniah (2018): "An Experimental Study on the Use of Discarded Granite Stones in Concrete"

The strength parameter depends on the materials of the concrete. From the study it concludes that the compression and flexure strength of the granite stones replaced concrete varies than the conventional concrete. The use of the granite stones and chemical admixture plays a great role in increasing the strength parameters of concrete. Compressive strength results in 6.6% increase at 50% replacement of granite stones. Without added admixtures compressive strength at 28 days, is 27.30 N/mm at 50% replacement. If ADVA-950 is added, compressive strength at 28 days, is 33.90 N/mm2 up to 50% replacement. Flexural strength attains its maximum both for conventional & non-conventional concrete at 50%, where 100% replacement also gave fair results satisfying the economical, and strength requirements. Based on the cost analysis done, granite stones proved to be a better economical alternative for normal coarse aggregates both in terms of strength and economy.

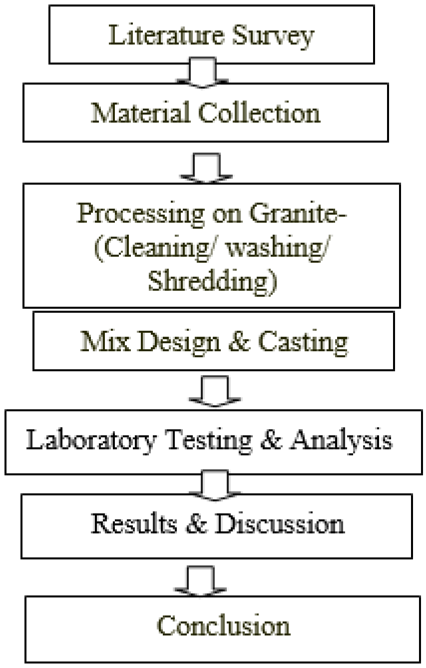
III. PROBLEM STATEMENT

1. Rapid infrastructure growth has led to excessive extraction of natural aggregates from rivers.
2. Loss of natural resources, and higher construction costs.
3. Granite industries generate large volumes of waste during cutting and polishing operations.
4. Most of this waste is disposed of in open lands or water bodies, causing pollution and land contamination.
5. Utilizing granite waste as a partial replacement for coarse aggregate could provide an effective solution to these challenges.

IV. OBJECTIVES

1. To Study the properties of concrete.
2. To find the optimum replacement level of granite waste.
3. To provide economical construction material.

V. METHDOLOGY



Material Collection and Processing -

- **Collection and washing:** Waste Granite is collected, cleaned to remove contaminants, and washed.

- **Shredding Process:** The various granite wastes are combined, and the granite is then cut into 16 to 20 mm size pieces.

- **Mix Design and Casting:** Replacement Percentage: Granite aggregates are typically introduced in 0%, 10%, 20%, 30%, and 40% replacements by weight of natural coarse aggregate.

- **Mixing:** A standard mix (e.g., M20, 1:1.5:3) is prepared. Cement and fine aggregate (sand) are mixed in dry condition, followed by the addition of the prepared granite coarse aggregates. Water is added last.

- **Casting:** The concrete is poured into 150mm x 150mm x 150mm steel moulds in three layers, with each layer tamping 25-35 times to minimize voids.

- **Compaction:** A vibrating table is used to remove entrapped air.

Testing of Materials

- **Test on Coarse Aggregate**

Sr No.	Tests Conducted	Results on Coarse Aggregate	Range
1.	Impact Value [IS.2386 (4)-1963]	5.95%	10-30
2.	Crushing Value Test [IS.2386 (4)-1963]	1.67%	<30
3.	Abrasion Test [IS.2386 (3)-1963]	96.85%	<30
4.	Bulking of Aggregate	2.39	-
5.	Flakiness Index [IS.2386 (1)-1963]	11.694%	<15
6.	Elongation Index [IS.2386 (1)-1963]	11.864%	<15

VI. MATERIAL PROPERTIES

Coarse Aggregate - 20mm size were used for the experiment. The aggregates were washed to remove dust and dirty particles and were air dried. Passed by 16 mm to retained 20mm sieve.

Fine Aggregate – Sieve analysis of fine aggregates was carried out in the laboratory. The sand was first sieved through 4.75 mm IS sieve to remove particles greater than 4.75 mm. It is then passed through 2.75 mm IS sieve and the retained particles are taken.

Granite Waste: In this project these granite wastes were crushed and used in the place of 20mm coarse aggregate.

Cement– The ordinary Portland Cement (OPC) was used for this experiment. The cement was in dry state with fine grey powder. The cement used was from a single lot throughout the experiment. It was in fresh form without any lumps.

