



Partial Replacement of Cement in Concrete with Granite Waste Powder

Jerin Jose¹, Akhil Sunil², Gijo Paul³, Sandra Rojas⁴, Texla Felix⁵

Assistant professor, Department of Civil Engineering Viswajyothi College of Engineering and Technology, Vazhakulam, Kerala, India¹

Final Year Student, Department of Civil Engineering Viswajyothi College of Engineering and Technology, Vazhakulam, Kerala, India^{2,3,4,5}

ABSTRACT: The most widely used man made material in the world is concrete made with Portland cement. The production of concrete result in emission of co2 which result in global warming. This will reduce the sustainability and effect the environment to reduce the emission of CO2 ,thus we should reduce the production of cement by replacing it with cementations' material so that more natural resources are saved . Hence an attempt is made to replace cement by granite waste powder in concrete

By studying the effects of blending of granite dust powder with cement on the performance of fresh and hardened concrete, the possibility of using granite dust powder in concrete can be examined. Replacement of cement was done in different percentage and they were 5%, 10 ,15% ,20% by weight of cement . For each replacement compressive strength , splitting tensile strength and flexural strength was conducted . These test were conducted after 28 days curing. From the test result 15% replacement of cement with granite dust powder is optimum .Since granite powder is free of cost it seems to be more economical

KEYWORDS: concrete, cementations material, blending, granite dust powder,

I. INTRODUCTION

Man made material like concrete is widely used in the construction field .concrete is at 2nd place in the list of most consumed material in the world followed by water. Cement is the major constituent in concrete .its production satisfy the rapidly growing infrastructure demand all over the the world .Energy consumption ,consumption of raw material and emission of toxic and harmful oxides (nitrogen oxide, sulphur dioxide, carbon monoxide) result due to production of cement .Since India is a developing country therefore require large cement production for its infrastructure growth. Indian cement industries produced 217 Mt of cement in 2010 which increase to 280Mt in 2017 and it will be increased by 6% to 7% in the year 2025The key reason behind their increase is rapid urbanisation, industrialisation and housing needs in this country . to safe environment ,the cement production should be reduced .hence the reuse of waste material has been emphasised . these waste can be used to produce cementations material so the natural resources are used more efficiently and the environment is protected from waste disposal Among these waste granite waste which is the by product of granite processing factory is used as cementations material in this study .most researchers showed positive result and benefit regarding this matter the properties of granite is shown in table 1

<ul style="list-style-type: none"> • Specific gravity g/cc • Chemistry • Density(lbs/ft³) • Melting point • Solubility in water • Boiling point • Thermal conductivity • Particle shape • colour 	<p>2.77-2.82 Felsic 166.5 Approx.3000 Insoluble Approx. 4000 ~2.2 Irregular Pink, light gray, dark grey</p>
--	---

Table 1: physical properties of granite dust powder

In this experimental study, the granite dust powder is replaced in several percentage (5%, 10%, 15%). The main objective is to study the influence of partial replacement of cement with granite dust powder, and to its compressive strength, flexural strength, splitting tensile strength with conventional M₂₀ grade concrete.

II. EXPERIMENTAL TECHNIQUE

Cement: As per IS:12269-1987, Ordinary Portland cement corresponding to 53 grade of Chettinad was used. Different test were conducted on cement and various physical and chemical characteristics were determined according to the procedure.

Granite powder: Granite powder was collected from the local region which had to be used for conducting the test. Granite powder required for the project was collected from the Rajasthan marbles, Kadamattam. Since only a small quantity of the material was required it was only necessary to collect from one industry.

Fine aggregate: As per IS:383-1970, manufactured sand conforming to zone 2 which relates to the fact that it is free from organic matter, sit and passing through 4.75mm sieve was used. The fine aggregate collected from the local region was subjected for conducting the test for determining its properties and results were obtained.

Coarse aggregate: From the local region coarse aggregate required for the project was obtained and it corresponds to 20mm size aggregate. Later, the specific gravity and fineness modulus which are considered to be the physical properties were determined.

Water: The water used for the project was potable water. A temperature of 20-30 degree Celsius was maintained for the mixing of water.

Test conducted:

Compressive strength: Compressive strength is an important parameter in the project. The strength of concrete specimen as a matter of fact depends upon cement aggregate, bond, w/c ratio, curing temperature and size of specimen. For conducting the test cube was prepared in mould of dimension 150*150*150cm. As through the project it is clearly understood that there are differences in 28days compressive strength. It is clearly observed that the compressive strength initially increase with partial replacement of granite powder and afterwards it reaches an optimum value at 15% replacement of cement and then decreases its value. Concrete cube which is casted is tested for 28days curing period and values were obtained which is explained later.

