A STUDY ON COMPRESSIVE BEHAVIOR OF REINFORCED CONCRETE COLUMN CONTAINING GRANITE POWDER WASTE

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ABSTRACT

In the era, as a result of growth in infrastructure development and the consequent increase in consumption have led to the fast decline in available natural resources. So that the engineers are constrained to implement new materials and techniques to efficiently develop the conventional concrete. Concrete containing conventional granite powder (GP) waste is showing good mechanical properties such as workability, compressive strength, tensile strength and elastic modulus. However, more investigation is required in order to understand structural behavior of granite powder concrete at the structural member scale. The main objective of this study is to experimentally investigate the compressive behavior of RC column containing granite industry waste and experimental parameter is grade of concrete. Granite waste with the sand replacement of 0% and 15% was used in this experiment. Experiments were undertaken under failure to fully understand the effect granite powder on the cubes and compressive behavior of RC column. From the above observation it is suggested that the concrete with substitution of 15%GP waste can be used in the structural concrete

KEYWORDS: Granite Powder, Water absorbtion, Compressive Strength Of Cube, Compressive Strength Of Column.

I. INTRODUCTION

Fine aggregate is an essential component of concrete. A situation that is responsible for increase in the price of sand, and the cost of concrete On the other hand, the granite waste generated by the industry has accumulated over years. The main objective of this study is to investigate experimentally the suitability of granite powder (GP) waste as a substitute material for fine/natural aggregate in concrete production.

To understand fully the influence of GP waste on the behavior of concrete, several tests such as density, slump cone, split tensile strength, flexural strength; ultra sonic pulse velocity (UPV) and compressive strength tests were performed.

Huseyin Yılmaz Aruntas et al (2010) studied the Utilization of waste marble dust as an additive in cement production. In this experimental study, the usability of waste marble dust (WMD) as an additive material in blended cement has been investigated. For this purpose, waste marble dust added cements (WMDCs) have been obtained by intergrinding WMD with Portland cement clinker at different blend ratios: 2.5%, 5.0%, 7.5% and 10% by weight.

bu Hebhoub et al (2011) investigated the use of waste marble aggregates in concrete. Today we are faced with an important consumption and a growing need for aggregates because of the growth in industrial production, this situation has led to a fast decrease of available resources. On the other hand, a high volume of marble production has generated a considerable amount of waste materials; almost 70% of this mineral gets wasted in the mining, processing and polishing stages which have a serious impact on the environment. The processing waste is dumped and threatening the aquifer. Therefore, it has become necessary to reuse these wastes particularly in the manufacture of concrete products for construction purposes. The main goal of this study is to demonstrate the possibility of using marble wastes as a substitute rather than natural aggregates in concrete production. The paper presents the study methodology, the characterization of waste marble aggregates and various practical formulations of concrete. This experimental investigation was carried out on three series of concrete mixtures: sand substitution mixture, gravel substitution mixture and a mixture of both aggregates (sand and gravel). The concrete formulations were produced with a constant water/cement ratio. The results obtained show that the mechanical properties of concrete specimens produced using the marble wastes were found to conform with the concrete production standards and the substitution of natural aggregates by waste marble aggregates up to 75% of any formulation is beneficial for the concrete resistance.

Mucteba Uysal et al (2012) experimentally investigated the effect of mineral admixtures on mechanical properties, chloride ion permeability and impermeability of self-compacting concrete. The objective of this study was to evaluate the effectiveness of various mineral admixtures in producing self-compacting concrete (SCC). For this purpose, fly ash (FA), granulated blast furnace slag (GBFS), limestone powder (LP), basalt powder (BP) and marble powder (MP) were used. It was concluded that among the mineral admixtures used, FA and GBSF significantly increased the workability of SCC.

Vijayalakshmi et al (2012) experimentally investigated the suitability of granite powder (GP) waste as a substitute material for fine/natural aggregate in concrete production. The physical and chemical characterization of the GP waste was also addressed. The cubes and cylinders were prepared by 0%, 5%, 10%, 15%, 20%and 25% of fine/natural aggregate substituted by GP waste. Finally it is recommended that the replacement of natural sand by GP waste up to 15% of any formulation is favorable for the concrete making.

