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AN EXPERIMENTAL STUDY ON CONCRETE AS A PARTIAL REPLACEMENT OF SAND WITH STONE DUST AND STEEL SCRAP

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ABSTRACT- *With the still increase in the require of natural river fine aggregate and decrease in its availability, there is an direct need for finding suitable alternatives which can replace fine aggregate partially or at a high proportion. Many research studies investigates the effect of numerous waste products such as Glass powder, Burned Sewage sludge, foundry bed waste, crushed rock dust, building demolition excess in the partial replacement of river fine aggregate. Consumption of Stone dust and steel scrap are one of the lively research area that include the effectiveness of replacement in all the aspects of construction materials. It is very significant to develop eco-friendly concrete from ceramic waste. This theory deals with the experimental study on the mechanical strength properties of M20 grade concrete with the partial replacement of fine aggregate by using stone dust and Steel Scrap. In order to analyze the mechanical properties such as Compressive Strength, Flexural Strength, and Workability the samples were casted with 10%, 20%, 30%, 40% & 50% replacement of fine aggregate using stone dust and steel scrap and tested at a different periods of curing 7 days, 14 days and 28 days. The optimal of percentage addition of stone dust and steel scrap are analyzed considering the needs of mechanical properties of concrete.*

KEYWORDS:- **Stone Dust, Steel Scrap, Compressive Strength, Flexural Strength, Mechanical properties, and Slump for Concrete.**

I. INTRODUCTION

Concrete is a most frequently used construction material which is a mixture of cement, fine aggregate, coarse aggregate and water. It is used for construction of multistory buildings, dams, road pavement, tanks, offshore structures, canal lining. The method of selecting suitable ingredients of concrete and determining their relative amount with the intention of producing a concrete of the required strength durability and workability as efficiently as possible is termed the concrete mix design. The compressive strength of harden concrete is commonly considered to be an index of its extra properties depends upon a lot of factors e.g. value and amount of cement water and aggregates batching and mixing placing compaction and curing. The cost of concrete prepared by the cost of materials plant, the variation in the cost of material initiate from the information that the cement is very costly than the aggregates thus the intent is to produce a mix as feasible from the practical point of view the rich mixes may lead to high shrinkage and crack in the structural concrete and to development of high heat of hydration is mass concrete which may affect cracking. The genuine cost of concrete is related to cost of materials essential for produce a minimum mean strength called characteristic strength that is specific by designer of the structures. This depends on the quality control measures but there is no doubt that quality control add to the cost of concrete. The level of quality control is often an cheap assistance and depends on the size and type of job nowadays researchers, engineers and scientists are trying to improve the strength of concrete by adding the several other economical and waste material as a partial substitute of cement, fine aggregate or as a admixture fly ash, silica fume, steel slag steel chips etc are the few examples of these types of materials. These materials are generally by-product from further industries for example fly ash is a waste product from power plants and stone dust.

If the large amount of waste material generated is used instead of natural material in the construction and industry, there would be three benefits:

1. Conserving natural resources
2. Disposing of waste materials and
3. Freeing up valuable land for their uses

II. MATERIAL USED

1) Cement- The cement used in this experimental project was 43 Grade ordinary Portland cement (OPC) conforming to IS 8112-1989 for casting the specimens of all concrete mixes. Physical properties of cement were calculated and formulated as given below.

Table 1.1 – Cement Properties

Sr. No.	Properties	Test Result
1.	Consistency	34%
2.	Initial Setting Time	38min.
3.	Final Setting Time	8hrs.
4.	Specific Gravity	3.10

2) Fine aggregate- The fine aggregate used for study belongs to the zone I, was procured from the local fine aggregate suppliers and conform all requirements as per IS: 383-1970. The specific gravity test was performed in the laboratory and value achieved is 2.74.

3) Coarse aggregates- Coarse aggregate of 10 mm and 20 mm sizes were used in this study and they conform all requirements as per IS: 383-1970. It was free from dust particles, vegetation, organic matters, and clay. The specific gravity test was performed in the laboratory and value achieved is 2.74.

4) Water- Ordinary water available in the laboratory was used in this investigation both for mixing and curing the concrete specimen as per IS: 456-2000 and as per IS: 3025 – 1964 part 22 throughout the investigation.

5) Stone Dust- Stone Dust is a byproduct of washing Crushed Metals inside the Metal Washing Plant. It can also be found by placing cobblestone inside the Thermal Centrifuge. This material is especially useful in rebuilding worn out soils but can be beneficial on most any soil. First one must have the proper stone available. Glacial till is a good source, also volcanic and sites, lavas or volcanic ash, new or old. However the stones used must have a wide range of minerals available. The problem of producing rock dust is also the energy involved in the grinding and the cost of the equipment.