Tensile strength: Concrete tends to possess high compressive strength whereas it takes lower tensile strength. The tensile strength of the concrete can be increased by the additives like steel which we name as reinforced concrete. In this project we can observe change in tensile strength of concrete with replacement of granite powder partially. For determining the tensile strength cylinder specimen were casted in mould of dimension 150*300cm. Tensile strength value is observed to have fluctuations. Initially tensile strength value increases and reaches an optimum value at 15% replacement and then decreases. Tensile strength values obtained through the test are recorded

Flexural strength: Flexural strength may be defined as the ability of a beam or slab to resist failure in bending. As per IS:516-1959 flexural strength of concrete has been determined. For conducting the test the beam was casted in mould of dimension 100*100*500cm. In case of the test results of flexural strength, the samples of concrete mix show same behaviour which was recorded.



Fig 1 : Preparing materials and mixing process

III. EXPERIMENTAL RESULTS

MIX DESIGN

Mix design of concrete = M20

M20 ratio = 1:1.5:3

For 50Kg of cement, 250kg of (course aggregate and fine aggregate), 30 litres of water

Coarse aggregate = fine aggregate = 250

Therefore proportion of fine aggregate : course aggregate= 1.2

Quantity of fine aggregate = $250 \times 1/3$

Quantity of coarse aggregate = $250 \times 2/3$

Quantity of water = 30litres

Water cement ratio = 30/50

Proportion = 50: 250/3: 500/3 : 30

= 1: 5/3 : 10/3 : 3/5

= 1 : 1.67 : 3.30 : 0.6

= 6.61

Quantity of material required for 1 m³ of concrete

1m³ of concrete = 2400kg

Weight of cement = $2400 \times 1/6.61 \text{kg} = 363.086 \text{kg}$

Weight of fine aggregate = $2400 \times 1.67/6.61 \text{kg} = 606.354 \text{kg}$

Weight of coarse aggregate = $2400 \times 3.34/6.61 \text{kg} = 1212.708 \text{kg}$

Weight of water = $2400 \times 0.6/6.61 \text{kg} = 217.851 \text{kg}$

MIX CALCULATION OF CUBE

Volume of 1 cube = 0.15m³

Taking 20% excess = 4.05×10^{-3}

Weight of cement = 1.470kg

Weight of fine aggregate = 2.456kg

Weight of course aggregate = 4.911

Weight of water = 0.882

MIX CALCULATION CYLINDER

Volume = $\pi/4 \times 0.15^2 \times 0.3 = 5.301 \times 10^{-3} \text{kg}$

Taking 20% excess = $6.3612 \times 10^{-3} \text{kg}$

Weight of cement = 2.302kg

Weight of fine aggregate = 3.857kg

Weight of course aggregate = 7.714kg

Weight of water = 1.385kg

MIX CALCULATION OF BEAM

Volume = 100cm × 100cm × 500cm = $5 \times 10^{-3} \text{kg}$

Taking 20% excess = $6 \times 10^{-3} \text{kg}$



Weight of cement = 2.178 kg
 Weight of fine aggregate = 3.638kg
 Weight of course aggregate = 7.276kg
 Weight of water = 1.307kg

Table 2 : compressive strengths of cubes with different proportion of granite waste powder (kg)

Mix design	Nominal mix	M 1	M2	M3	M4
% replacement of granite dust powder	0	5	10	15	20
Water content	0.6	0.6	0.6	0.6	0.6
Cement content	2.94	2.793	2.646	2.449	2.352
Granite content	0	0.747	0.294	0.491	0.588
Fine aggregate	4.912	4.912	4.912	4.912	4.912
Course aggregate	9.822	9.822	9.822	9.822	9.822
water	1.764	1.764	1.764	1.764	1.764
Compressive strength (28 days)N/mm ²	22	32	33.9	27.9	29.7

