AN EXPERIMENTAL INVESTIGATION OF STRENGTH OF "GRANITE FINES CONCRETE"

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***ABSTRACT*: Granite fines which are the byproduct produced in granite factories while cutting huge granite rocks to the desired shapes. While cutting the granite rocks, the powder produced is carried by the water and this water is stored in tanks. After evaporation of water the granite dust remained is transported and disposed on the lands. Disposing this granite fines is a major problem in an Urban set up. Factories are situated close to the residential areas that in case random disposal of the granite fines would lead to health hazards of the people dwelling in the areas in particular and also would prove to be an environmental hazard in general. With the properties of the granite fines, i.e., its size and fineness, it can be very effectively used as a filler material in the concrete, replacing the fine aggregate which will help in filling up the pores in the concrete which is otherwise porous. Filling up of the pores by the granite fines increase the strength of the concrete and also a material which is abundantly available and which has a disposal problem can be made use effectively. In this paper an attempt is made experimentally to investigate the Strength Behavior of Concrete with the use of Granite Fines as an additive.**

Concrete is prepared with granite fines as a replacement of fine aggregate in 5 different proportions namely 0%,10%,15%,20%and 25%various tests such as compressive strength, tensile strength and Flexural strength are investigated and these values are compared with the conventional concrete without granite fines.

***Keywords* – Granite fines, Strength Behavior of concrete, Compressive strength, tensile strength and Flexural strength, workability.**

INTRODUCTION

Fine aggregate is an essential component of concrete. The most commonly used fine aggregate is natural river sand. The global consumption of natural river sand is very high due to the extensive use of concrete. In particular, the demand of natural river sand is quite high in developed countries owing to infrastructural growth. The non-availability of sufficient quantity of ordinary river sand for making cement concrete is affecting the growth of construction industry in many parts of the country. Recently, Tamil Nadu government (India) has imposed restrictions on sand removal from the river beds due to its undesirable impact on the environment. On the other hand, the granite waste generated by the industry has accumulated over years. Only insignificant quantity has been utilized and the rest has been dumped unscrupulously resulting in pollution problems. With the enormous increase in the quantity of waste needing disposal, acute shortage of dumping sites, sharp increase in the transportation and dumping costs necessitate the need for effective utilization of this waste. The world wide of sand as fine aggregate in concrete production is very high, and several developing countries have encountered some strain in the supply of natural sand in order to meet the increasing needs of infrastructural development in recent years. A situation that is responsible for increase in the price of sand, and the cost of concrete. Expensive and scarcity of river sand which is one of the constituent material used in the production of conventional concrete was reported in India.

The present work is aimed at developing a concrete using the granite scrap, an industrial waste as a replacement material for the fine aggregate. By doing so, the objective of reduction of cost of construction can be met and it will also help to overcome the problem associated with its disposal including the environmental problems of the region. Accordingly this project work will examine M30 grades of concrete were cast by varying the percentage replacement of sand with granite fines.

Granite fines

Granite Granites was used as fine aggregate in concrete. Granites are plutonic light colored igneous rocks. The word granite is derived from Latin word granum meaning a grain. Many types of granites are distinguished on the basis of relative abundance of some accessory minerals and special textural features (hornblende-granite, augite granite etc). They generally possess all the essential qualities of a good building stone showing very high crushing strength, low absorption values etc. The density of granite is between 2.65 to 2.75 g/cm3 and compressive strength will be greater than 200 MPa. Granite powder obtained from the polishing units and the properties were found. Since the granite powder was fine, hydrometer analysis was carried out on the granite powder to determine the particle size distribution. From hydrometer analysis it was found that the coefficient of curvature was 1.95 and coefficient of uniformity was 7.82. The specific gravity of the granite fines was found to be 2.61. Below table gives the chemical composition of granite powder.

