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Experimental Study On M-30 Concrete Partial Replacement Of Fine Aggregate With Dolomite

[1]D. Yadagiri, [2]Ch.Venkatesh Naidu, [3]G. Lakshmi Pujitha, [4] Ch. Gopi Srinu, [5] P. Srilakshmi

[1]Student, [2]Student, [3]Student, [4]Student, [5] Asst. Professor

[1,2,3,4,5]Department of Civil Engineering

[1,2,3,4,5]R.V.R.&J.C. College of Engineering, Guntur, Andra Pradesh, India

ABSTRACT: This study aimed at investigating the effect of Dolomite material as partial replacement of fine aggregate on strength properties of concrete. The conventional concrete is made up of cement, fine aggregate, coarse aggregate and water, and the effect of aggregate in concrete properties are very important. This project attempts to study the use of dolomite Aggregate as fine aggregate replacement to crushed sand considering the increasing demand from construction industry and depleting crushed sand availability, in this regard dolomite Aggregate as fine aggregate (FA)replacement might be a sustainable option. Further dolomite Aggregate was chosen for this study, considering its local availability in abundance in the region of Guntur and its transportation within the region proves to be cost effective in comparison with crushed sand .Concrete design mix were prepared to achieve concrete grades of M30.Hence, in this research, we have proposed an eco-friendly solution by investigating the utilization of Dolomite aggregate with 0, 10, 20 and 30% as fine aggregate in concrete .Dolomite aggregate was characterized to determine its suitability as fine aggregate by determining physical and chemical properties as well as investigating its morphology at micro and macro level. Thereafter, in fresh state, the Dolomite aggregate concrete was tested for slump, shrinkage and density while in hardened state; it was tested for Compressive Strength, Split Tensile Strength, Flexural Strength, Ultrasonic pulse velocity, and Rebound Hammer at the age of 7, and 28 days. At 20% replacement of fine aggregate maximum strength shall be occurred

Index Terms - – Dolomite Aggregate, Compressive Strength, Split Tensile Strength, Flexural Strength

I. INTRODUCTION

The concrete industry is, in fact, a giant one, having a worth of over $137 billion. Most of the structures you see are made of concrete. Being the most widely used construction material globally, concrete provides the foundation for all kinds of infrastructures. Each year, its production rate is about 10 billion tons because of its versatile and robust usage. Concrete is a mixture of cement, fine aggregates, coarse aggregates, and water. It is composed of mainly cement, fine aggregate, coarse aggregate and water. River sand is one of the most widely used fine aggregate for concrete. With an increasing in construction activities the demand for river sand has also been increased. As a result, it has been mined at a high rate depleting its natural resources causing serious environmental issues and also it is high expensive in cost. There is a need to replace the fine aggregate either completely or partially with an alternative material that can satisfy the properties required for concrete which is cost effective and at the same time sustainable. Dolomite rock available across India. The crushed particle of dolomite rock is used as partial replacement of coarse aggregate and FA. The powder which was comes from crushed stone dolomite also useful for partial replacement of cement. Disposal of dolomite waste is a very severe problem. This experimental study has been carried out to assess the effect of partial replacement of fine aggregate by dolomite waste and workability, compressive strength and flexural strength of concrete.

II. EXPERIMENTAL MATERIALS

Cement is of IS 10262:2009 Confirmed 40 grade of OPC as per IS Zone III fine aggregate of natural sand having specific gravity 2.95 similarly IS 383:2016 confirmed 40mm, 20mm and 10mm size stone aggregate. To make concrete, you'll need four basic ingredients: cement, sand, aggregate, water, Dolomite aggregate.

PHYSICAL PROPERTIES OF DOLOMITE

Table.1

Colour	White
Streak	White
Lustre	Vitreous
Cleavage	Perfect, Three Directional
Mohs Hardness	3.4 – 4
Crystal system	Hexagonal
Tenacity	Brittle

III. EXPERIMENTAL PROGRAM

The description of propotion of mix design

Table.2 Mix propotion

Cement	Coarse Aggregate	Fine Aggregate	Water Cement Ratio
1	3.16	1.73	0.416

By using the above mixed proportion concrete mixes were prepared concrete cubes of size 150mm x 150mm x 150mm, concrete cylinder of size 150mm x 300mm and concrete beams of size 700mm x 150mm x 150mm were casted. these casted specimens were placed in the curing tank. After de-molding until the day of testing. For testing this specimen UTM is used to get compressive flexural split tensile strengths. After 7 days and 28 days of age compression tests were conducted to specimens and similarly flexural strength test and split tension test were performed to specimen at age of 28 days.

