PARTIAL REPLACEMENT OF CEMENT AND FINE AGGREGATE WITH STONE DUST IN CONCRETE

V. Manoj Kumar
S.K.Naseem, K.Swathi, U.Uday Kumar
Adhoc Lecturer, Student, Student, Student
Department of Civil Engineering
Jawaharlal Nehru Technological University Anantapur College of Engineering
(Autonomous) Pulivendula A.P. (INDIA)

ABSTRACT

Concrete is the major construction material which contains the basic ingredients as binding material, fine aggregate, coarse aggregate and water in maximum proportion. These ingredients should be mixed thoroughly to obtain resulting mixed of desired strength. In this investigation, stone dust, a waste material obtained from crusher plants is used as partial replacement of cement and fine aggregate. M25 grade of concrete was taken for this investigation with a final mix proportion of 1:1.79:2.92 at w/c ratio of 0.50. The replacement levels of cement and fine aggregate with stone dust were 5%, 10%, 15%. The compressive strength of specimens cast for different proportions of stone dust was determined and compare the same with referral concrete. The result showed that the stone dust can effectively been used as partial replacement of cement and fine aggregate without compromising the compressive strength.

KEYWORDS:-Concrete, mix design, workability, compressive strength, split tensile strength.

INTRODUCTION

In the present era of development due to very advanced techniques and materials available and growing standards of living being the construction activities are increasing exponentially with time .It is mainly due to the effect of technology in now days .The increasing construction activities consumes the available natural resources heavily and posing serious environmental problem .However construction activities are leading to the development in social and economical aspects cannot be stopped or reduced for the sake of conservation of natural resources .In view use of non-conventional materials could be an alternative to overcome the problem stated above.

Concrete is the most used construction material in world wide. In India about 370 million cubic meter concrete is used in construction industry annually. The same quantity is expected to increase 30 million m3/ year. As concrete is the good building material used worldwide in various structural members such as slabs, beams, columns, foundation, etc., Concrete has been used as a major construction material. Construction activities are taking place on huge scale all over the world.

Therefore demand of construction materials are increasing day by day. Aggregate is one of the main ingredients in producing concrete which covers 60%-80% of the total for any concrete mix. Strength of concrete is depends on the properties of aggregates and Cement. There is a large demand for alternative materials from industrial waste.The use of stone dust in concrete is beneficial in different manner such as environmental aspects , non-availability of aggregates , strength criteria etc.,Stone dust will be efficient in improving strength characteristics of concrete and it may help in produce high strength characteristics.Stone dust is a waste material, obtain from crusher plants during the process of making of coarse aggregate of different sizes ,every year over 175 million ton stone dust is produced , which is kept in abundance. This used quantity of stone dust requires a suitable disposal site for its easy and safe disposal a huge land area is required to accomplish the requirement which would again be a heavy problem in a country of thickly populated like India.

Stone dust, is an inert material and may be used in concrete making as partial replacement of cement and fine aggregate. Natural sand is basically and mostly used fine aggregate all over India, but as compare to some advanced countries, the volume of concrete

manufactured in India has not been much, many infrastructure and industrial development are increasing and demand of huge amount of natural Sand is growing heavily. Due to this raised demand of natural sand, the illegal and over dredging of river sand are also increased that causes huge digging of river beds which is a very serious environmental threat. The natural sand is one of the main constituent of concrete but due to the involvement of local sand mafia and its non-availability at a time increases its cost. So Governments are restricting the collection of river sand from river bed. In such a situation the crusher dust can be an economical alternative to river sand. Crusher dust is a byproduct generated from quarrying activities involved in the production of crushed coarse aggregate.

Literature Review

This project is taken by the study of different journals as mentioned below. There are so many projects and journals regarding to the partial replacement of fine aggregate with stone dust and partial replacement of cement with stone dust.

But no project is done on STONE DUST AS THE PARTIAL REPLACEMENT FOR BOTH CEMENT AND FINE AGGREGATE. To fill this GAP we taking this investigation. People have used sand and stone for foundations for thousands of years. Significant refinement of the production and use of aggregate occurring during the ROMAN EMPIRE, which used aggregate to build its vast network of roads and aqueducts. The invention of concrete, which was essential to architecture utilizing arches, created an immediate, permanent demand for construction aggregates.

