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Investigation of Concrete in Partial Replacement of Fine Aggregate using Granite Powder

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Abstract -*Now a day's granites are widely used as a flooring material. The waste of granite powder is taken for our experimental investigation. This project intends to investigate possibility of producing low cost enhanced performance concrete by using granite powder. This partial replacement in concrete gives the general characteristics like density, strength, workability, durability which is greater than cast in situ concrete. The conventional concrete mixture consists of cement, coarse aggregate, fine aggregate & water. In this project granite powder is used with different percentage of 10, 30, 50, 100. The total number of 45 cubes size of 150×150×150mm is cast using the grade of concrete M20, M25, M30. The compressive strength of concrete cubes are compared. In our project was use granite powder 10 to 100% by the weight of sand is taken of making concrete. Analyse for fine aggregate with granite powder results is taken. This mixture is prepared for concrete cubes and beams conduct the compressive strength for 28 days and achieve the strength which is designed.*

Key Words: **Granite powder, compressive strength.**

1. INTRODUCTION

A. General

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 utilisation of this waste. 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.

B. Granites

Granite may be defined as plutonic light coloured igneous rock, it is generally coarse to medium grained, holocrystalline and equigranular rock. It occurs on the surface of the earth is attributed to prolonged weathering and erosion of the strata. It is comes from magma that erupted on the ground surface. Granite as a building material especially in palaces and monuments has been in use for ages, however the uses is limited as stone as brick wall or arches or as lining slab in walls, roof or floors, leaving its wastage at guarry or at the sizing industry generally unattended for use in the building industry itself as filler or plasticizer in mortar or concrete. The result in that mass which 40% of total granite quarried has reached as high millions of tones. This huge unattended mass of granite waste consisting of very fine particle is today one of the environmental problems around the world. Some attempts have been made to find and assess the possibilities of using waste granite aggregate in mortars and concrete and result about strength and workability were compared with control samples of conventional cements, sand mortar/concrete.

Fig 1 Granite Powder

C. Advantages

- Granite shows very high crushing strength.
- It is least porosity so it to leads to low water absorption value than the concrete.
- It is heat and fire resistance material so it controls the formation of cracks.
- Granite stone has low thermal expansion value of concrete so it can be control expansion and shrinkage of concrete.
- Granite stone has high impermeability material.
- It has greater advantage of mass construction of using granites.

- It is good on frost resistance.

Shirule P.A et al (2012) In this study the successfuldetermined the compressive strength and split tensile strength of concrete in which cement was partially replaced with marble dust powder (0%,5%,10%,15%, 20%).The result indicated that the Compressive strength of concrete increased with addition of waste marble powder up to 10% replaced by weight of cement and further addition of waste marble powder was found to decrease the compressive strength. The optimal percentage replacement was found to be 10%.

D. Objectives of the Project

- To minimize the utilization of the aggregate, Granite waste used as fine aggregate.
- To attain the concrete strength of 20MPa, 25MPa, 30MPa.
- To study the properties of material.
- To study the compressive strength of cube specimen with the fine aggregate & different percentage of granite waste aggregate.
- The main objective of this work is to increase the strength of concrete by using granite waste.
- Granite waste is heat resistance material thus it prevents the formation of cracks.
- It has the low thermal expansion property so it reduces the shrinkage as per IS456.
- With the increase in construction activities, there is heavy demand on concrete and consequently on its ingredient like aggregate also. So granite waste can be used as an alternative to this demand.
- However, our objective of the project is to study and compare the strength behavior of concrete using granite waste as a replacement material to fine aggregate.

2. METHODOLOGY

- The collect the journal about this project.
- Collection of material like Sand, Aggregate, and Granite powder, cement.
- To study the property of material.
- Mix Design using IS:10262:1982 for M30 M20 M25Grade.
- Casting of cubes(Granite waste specimen with various percentage)
- To place the casted specimens into curing process.
- Study on the mechanical characteristics of concrete Compressive strength.
- Comparison of test result on strength of control and granite waste added specimens

CONCRETE MIXTURES

The concrete mixture consists of the following ingredients.