IV. RESULTS AND DISCUSSION

In this research Dolomite aggregate is used as a partial replacement material to fine aggregate. The designations given for compression, tension, flexural strength

Percentage (%)	Compressive Strength		Split Tensile Strength		Flexural Strength	
	7days(N/mm)	28 days	7days	28days	7days	28days
Dolomite-0% Fine aggregate-100%	27.8	37.6	1.57	1.88	3.32	4.8
Dolomite-10% Fine aggregate-90%	34.28	49.8	1.88	2.01	3.35	5.01
Dolomite-20% Fine aggregatre-80%	40.20	52.50	1.77	2.24	3.1	4.71
Dolomite-30% Fine aggregate-70%	30.10	40.30	1.50	1.85	3.05	4.52

Table.3

provides the compression, split tension, flexural strength of concrete with partial replacement of dolomite

Figure 1 Dolomite

Figure 2 Compression

Graph Representation

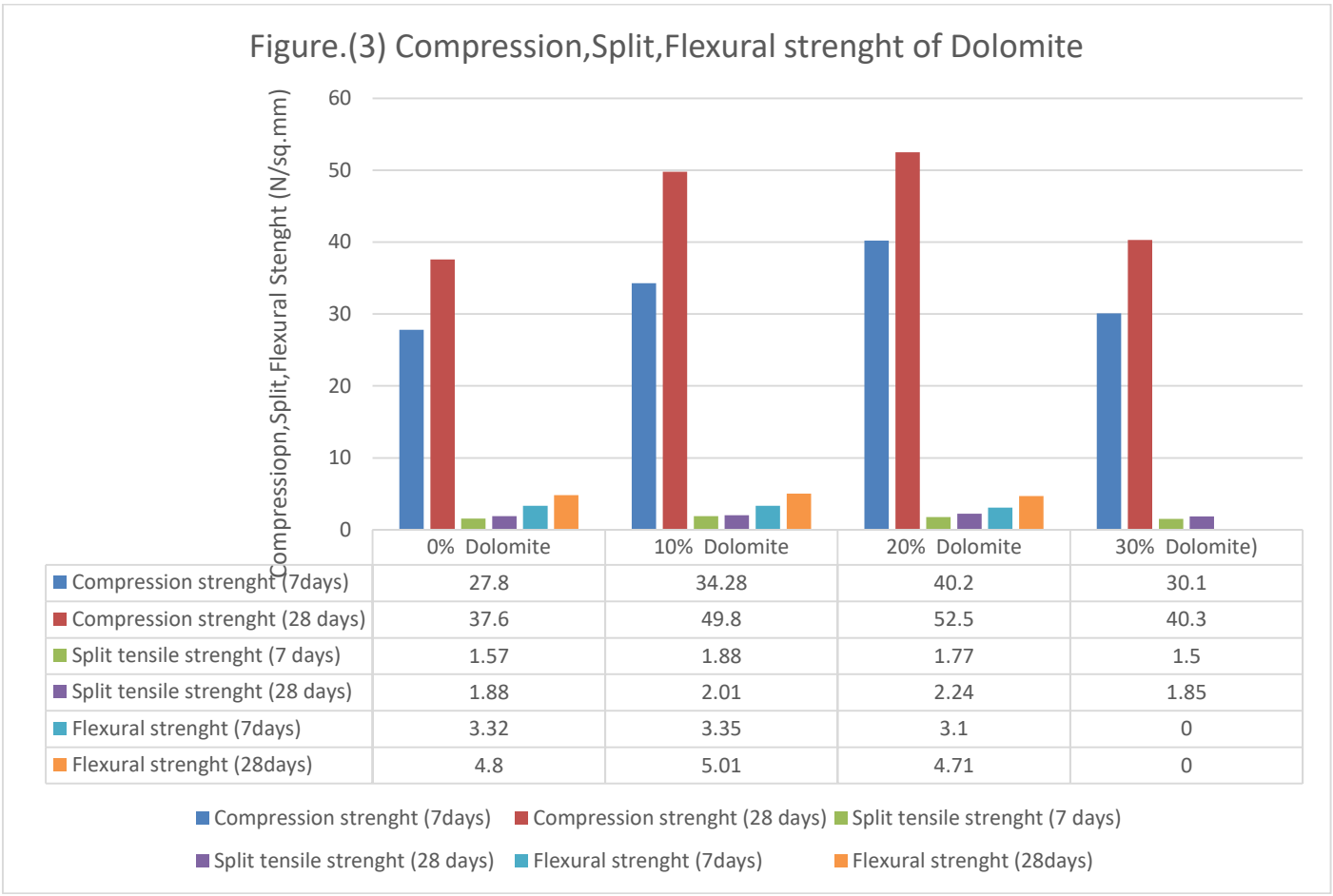

Table.3

Ultra Sonic Pulse Velocity

Percentage of Dolomite	UPV(m/s) 28 days	Quality Grading
Dolomite-0%	5108	Excellent
Dolomite-10%	5289	Excellent
Dolomite-20%	5464	Excellent
Dolomite-30%	4717	Excellent

Table.4

Rebound Hammer Test

z	Avarage Rebound Number (N/sq.mm)	Quality of Concrete
0% Dolomite	32	Good
10% Dolomite	39	Good
20% Dolomite	44	Excellent
30% Dolomite	33	Good

4.1 Compressive Strength

On analyzing the above test results the compressive strength results show that 20% dolomite replacement yields the highest strength at both 7 days (40.20 N/mm²) and 28 days (52.50 N/mm²), surpassing the control mix and other replacement percentages. The 10% replacement also shows significant strength gains, with values of 34.28 N/mm² at 7 days and 49.8 N/mm² at 28 days.

4.2 Flexural Strength

On analyzing the above test results the flexural strength results show that at 7 days, the control mix (0% dolomite) and 10% dolomite replacement have comparable values of 3.32 N/mm² and 3.35 N/mm², respectively. At 28 days, the 10% dolomite replacement exhibits the highest flexural strength of 5.01 N/mm², while the control mix shows a value of 4.8 N/mm². The 20% and 30% replacements have slightly lower flexural strengths at 28 days.

4.3 Tensile Strength