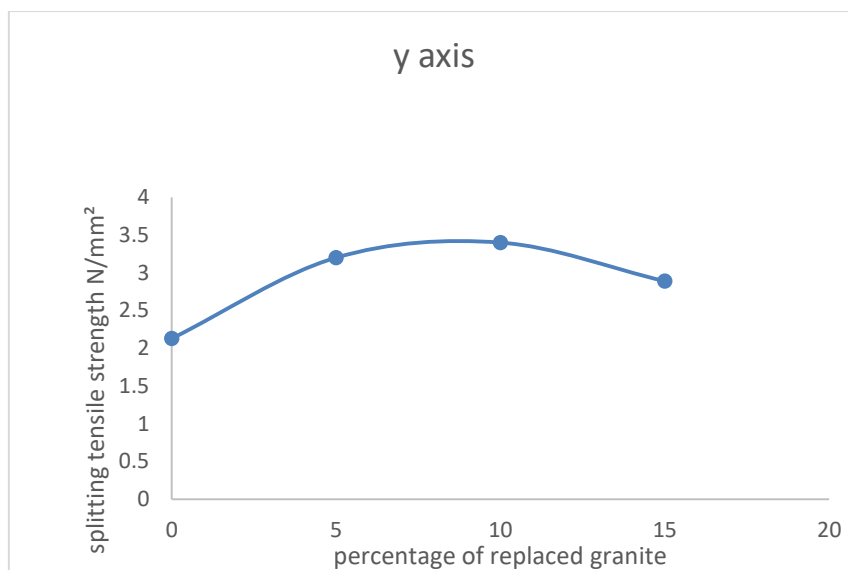
Table 3: split tensile strength of granite powder values for different proposition (kg)

Mix design	Nominal mix	M 1	M2	M3	M4
% replacement of granite dust powder	0	5	10	15	20
Water content	0.6	0.6	0.6	0.6	0.6
Cement content	6.927	6.581	6.2343	5.887	5.5416
Granite content	0	0.346	0.6927	1.040	1.3854
Fine aggregate	11.571	11.571	11.571	11.571	11.571
Course aggregate	23.142	23.142	23.142	23.142	23.142
water	4.155	4.155	4.155	4.155	4.155
splitting strength (28 days)N/mm ²	2.13	3.2	3.4	3.89	2.93

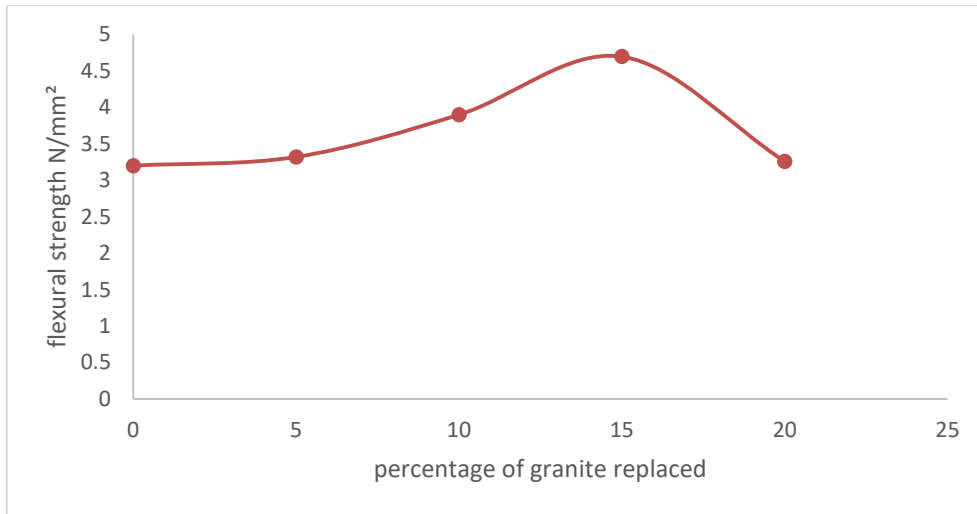


Table 4: Flexural strength of granite powder values for different proposition(kg)