SYED YAQUB ABBAS,V.C.AGARWAL (2015) they studied by taking M25 grade concrete using stone dust as partial replacement at different mix proportions like 10%,20%,30%,40%,50%,60% to the total weight of fine aggregate. They got the maximum compressive strength at 50% replacement. The aim of their project is to study the strength parameters of concrete.

SANDEEP KUMAR SINGH, VIKAS SRI VASTAVA (2014) in their study, they taken M25 grade concrete using stone dust as partial replacement at different mix proportions like 20%, 30%, 40% and 50% to the total weight of fine aggregate. They got the maximum compressive strength at 40% replacement.

Mr. LOKESH KUMAR AND Prof. GAUTAM BHADORIYA (2015) these authors explained that, with 25% cement replacement with fly ash and 40% fine aggregate replacement with stone dust gives the maximum compressive strength of concrete.

MATERIALS AND METHODS

An experimental investigation was conducted to get the strength of specimen made with the use of stone dust in partial replacement of cement and fine aggregate. The strength of conventional concrete and other mix proportions were determined at the end of 7 and 28 days of moist curing. To study the effect of stone dust, cubes and cylinders of a design mix M25 grade concrete were cast. The cubes were tested for compressive strength and tensile strength. The M25 mix proportion was (1:1.79:2.92) taken at w/c ratio of 0.50.

Cement

In the present study, ordinary Portland Cement of Priya brand of single batches was used throughout the investigation. The physical and chemical properties of OPC as determined are given in table 1.

Table 1.properties of cement (method of test refers to IS: 1489:1985)

Properties	Experimental	Codal requirement [IS 1489 (pt-1)-1985]
Normal consistency	31%	
Initial setting time	30 min	(not less than 30 minutes)
Final setting time	10 hours	(not less than 600 minutes)
Fineness of cement (% retained on 75 microns IS sieve)	8.75%<10%	10%
Specific gravity of cement	3.14	3.15

Fine aggregate

The fine aggregate used was locally available river sand, which passed through 4.75 mm. Result of sieve analysis of fine aggregate is given in table 2. The specific gravity of fine aggregate is 2.43 and fineness modulus is 3.94.

Table 2.Sieve analysis for fine aggregate

sl.no	Sieve size	Weight retained (gms)	Cumulative weight retained	Cumulative percentage weight retained	Passing %	Standard % weight passing for zone II
1.	4.75mm	6	6	0.6	99.4	100
2.	2.36mm	63	69	6.9	93.1	75-100
3.	1.18mm	153	222	22.2	77.8	55-90
4.	600mm	543	765	76.5	23.5	35-59
5.	300µ	140	905	90.5	9.5	8-30
6.	150µ	80	985	98.5	9.5	0-10
7.	75 µ	4	989	98.5	7.5	0-10
8.	Pan	4	993	99.3	0.7	0
			Total	394.1		

Fineness modulus=394.1/100=3.94

Coarse aggregate

Locally available coarse aggregate having two fractions of 20mm and 10mm sizes were individually sieved and used in this present study. One fraction completely passed through 20 mm sieve and another 10 mm sieve. For the mix ratio of these aggregates was 60:40 respectively. The combined particle size distribution of coarse aggregate and properties are shown in table 3 respectively.

Table 3.properties of coarse aggregate

Fineness Modulus of 10 mm Aggregate	6.5
Fineness Modulus of 20 mm Aggregate	7.7
Water Absorption	1%
Specific Gravity	2.6

Stone dust

Stone dust was collected from local stone crushing units of Pulivendula. It was initially dry in condition when collected, and was sieved before mixing in concrete.

Result of sieve analysis of stone dust is given in table 3. Specific gravity of stone dust was 2.50 and Water absorption was 0.5%.

Table 4.sieve analysis for stone dust

Sl.no	Sieve size	Weight retained (gms)	Cumulative weight retained	Cumulative percentage weight retained	Passing %	Standard % weight passing for zone II

1.	4.75mm	4	4	0.4	99.6	100
2.	2.36mm	80	84	8.4	91.6	75-100
3.	1.18mm	336	420	42.0	58.0	55-90
4.	600mm	510	930	93.0	7.0	35-59
5.	300µ	70	1000	100.0	0	8-30
6.	150µ	-	-	-	-	0-10
7.	Pan	-	-	-	-	0
			Total	243.8		

Fineness modulus=243.8/100=2.43.