From the test results the split tensile strength results show that at 7 days, the 10% dolomite replacement yields the highest value of 1.88 N/mm², while at 28 days, the 20% dolomite replacement exhibits the highest value of 2.24 N/mm². The control mix (0% dolomite) and 30% replacement show lower split tensile strengths compared to the 10% and 20% replacements.

4.4 Ultrasonic Pulse Velocity

The Ultrasonic Pulse Velocity (UPV) test results show that all mixes, including the control (0% dolomite) and dolomite replacements (10%, 20%, and 30%), exhibit "Excellent" quality grading according to the UPV values at 28 days. The UPV values range from 4717 m/s to 5464 m/s, with the 20% dolomite replacement showing the highest value of 5464 m/s.

4.5 Rebound Hammer

The Rebound Hammer Test results show that the 20% dolomite replacement exhibits the highest average rebound number of 44, indicating "Excellent" quality concrete. The control mix (0% dolomite) and other dolomite replacements (10% and 30%) show "Good" quality concrete, with average rebound numbers ranging from 32 to 39.

Conclusion

Based on the experimental results, the conclusions drawn are as follow:

- The concrete with the use of River sand and dolomite aggregate is found to be economical and environment friendly.
- From the study, it is evident that fine aggregate can be replaced partially for sand upto 30% and the hardened concrete test results obtained were satisfactory for this replacement of fine aggregate.
- The maximum compressive strength is obtained for Mix 3(DA-20%) with a strength of 49.72 MPa at 28 days.
- The maximum split tensile strength occurring for mix 3 (DA-20%) with a strength of 2.24 Mpa at 28 days.
- The maximum Flexural strength occurring for Mix 2(DA-10%) with a strength of 5.01Mpa at 28 days.
- Based on the above values thus, the optimum value is chosen as mix 3 (20%) which consists of Dolomite aggregate 20% as replacement of fine aggregate.
- Satisfactory workability was maintained while mixing the concrete.
- Them main aspect followed in this project is to reduce mining of sand and save the earth from environmental hazards.

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