VII. MIX DESIGN

Mix Proportion for M20 grade (IS 10262:2019)

For 53 grade OPC Cement 4.75mm 16mm grade granite aggregate Degree of workability 75 compaction factor, 75 mm slump adopted Coarse aggregate size used granite aggregate Cement: Fine Aggregate: Coarse aggregate 1:1.5:3Water used for M20 grade is 0.45 for mix design

VIII. PROCEDURE

Procedure for Concrete Cube Casting:

Preparation: Ensure moulds (typically 150mm x 150mm x 150mm) are clean, assembled, and coated with a thin layer of mould oil to prevent concrete adhesion.

Sampling: Take a representative sample of fresh concrete from the site mixer or batch.

Filling: Pour concrete into the moulds in three roughly equal layers (approx. 5 cm deep each).

Compaction:

Manual: Tamp each layer at least 35 times with the 16mm diameter standard tamping rod, ensuring the rod penetrates into the underlying layer, or use 35 strokes across the surface.

Vibration: Use a vibrating table to compact the concrete until a thin film of mortar appears on top and no air bubbles are trapped.

Finishing: After the final layer is compacted, level the surface with a trowel or float.

Marking: Identify the cube with a unique ID, date, and mix design details, typically by marking with a permanent marker.

Initial Setting: Allow the cubes to rest undisturbed for 24 hours.

Demoulding & Curing: Carefully remove the cubes from the moulds (demoulding) and submerge them in clean water for curing until the day of testing (usually 7, 14, or 28 days).

IX. RESULTS

I. Compressive Strength

Compressive Strength after 7 days

Sr. No	Block	Compressive Strength			Mean (N/mm2)
		B1	B2	B3	
	Normal	18.90	20.1	16.70	18.90
2	10% Of Granite Aggregate	14.62	18.98	18.50	17.37
3	20% Of Granite Aggregate	22.83	22.42	23.75	23
4	30% Of Granite Aggregate	23.82	22.82	29.29	25.31
5	40% Of Granite Aggregate	24.96	24.36	22.94	24.09

Compressive Strength after 14 days

Sr. No	Block	Compressive Strength			Mean (N/mm2)
		B1	B2	B3	
	Normal	20.18	21.13	21.48	20.93
2	10% Of Granite Aggregate	19.82	23.57	16.89	20.09
3	20% Of Granite Aggregate	19.10	32.57	31.91	27.86

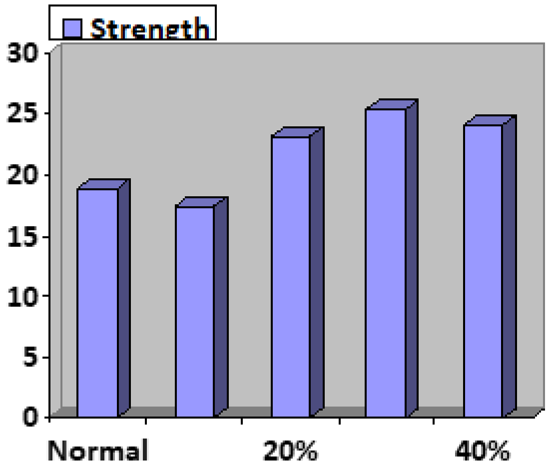
4	30% Of Granite Aggregate	38.85	34.89	31.93	35.22
5	40% Of Granite Aggregate	24.56	18.82	11.32	18.23

Compressive Strength after 28 days

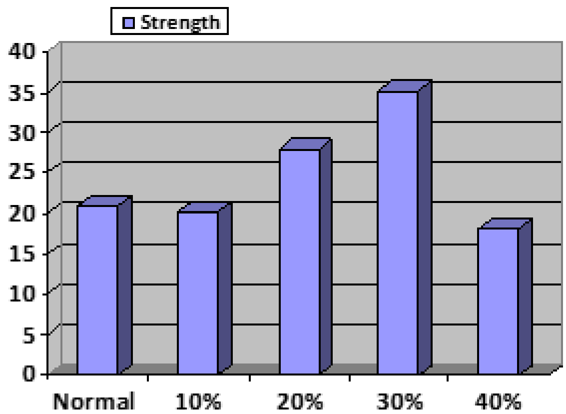
Sr. No	Block	Compressive Strength			Mean (N/mm2)
		B1	B2	B3	
	Normal	27.47	27.04	26.75	27.09
2	10% Of Granite Aggregate	32.08	32.35	32.53	32.32
3	20% Of Granite Aggregate	39.86	33.65	34.18	35.89
4	30% Of Granite Aggregate	43.03	43.50	34.85	40.46
5	40% Of Granite Aggregate	44.33	44.10	43.50	43.97

X. GRAPHS

(Compressive Strength after 7 days)