Researches carried our so far are boundless in the mechanical properties of concrete blended with granite powder waste however, more investigation is required in order to understand structural behaviour of granite powder concrete at the structural member scale. The purpose of this study is to experimentally investigate compressive behaviour of RC columns containing granite industry waste and the experimental parameter is grade of concrete. Granite concrete (GC) with the sand replacement of 0% and 15% was used in this study.

II. EXPERIMENTAL PROGRAM

2.1.MATERIALS USED

2.1.1.CEMENT

In the present investigation OPC 53 Grade PENNA brand cement confirming to IS: 12269-(1987) was used and its properties are tabulated in Table 1.

Sl.No	Physical properties of cement	Results
1	Specific gravity	3.15
2	Standard consistency (%)	33%
3	Initial setting time (min)	30
4	Final setting time (min)	690

Table 1: Properties of Cement

2.1.2. FINE AGGREGATE

The fine aggregate used in this experimental investigation was natural river sand confirming to zone II as per IS: 383-1987. Specific Gravity of sand is 2.7

2.1.3. COARSE AGGREGATE

Crushed aggregates particles passing through 19mm and retained on 12.7mm I.S sieve was used as natural aggregates which met the grading requirements. Specific Gravity of sand is 2.67

2.1.4.GRANITE POWDER

It is a fine powder collected as a by-product of the GRANITE production that was purchased from Moon Traders, Madurai.

1	Color	Greyish white
2	Specific gravity	2.386

3	pH	6.7
4	Gradation	55% of granite powder is less than 150micron and the 31% of particles are less than 45micron
5	Moisture	0.37%
6	Specific surface area	351m^2/kg

Table 2: Properties of silica fume

2.1.5.SUPER PLASTICIZER

A vertical slump of 28 cm was aimed and it was achieved by adding commercially available super-plasticizer SUPAFLO PC 711.

2.2. MIX PROPORTIONING

Grade of concrete	**M20 grade of concrete**		**M30 grade of concrete**	
Mixture	**Control Mixture**	**CGP 15%**	**Control Mixture**	**CGP 15%**
W/C ratio	0.5	0.5	0.4	0.4
Water (kg/m^3)	177	177	177	177
Cement (kg/m^3)	354	354	443	443
Sand (kg/m^3)	645.4	556.24	618.9	526.065
Coarse Aggregate (kg/m^3)	1189.6	1189.6	1140.9	1140.9

Granite Powder (GP) (kg/m^3)	0	98.16	0	92.835

Table 3: Mix proportioning

III. EXPERIMENTAL METHODOLGY

The specimen of standard cube of 150mm x 150mm x 150mm and columns of 600mm x100mm were used to determine the compressive strength of concrete. For each proportion of specimen granite powder waste is added and three cubes and three columns were casted. The constituents were weighed and the materials were mixed by machine mixing and vibrated by hand compaction. The granite powder is replaced 15% by fine aggregate were casted. The water cement ratio adopted was 0.40 through all the mix proportions. The concrete was filled in different layers and each layer was compacted. The specimens were demoulded after 24 hrs, cured in water for 7 and 28 days and Compression Testing Machine (CTM) with capacity of 2000KN were used to test its compressive strength. All columns were tested in universal testing machine of capacity 400 kN to determine compressive strength.

IV. RESULTS AND DISCUSSIONS

4.1. COMPRESSIVE STRENGTH

In concrete, the compressive strength is a considered as the most important mechanical properties. Substitution of GP in concrete affected the compressive strength development process over time depending on their characteristics. Compressive strength value of all mixtures is listed in the below Table .4.