CONSTITUENT OF GRANITE FINES

Sr.No.	Constituent	% present in Granite fines
1.	Alumina (Al2O3)	14.42
2.	Magnesium oxide (MgO)	0.72
3.	Calcium oxide (CaO)	1.82
4.	K2O	4.12
5.	Na2O	3.69
6.	Silica (SiO2)	72.02
7.	Fe2O3	1.22

PROPERTIES OF GRANITE FINES

Sr.No.	Properties	Values
1.	Absorption	1%
2.	Specific Gravity	2.6to2.8
3.	Crushing Strength	2500 N/m2
4.	Color	Mostly light color
5.	Fineness Modulus	2.41
6.	Density	2500-2650kg/m2
7.	Frost resistance	Good

Materials

Cement

Portland Pozzolano (Ultratech) cement available in local market is used in the investigation. The cement used has been tested for various proportions as per IS :4031-1998 and found to be conforming to various specifications of IS :12269-1987

Coarse aggregate

The crushed aggregates used were minimum size of aggregate 12mm.

Fine aggregate

Locally available Manjara river bed sand was used as fine aggregate.

Properties of fine and coarse aggregates

Properties	Fine Aggregate(River Sand)	Coarse Aggregate (crushed stone)
Specific Gravity	2.63	2.68
Fineness Modulus	3.75	7.13
Loose Bulk Density (kg/m3)	1450	1350
Compacted Bulk Density(kg/m3)	1700	1610

Water
Locally available potable water is used.

Mixing of concrete

The performance of the concrete is influenced by the mixing. This means that a proper and good practice of mixing can lead a better performance and quality of the concrete. The quality of concrete is influenced by the homogeneity of the mix material used while mixing and placing of fresh concrete. A proper mix of concrete will achieve good strength of concrete and better bonding of cement with the aggregates.
The mixing of concrete was carried out manually in the concrete laboratory at M.S. Bidwe engineering College latur. Before the concrete mixing begins, all of the mix materials were weighted and prepared according to the mix design given in IS code method for M30 grade of concrete. The various percentages of fine aggregates are replaced by granite fines with equivalent weights.

Mix proportion-

Water	Cement	FA	CA
200	500	644	985
0.40	01	1.28	1.97
20	50	64	98

METHODOLOGY:

1] Workability

The workability tests were performed using standard sizes of Slump mould as per IS: 1199 - 1999 and Compaction Factor apparatus which was developed in UK and is described in IS: 1199 - 1999.

2] Compressive Strength

Casted 100 x 100 x 100 mm cubes & allowed for curing in curing tank for 7 days & 28 days & tested in 200 tones compression testing machine**.**

3] Flexural strength

Casting beam 100 x 100 x 500 mm& they were allowed for curing in a curing tank for 28 days and they were tested in flexural testing machine.

4] Tensile Strength

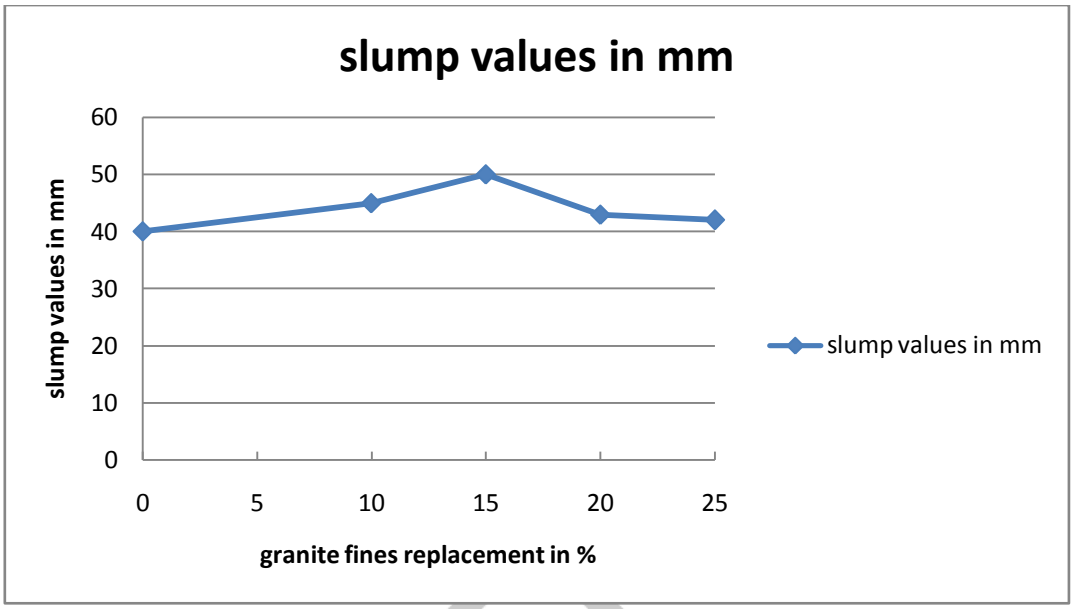
Casted 100 x 100 x 100 mm cubes& they were allowed for curing in a curing tank for 7 days & 28 days and they were tested in Compression testing machine.