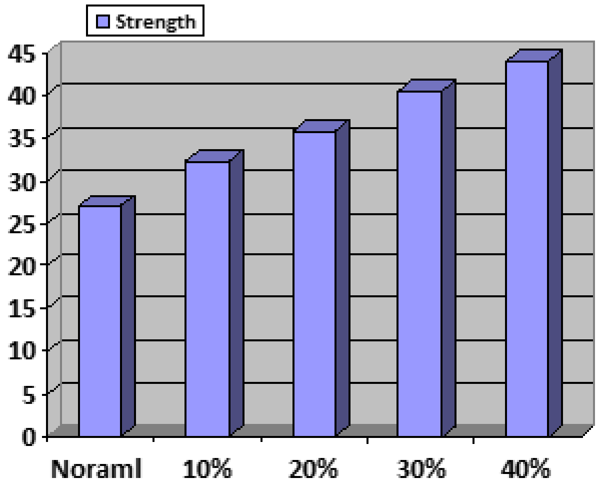


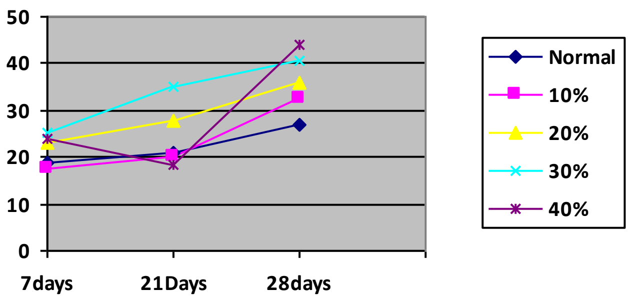
(Compressive Strength after 14 days)



Sr. No	Block	Split Tensile Strength N/mm^2
	Normal	2.10
2	10% Of Granite Aggregate	2.30
3	20% Of Granite Aggregate	2.45
4	30% Of Granite Aggregate	2.35
5	40% Of Granite Aggregate	2.20

(Compressive Strength after 28 days)

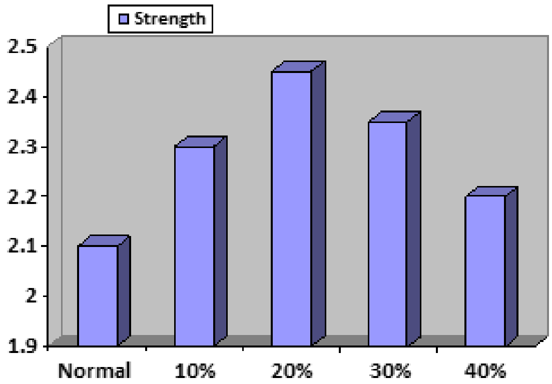




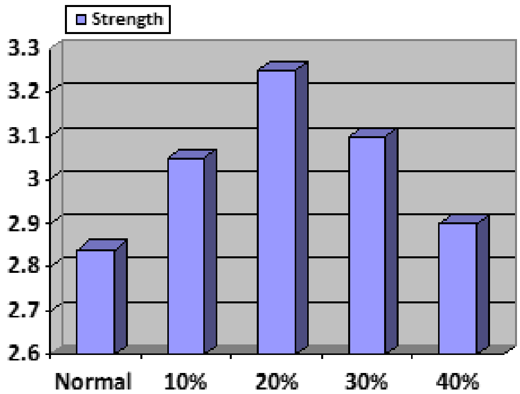
II. Split Tensile Strength Test

Split Tensile Strength Test 14 Days

Sr. No	Block	Split Tensile Strength N/mm^2
	Normal	2.84
2	10% Of Granite Aggregate	3.05
3	20% Of Granite Aggregate	3.25
4	30% Of Granite Aggregate	3.10
5	40% Of Granite Aggregate	2.90

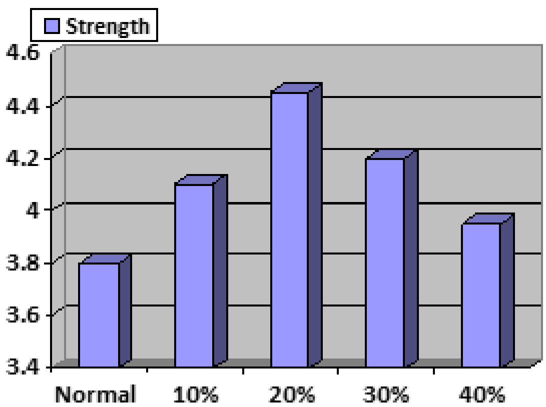


Split Tensile Strength Test 28 Days



III. Flexural Tensile Strength Test

Sr. No	Block	Flexural Tensile Strength N/mm^2
	Normal	3.80
2	10% Of Granite Aggregate	4.10
3	20% Of Granite Aggregate	4.45
4	30% Of Granite Aggregate	4.20
5	40% Of Granite Aggregate	3.95



XI. CONCLUSION

1. Using of Crushed Granite Stone as Partial Replacement of Aggregate in Concrete concludes that partial replacement of natural coarse aggregate with crushed granite stone can significantly improve the properties of concrete.
2. At an optimum replacement level, enhancements are observed in compressive strength, durability, and overall performance.
3. Crushed granite stone, being a hard and durable material with high abrasion resistance, contributes to increasing the strength and longevity of concrete structures. Additionally, its use helps in reducing the consumption of natural aggregates, thereby supporting sustainable construction practices and environmental conservation.

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