Water
Potable water was used for mixing and curing.

Mix design
The design mix proportion of 1:1.79:2.92 at W/C ratio of 0.50 were used for M25 grade of concrete and the cement content was 394.32 kg/m3, satisfying the requirements of IS-10262-2009.

Curing of concrete
Casting of concrete after the completion of 24 hours mould will be removed then cured by using potable water. The specimen is fully immersed in portable water for specific age of 7, 28 days. After the completion of curing it will be tested.

RESULTS AND DISCUSSION

Casting
The concrete is prepared in laboratory. The concrete is poured into the mould in 3 layers by 25 strokes with tamping rod. The cast specimens are removed after 24 hours and these are immersed in a sump. After curing 7 and 28, days the specimens were removed and these are tested for Compression, and Split tensile strength is found out for concrete which was replaced with stone dust in the proportion of 5%, 10%, 15%. This was to be partial replacement of fine aggregate and cement with stone dust. The results compared with conventional concrete.

Workability
Slump test and compacting factor tests are the most widely used workability tests for concrete. The degree of workability of concrete depends on the values of test results obtained from slump test and compacting factor tests as in table 5

Slump Value: Slump Value =h1−h2, where h1 is Initial height of the cone which is 300 mm and h2 is height of the concrete after removal of the mould.

Table.5 Slump value and compaction factor

Concrete mix	Slump value	w/c ratio	Compaction factor
Conventional concrete	3mm	0.5	0.86
5% replacement	3mm	0.5	0.87
10% replacement	5mm	0.5	0.853
15% replacement	7mm	0.5	0.83

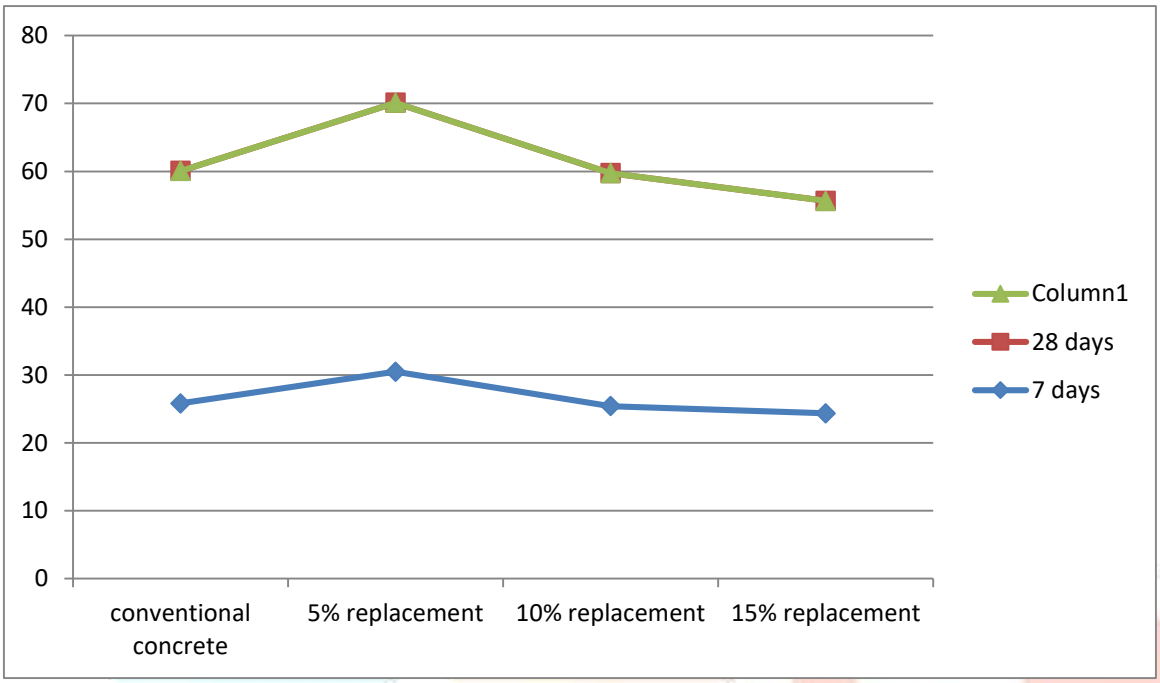
Compressive strength test
The compressive strength of different mixes for 7 and 28 days are shown in Table – 6.Conventional concrete and different mixes of partial replacement of cement and fine aggregate with stone dust in concrete. Compressive strength results are compared by plotting graphs shown in Figure 1.