RESULTS AND DISCUSSIONS

Effect of granite fines on workability of granite fines concrete

The workability of concrete of M30 grade is measured by using two widely used empirical tests i.e slump test and compaction factor with same w/c ratio 0.4 for addition of different percentage of granite fines. Values obtained for different percentage mix is as shown in following table.

% of sand replaced by granite fines	**Slump value (mm)**
0	**40**
10	**45**
15	**50**
20	**43**
25	**42**

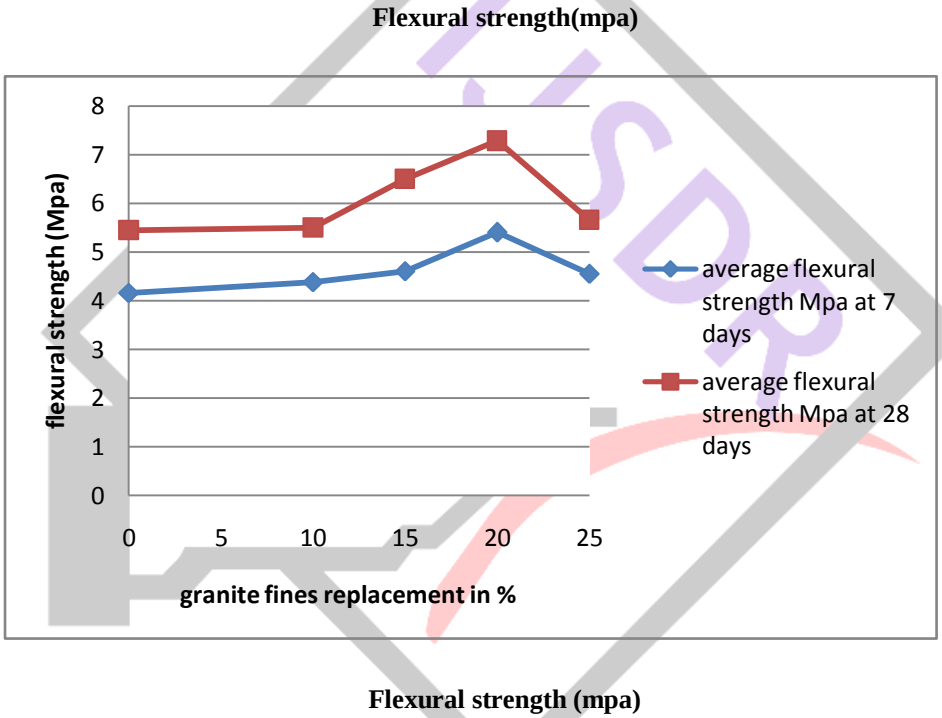


Results of test :

1] **Flexural Strength**

Sample No.	%of granite fines	Flexural Strength MPa (N/mm^2) 7 days	Average Flexural Strength MPa 7 days
1	0 %	4.5	4.16
2	0 %	3.09	
3	0 %	4.90	
4	10%	4.75	4.38
5	10%	3.25	
6	10%	5.15	
7	15%	4.125	4.60
8	15%	4.95	
9	15%	4.75	
10	20%	5.00	5.40
11	20%	5.37	
12	20%	5.84	
13	25%	4.125	4.55
14	25%	4.82	
15	25%	4.72	