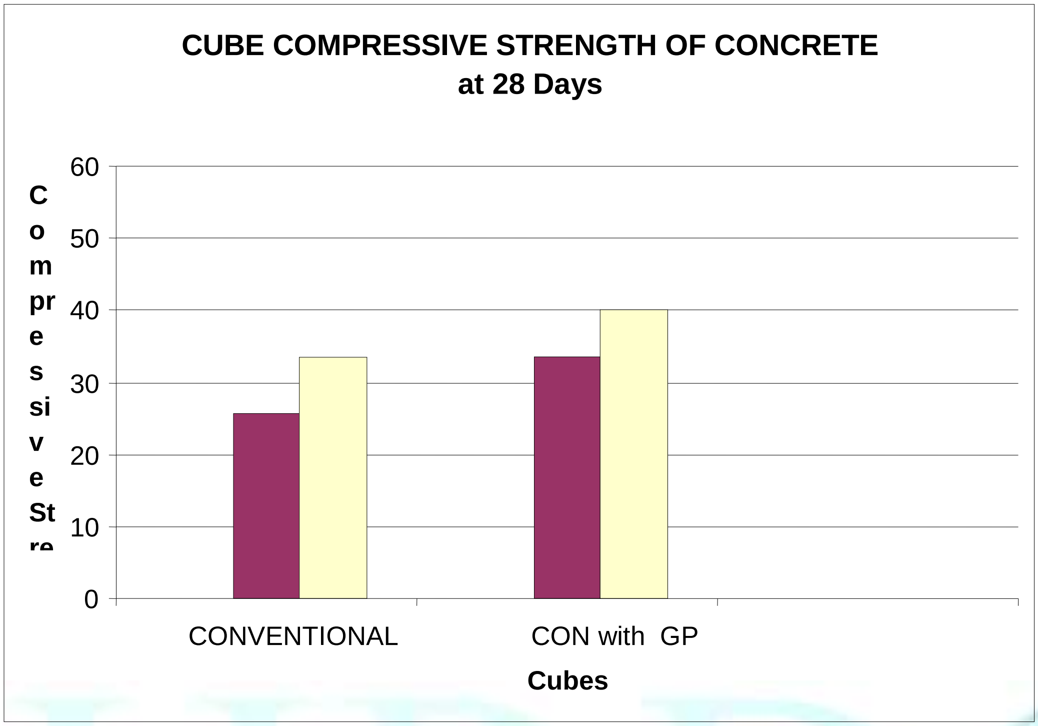

Figure 1: Average Compressive Strength Of Cube At 28 Days

Sl.No	Column Designation	Failure Load (kN)	axial deformation (mm)	%of increase in deformation
1	RCC-20-0% (1)	178.86	2.3	--
2	RCC-20-0% (2)	135.58	2.7	--
3	RCC-20-15% (1)	136.8	2.8	1.56%
4	RCC-20-15% (2)	107.16	2	1%
5	RCC-30-0% (1)	203.2	3.2	--
6	RCC-30-0% (2)	146.8	2.2	--
7	RCC-30-15% (1)	139.14	3.3	1.6%

8	RCC-30-15% (2)	102.42	2.1	1.55%

Table4. Compressive strength value of all mixtures

4.2MOMENT CARRYING CAPACITY

The main objective of this study is to incorporate the GP waste in concrete production without affecting the structural properties of the concrete. As expected, the inclusion of does not affect the structural behaviour of the concrete and the compressive strength of the concrete relatively equal to the concrete without GP waste which is shown