1. cement
2. coarse aggregate
3. fine aggregate
4. granite powder
5. water

A. Cement: Cement in a general sense are adhesive & cohesive materials which are capable of bonding together particles of solids matter into a compact durable mass. Cements used in construction industry may be classified as,

1. hydraulic cement
2. non hydraulic cement

- Hydraulic Cements: The hydraulic cements set & harden in water& give a product which is stable. Ex: Portland cement.
- Non Hydraulic Cement*:* This type of cement does not set &harden in water such as hydraulic lime (or) which are unstable in water. Ex: plaster of paris.
- Ordinary Portland Cement*:* Portland cement may be defined as a product obtained by finely pulverizing the clinker produced by calcining to fusion, an intimate & properly proportioned mixture of argillaceous & calcareous materials. The ordinary Portland cement has been classified as,
  1. 33 Grade (IS 269-1989)
  2. 43 Grade (IS 8112-1989)
  3. 53 Grade (IS 12669-1987)

TABLE 1

CHEMICAL COMPOSITION OF OPC

Chemical Composition	Percentage
Cao	60 - 65%
Sio_2	17 - 25%
Al_2o_3	3 - 8%
Fe_2o_3	0.5 - 6%
Mgo	0.5 - 4%
So_3	1-2%

- specific gravity of given sample of cement= 3.15.
- Fineness of cement is 2.33%.

B. Fine Aggregate:

The material passing through 4.75mmsieve is called fine aggregate. Natural sands are generally used as fine aggregate. It may be obtained from pits, rivers, lakes or sea shore, but it should free from clay and silt. Sea shore sand may contain chlorides, which may cause efflorescence and may cause corrosion of reinforcement Angular grained sand produces. Good and strong concrete because it has good

interlocking property, while round grained particle of sand do not afford such inter locking. River sand was used in preparing the concrete as it was locally available in sand quarry. The smallest size of fine aggregate is 0.06mm. The specific gravity and water absorption were found to be 2.73 and 2.5% respectively. The functions of sand are to achieve economy by its use as adulterant in mortar, prevent shrinkage and development of cracks in mortar, furnish strength to mortar crushing & allow carbon dioxide from the atmosphere to penetrate the fat lime mortars necessary for its air hardening.

- The specific gravity of sand= 2.53
- The specific gravity of given sample of granite powder= 2.95
- Finenessmodulus = 2.78

C. Coarse Aggregate:

Aggregate retained on 4.75mm sieve are identified as coarse aggregate. They are obtained by natural disintegration or by artificial crushing of rocks. The maximum size should be as large as possible but not more than one-fourth, of the minimum thickness of the member. Coarse aggregate is obtained by crushing various types of granites, schist and gneiss, crystalline and lime stone and good quality sand stones. When high strength concrete is required very fine grained granite perhaps the best aggregate. Concrete made with sand stone aggregate give trouble due to cracking because of high degree of shrinkage. For coarse aggregate crushed 20mm, normal size graded aggregate was used. The specific gravity and water absorption were found to be 2.65 and 1.0% respectively. The grading of aggregate conformed to the requirement as per IS: 383- 1970.They should be hard, strong, dense, durable, clear& tree from veins & adherent coatings; & free from injurious amounts of disintegrated pieces, alkali, organic matter & other deleterious substances. Functions of coarse aggregate are almost same as fine aggregate.

- The specific gravity of coarse aggregate= 2.75

3. CONCRETE MIX DESIGN (M20, M25, M30)

A. Design Mix of M20, M25 and M30 grade was designed as per IS 10262:2009 and the same was used to prepare the test samples. The design mix proportion is shown in

TABLE 2

MIX DESIGN

Grade	Cement	FA	CA	Water
M20	0.46	1	1.46	2.94
M25	0.40	1	1.15	2.30
M30	0.38	1	1.10	2.23

4. EXPERIMENTAL INVESTIGATION

A. Cube Compression Test (FCU): (ASTM C109/C109M)

For the determination of cube compressive strength of concrete. Specimens, of size 150x150x150mm size were cast and cured for 28 days in tap water. After the specimens are dried in open air, subjected to cube compression testing under digital universal testing machine. The rate of loading was so adjusted as 0.2 to0.4 MPa /sec as per Indian standards specification.

B. Formula: The cube compressive strength (fcu) was computed from the fundamental principle as,

f_{cu}= load at failure / cross sectional area(N/mm^2)

Where,

P = load at failure (N)

A = Area of the specimen (mm^2)

C. Test Procedure: Measure the dimensions of the given specimen and keep it over the platform of the compression testing table. Close the release valve, rise the platform until the specimen just touches the top surface, using the left side cover of hand pump. Apply the load using the right side lever and note the loads corresponding to initial hair crack and final collapse of specimen. Release the load using valve and remove the specimen.