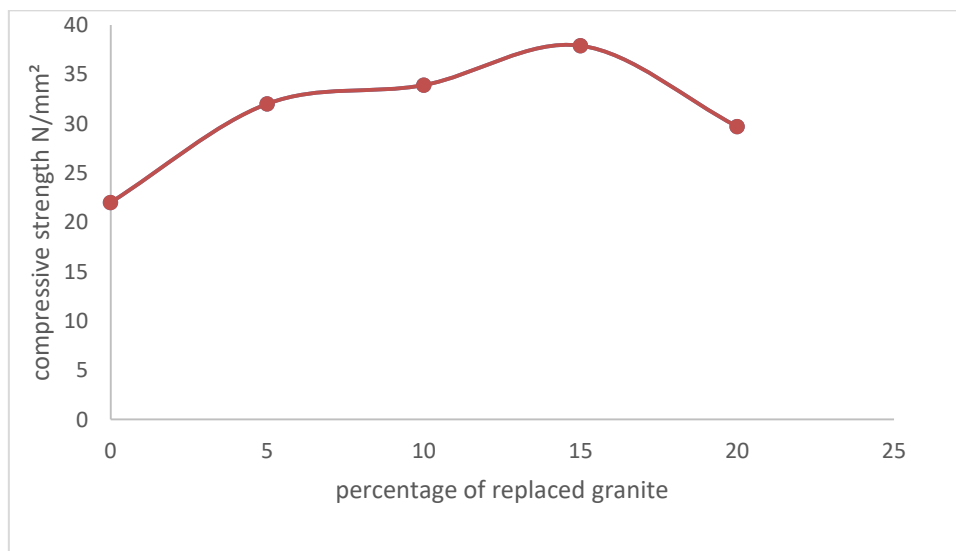
Mix design	Nominal mix	M 1	M2	M3	M4
% replacement of granite dust powder	0	5	10	15	20
Water content	0.6	0.6	0.6	0.6	0.6
Cement content	2.178	2.0691	1.9602	1.8513	1.7424
Granite content	0	0.1089	0.2178	0.3267	0.4356
Fine aggregate	3.638	3.638	3.638	3.638	3.638
Course aggregate	7.276	7.276	7.276	7.276	7.276
water	1.307	1.307	1.307	1.307	1.307
Flexural strenght(28 days)N /mm ²	3.20	3.32	3.9	4.7	3.26



Graph :1



Graph: 2



Graph:3

IV CONCLUSION

Experimental investigation carried as part of our project subtitled “partial replacement of cement in concrete with granite”. Observation were made regarding for compressive strength , split tensile strength, and flexural strength of concrete. So it was found that compressive strength increased when the cement was partially replaced with granite . the optimum value of compressive strength was obtained at 15 % replacement and was found to be Split tensile strength and flexural strength was also found to be resulting increased value and optimum at 15% replacement of cement and was found to be .

Based on our experiment investigation we have concluded that granite waste to some extend imparts strength and is environment friendly.

REFERENCES

- [1]. The cement sustainability initiative: our agenda for action July 2002, World business council for sustainable Development.
- [2]. The cement sustainability initiative: recycling concrete 2006, World business council for sustainable Development.



- [3]. Low carbon technology roadmap for the Indian cement sector: status review 2018, World business council for sustainable Development.
- [4]. Sharma S., Gupta T., and Sharma R.K., Assessment of Mechanical Properties of Concrete Containing Slurry Waste, International Journal of Engineering, 29,2016, 599-605.
- [5]. Ying P., Liu F., Ren S. and Dong G., The research on the effect of granite powder on concrete performance, Applied Mechanics and Materials 204, 2012, 3760-3764.
- [6]. Elmoaty A.E.M, Mechanical properties and corrosion resistance of concrete modified with granite dust, Construction and Building Materials 47, 2013, 743-752.
- [7]. Chowdhary P.L., Studies on strength properties of Effect of waste powder on the compressive strength of concrete, Journal of Environmental science, Computer Science and Engineering & Technology, 4, 2015, 716-727.
- [8]. Kumar Y.Y., Vardhan C.M.V. and Anitha A., Use of granite waste as partial substitute to cement in concrete, International Journal of Engineering Research and Applications, 5, 2015, 25-31.
- [9] Blessen Skariah Thomas a, Alok Damare b, R.C. Gupta, "Strength and durability characteristics of copper tailing concrete", Construction and Building Materials 48(2013)894-900.
- [10] Garas G. L., Allam M. E. and Bakhoum E. S., Studies undertaken to incorporate granite waste in green concrete production", ARPN journal of engineering and applied sciences vol.9,September 2014.
- [11] Y. Yaswanth Kumar^{1*}, C.M. Vivek Vardhan¹, A. Anitha," Use of granite waste as partial substitute to cement concrete", Y. Yaswanth Kumar et al. Int. Journal of Engineering Research and Applications ISSN: 2248-9622, Vol.5, Issue4, and (Part-6) April2015.
- [12] Dr. T. Felix Kala, Effect of granite powder on strength properties of concrete", International journal of engineering and science vol.2, Issue 12 (May 2013).