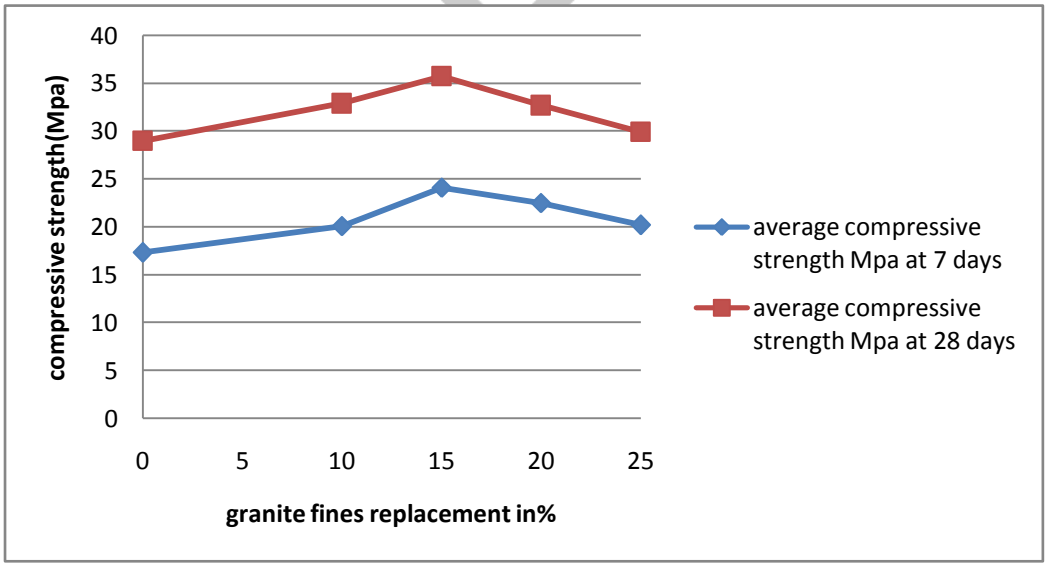
Sample No.	%of granite fines	Flexural Strength MPa (N/mm^2) 28 days	Average Flexural Strength MPa 28_{days}
1	0 %	5.75	5.45
2	0 %	4.85	
3	0 %	5.75	
4	10%	5.75	5.50
5	10%	5.00	
6	10%	5.75	
7	15%	6.25	6.50
8	15%	6.50	
9	15%	6.75	
10	20%	7.01	7.28
11	20%	7.35	
12	20%	7.50	
13	25%	6.50	6
14	25%	5.50	
15	25%	5.12	



2] **Compressive Strength :**

Sample No.	%of granite fines	Compressive Strength MPa (N/mm^2) 7 days	Average compressive Strength MPa 7 days
1	0 %	20.54	17.28
2	0 %	18.43	
3	0 %	12.87	
4	10%	21.52	20.06
5	10%	18.43	
6	10%	20.23	
7	15%	22.57	24.06
8	15%	22.62	
9	15%	28.42	
10	20%	22.62	22.49
11	20%	22.92	
12	20%	21.93	
13	25%	18.52	20.16
14	25%	21.56	
15	25%	20.42	

Sample No.	%of granite fines	Compressive Strength MPa 28 days	Average compressive Strength MPa 28days
1	0 %	26.11	28.95
2	0 %	30.38	
3	0 %	31.38	
4	10%	33.11	32.87
5	10%	32.12	
6	10%	33.38	
7	15%	39.30	35.70
8	15%	35.60	
9	15%	32.20	
10	20%	33.00	32.67
11	20%	32.10	
12	20%	32.93	
13	25%	29.11	.85
14	25%	30.32	
15	25%	30.12	