TABLE 3

Mix Design	Number of Days	Compressive Strength (N/Mm^2)	% of Granite Powder
M20	28	21.31	0
M25		26.69	
M30		30.66	
M20	28	21.11	10
M25		26.60	
M30		31.10	
M20	28	20.78	30
M25		24.85	
M30		30.39	
M20	28	21.80	50
M25		24.54	
M30		30.23	
M20	28	20.62	100
M25		24.71	
M30		29.21	

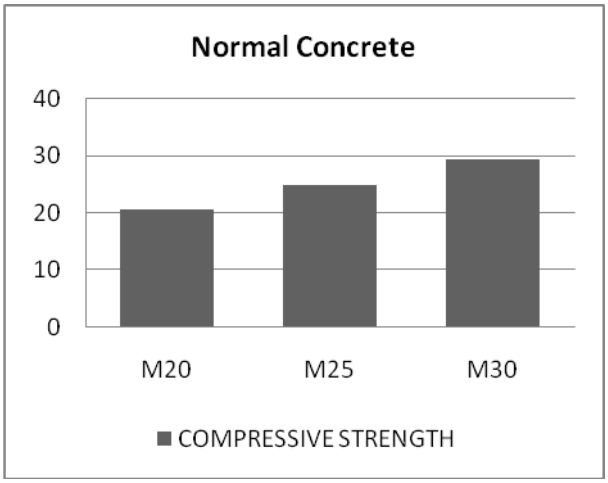

Fig 2 Compressive Strength in NC

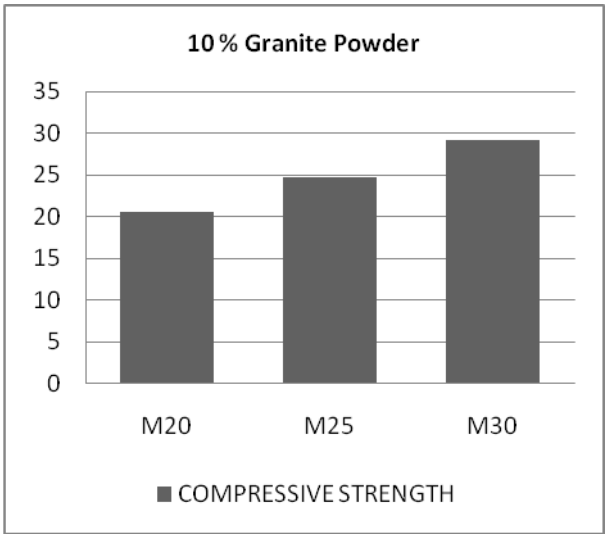

Fig 3 Compressive Strength in 10% GP

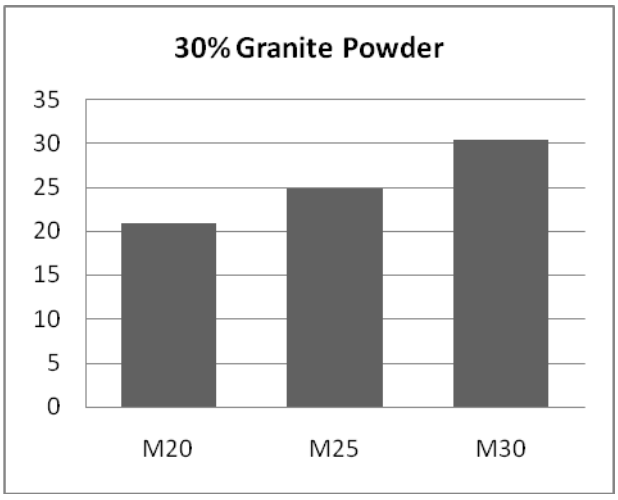

Fig 4 Compressive Strength in 30% GP

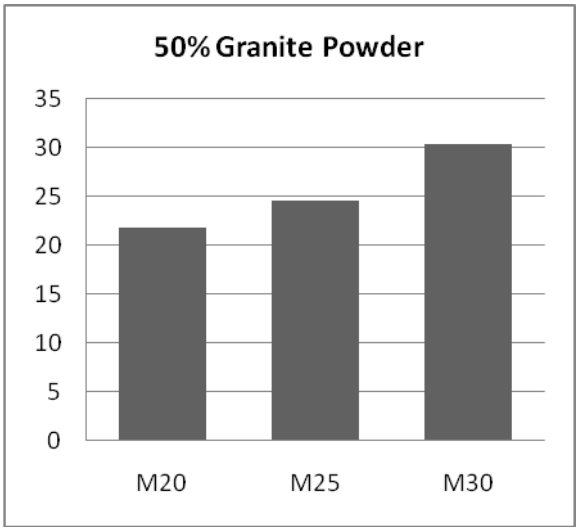

Fig 5 Compressive Strength in 50% GP

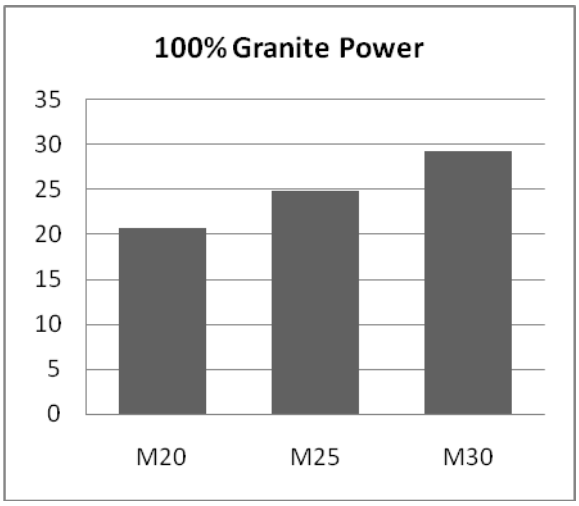

Fig 6 Compressive Strength in 100% GP

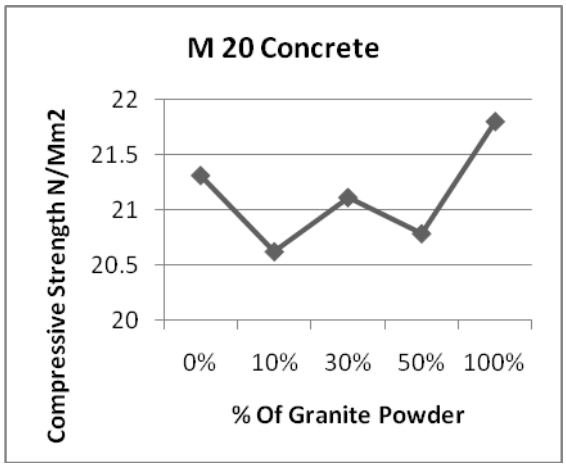

Fig 7 Compressive Strength in M20

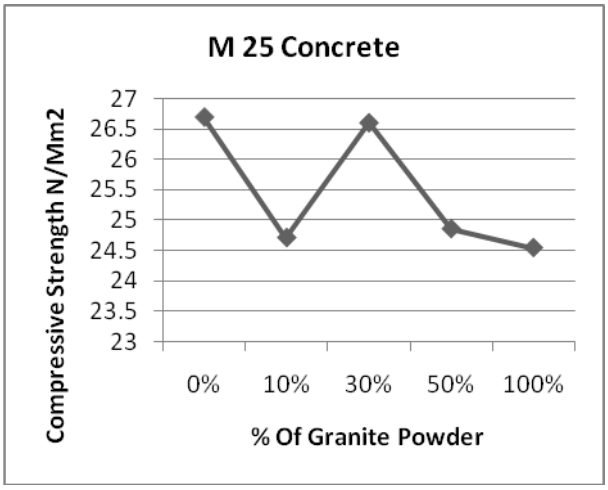

Fig 8 Compressive Strength in M25

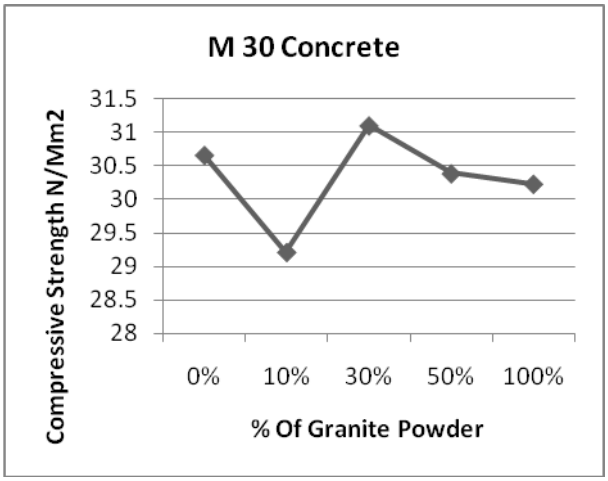

Fig 9 Compressive Strength in M30

5. CONCLUSIONS

Following conclusions and recommendations are made based on the study conducted

- Use of waste & byproducts as aggregates has greater potential because 75% of concrete is composed of aggregates.
- The physical and chemical properties of granite powder are suitable for its proposed use. Granite Powder had a positive effect on density, shrinkage and plasticity during all stages of the production process.
- Replacement of fine aggregate with granite powder is found to improve the strength of concrete. The optimal dosage of replacement is found to be 10-20%. Utilization of granite powder will avoid the disposal problems and related environmental issues. Utilization of granite powder will reduce the usage of river sand and conserve natural resources.
- In this project, for M20, M25, M30 the strength of concrete gets increased for every replacement of fine aggregate with granite powder upto 100% and its strength is high at 30% replacement. The strength of concrete may vary for further replacement of granite powder.
- The use of granite dust in construction might be cost effective because this waste is available free of cost.

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