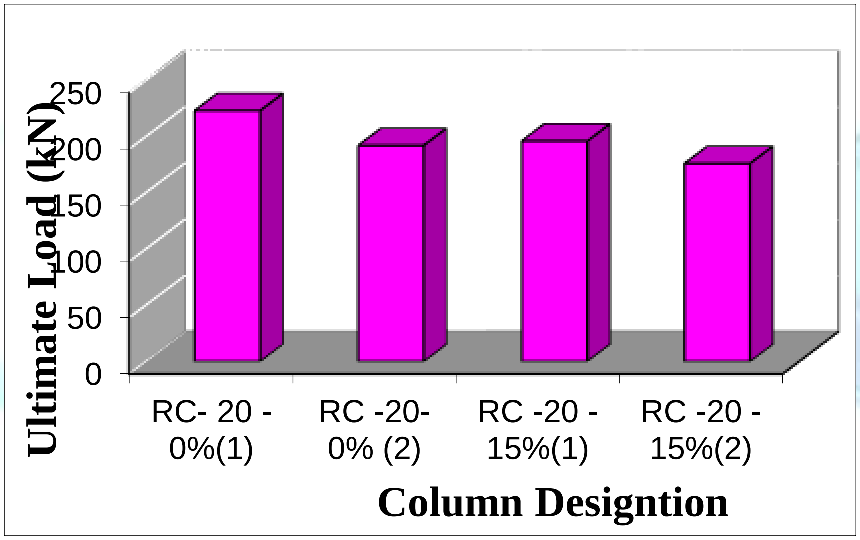

Figure 2.Compressive strength of all columns with M20 grade-comparision

The results obtained from 8 columns were revealed that the compressive strength of the column with 15% of GP waste is only 5% lesser than that of column without GP waste in both grades. The decrease in compressive strength is attributed to increased specific surface area and specific density of the GP waste which is create the increases in demand of paste volume and reduce the workability of the concrete resulting poor compactness. From the above observation it is suggested that the concrete with 15% of GP waste can be used in the structural concrete.

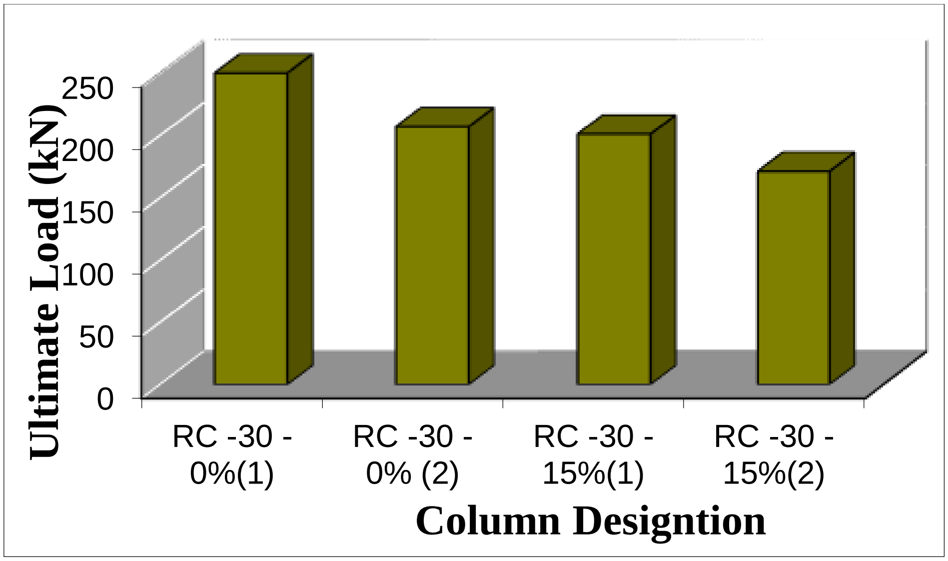

Figure 3.Compressive strength of all columns with M30 grade-comparision

V. CONCLUSIONS

The following conclusions may arrive from the experimental works carried out. In this project GP waste are used to minimize the cost and ensure sustainable development and partially replacement of fine aggregate with GP waste this will suggest a sustainable replacing methodology are used to develop strength and effect of partially replacement fine aggregate with GP reinforced concrete has been studied.

Compressive strength:. It can be seen that cube with GP waste provide better results. M20 and M30 cubes with the partially replacement of fine aggregate with GP results in increase in compressive strength than conventional concrete. All the columns were prepared by with and without GP waste in both grade of concrete were failed by cracking cum crushing failure, however the predominant failure mode of the column is crushing failure. In addition the initial cracking formation of RC column with GP waste has started at the load 60% of its ultimate load and these results are fairly agreed with the control column results. The load-deformation behaviour of columns with GP waste in both grades was relatively coinciding with the load-deformation behaviour RC columns without GP waste.

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