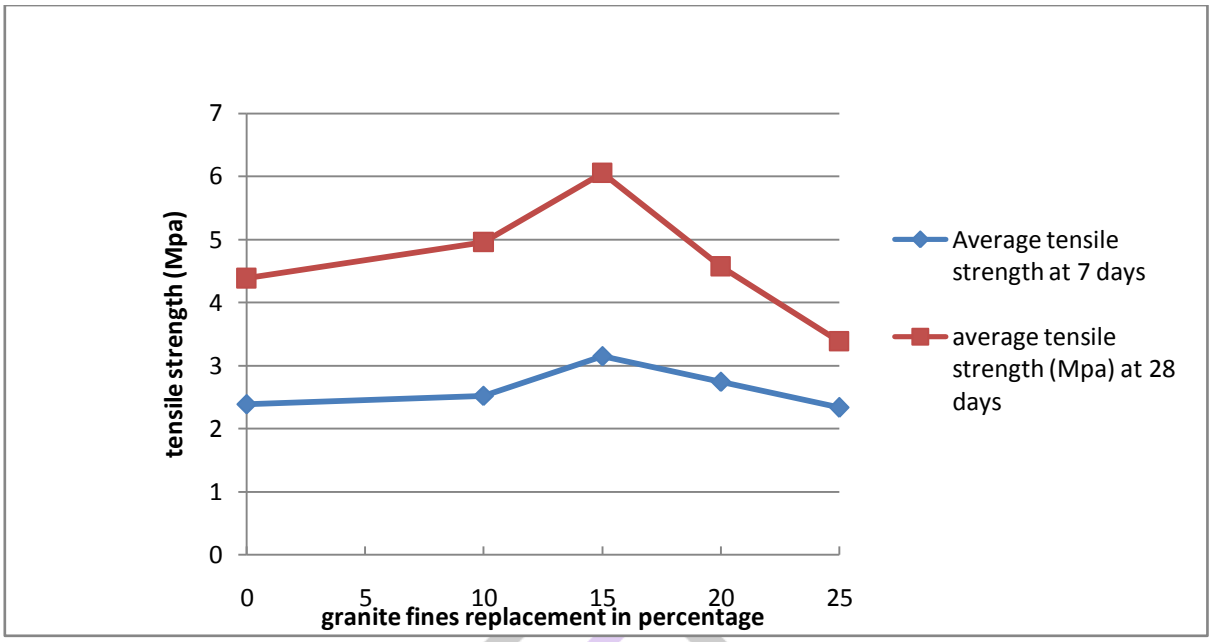


Compressive strength (MPa)

3]Tensile Strength :

Sample No.	% of granite fines	Tensile Strength MPa (N/mm^2) 7days	Average Tensile Strength MPa 7days
1	0 %	2.332	2.386
2	0 %	2.244	
3	0 %	2.584	
4	10%	2.362	2.523
5	10%	2.344	
6	10%	2.864	
7	15%	3.281	3.150
8	15%	3.146	
9	15%	3.023	
10	20%	2.040	2.742
11	20%	3.598	
12	20%	2.590	
13	25%	2.753	2.334
14	25%	2.202	
15	25%	2.048	

Sample No.	% of granite fines	Tensile Strength MPa (N/mm^2) 28days	Average Tensile Strength MPa 28 days
1	0 %	4.392	4.380
2	0 %	4.759	
3	0 %	3.989	
4	10%	4.872	4.955
5	10%	4.981	
6	10%	5.012	
7	15%	5.861	6.052
8	15%	6.525	
9	15%	5.982	
10	20%	4.721	4.574
11	20%	3.991	
12	20%	5.010	
13	25%	3.581	3.385
14	25%	4.001	
15	25%	3.981	



Tensile strength(mpa)

CONCLUSION

Based on the result and observation made in this experimental research study. The following conclusion are drawn.

1. It has been observed that, the maximum slump value is obtain at 15%replacement granite fines with fine aggregate. further increases in percentage there is decreases in slump.
2. The compressive strength is increased by 39.29% at 7 days and 24% for 28 days curing with the use of 15% replacement of fine aggregate with granite fines. Further increases in percentage there is decreases in strength but that value is greater than conventional concrete up to 25% replacement by using water cement ratio 0.4 and aggregate cement ratio 3.25.
3. The tensile strength is increased by 33.27% at 7 days and 38.01% at 28 days curing with the use of 15% replacement of granite fines in comparison to the strength o nominal concrete mix of 1:1.28:1.97(C:FA:CA) without granite fines . Further increases in percentage there is decreases in strength but that value is greater than conventional concrete up to 20% replacement.
4. Hence we can conclude that we can replace fine aggregate with granite fines up to 25%.but maximum strength is obtained at 15% replacement of granite fines.
5. The flexural strength of beam is increased by29.8% at 7 days and 33.57% at 28 days curing with 20% replacement of fine aggregate with granite fines. Further increases in percentage there is decreases in strength but that value is greater than conventional concrete up to 25% replacement.
6. The dimension of the granite fine particles is compatible with the purpose of filing up the transition zone and capillary pores, thus acting as micro filler.

ACKNOWGEMENT

M. S. Bidwe Enggineering college give us financial support for doing such investigation & Prof. G. N. Shete Sir give us full support for doing such work.

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