Table.6 compressive strength for 7 and 28 days

Concrete mix	7 days(N/mm2)	28 days(N/mm2)
Conventional concrete	25.8	34.26
5%	30.48	39.63

10%	25.42	34.31
15%	24.34	31.31

Graphical representation of split tensile strength results for 7 and 28 days



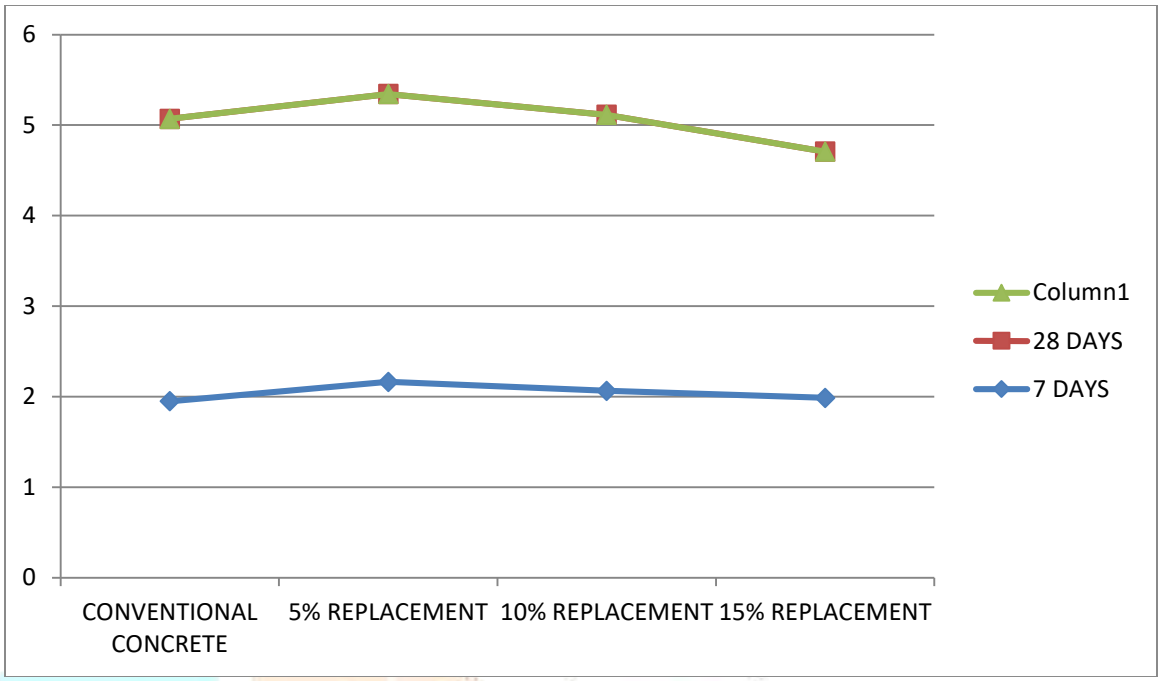
Tensile strength test

The split tensile strength of different mixes for 7 and 28 days are shown in Table – 7. Conventional concrete and different mixes of partial replacement of cement and fine aggregate with stone dust in concrete. Tensile strength results are compared by plotting graphs shown in Figure 2.

Table.7 split tensile strength for 7 and 28 days

Concrete mix	7 days(N/mm2)	28 days(N/mm2)
Conventional concrete	1.95	3.12
5%	2.163	3.18
10%	2.064	3.049
15%	1.987	2.72

Graphical representation of tensile strength results for 7 and 28 days



Conclusion

From the above study, the following conclusions were obtained.

1. Compressive strength of concrete make using stone dust as partial replacement for both cement and stone dust at 5% replacement level is comparable to that of referral concrete both at 7 and 28 days.
2. At 10% replacement level strength is slightly higher than that of referral concrete both at 7 and 28 days.
3. Tensile strength of concrete make using stone dust as partial replacement for both cement and stone dust at 5% replacement level is comparable to that of referral concrete both at 7 and 28 days.
4. At 10% replacement level strength is slightly higher than that of referral concrete both at 7 and 28 days.
5. Both cement and fine aggregate can be effectively replaced by the stone dust.

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