6) Steel Scrap- Scrap consists of recyclable materials left over from product manufacturing and consumption, such as parts of vehicles, building supplies, and surplus materials. Unlike waste, scrap has monetary value, especially recovered metals, and non-metallic materials are also recovered for recycling.

III. METHODOLOGY

The methodology adopted to complete the objective of the experimental study and execution of work was done in step by step as follow:

1) Concrete Mix- M20 grade of concrete as per the guidelines given in IS: 10262 (2009) and IS: 456 (2000). The design mix of 1:1.5:3 is adopted for casting specimens. Stone dust replaced with sand by 0%, 10%, 20%, 30%, 40% and 50% and steel scrape added by 0.5%, 1%, 1.5%, 2% and 2.5% by weight of sand respectively. The water to cement material ratio (w/c) was maintained at 0.45.

2) Weighing- The quantity of all ingredients of the concrete i.e. cement, stone dust, steel scrape, fine aggregate, coarse aggregate and water for each batch was determined as per the mix design ratio and weighed using weighing machine available in laboratory.

3) Mixing- Process of mixing of different ingredients adopted as per IS: 516-1959 and hand mixing process was adopted for mixing the concrete.

4) Preparation of moulds- Before casting the specimens, all cube, beam and cylinder moulds were cleaned, screwed tightly and oil was applied to all surfaces to prevent adhesion of concrete during casting.

5) Compaction- Placing of concrete in oiled moulds was done in three layers and each layer tamped 25 times with the tamping rod. After tamping the moulds, they were compacted using vibratory machine.

6) Curing- After 24 hours of curing period, all the casted specimens were demoulded from the moulds and marked (to identify the casting batch) and immediately put into the curing tank for a period of 7, 14 and 28 days. The specimens were not allowed to become dry during the curing period.

7) Testing- Specimens were taken out from the curing tank after 7, 14 and 28 days to perform various tests. Three numbers of specimens in each sample were tested and the average value was calculated. Fresh concrete property like workability was examined during casting by slump cone test. Hardened properties were found out by carrying out the experimental work on cubes and beams, which were casted in laboratory and their behavior under test were observed at 7, 14 & 28 days for compressive strength and flexural strength.

IV. RESULTS AND DISCUSSION

As work is carried out in single stages, result of all stage is presented in graphical form. Tests are performed on cubes, beams & cylinders and their 7 days, 14 days & 28 days strengths have been determined. A comparison based on strength of different mix proportions is carried out. A comparison of strengths for 7 days, 14 days and 28 days are also formulated.

1. Slump Cone Test-

The purpose of this test is to determine the workability of concrete mix. Workability means the ease with which mixing, handling, placing of concrete can be done. Concrete is filled in the standard slump cone which consists of a vessel whose shape is frustum of cone. Filling the slump cone with concrete is done in layers of thickness 8cm. After laying each layer, it is compacted with 25 strokes using a rod of 16mm, diameter of 60 cm, long whose striking end is bullet-pointed. After filling the vessel with concrete, the vessel is carefully removed, i.e. lifted. The vertical settlement of the body of concrete is called the slump cone of concrete.

Slump= 85 mm

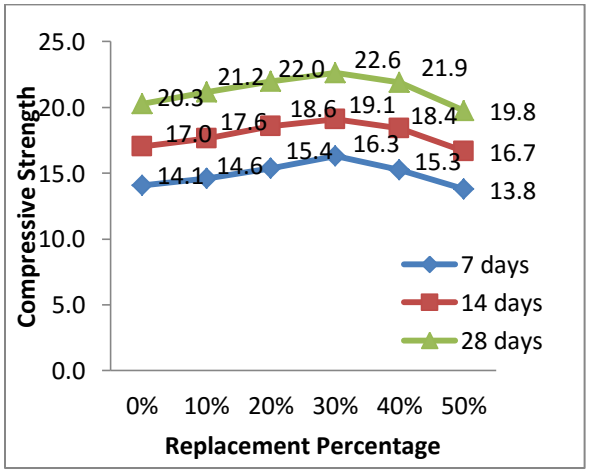
Table 1.2 - Workability

Batch Mix	Cement %	Fine aggregate%	Stone Dust %	Natural Coarse Aggregate%	Steel Scrap by Weight of Concrete %	Slump Test (mm)
1	100	100	-	100	-	85
2	100	90	10	100	-	80
3	100	80	20	100	-	75
4	100	70	30	100	-	70
5	100	60	40	100	-	70
6	100	50	50	100	-	65
7	100	90	10	100	0.5	80
8	100	80	20	100	1	75
9	100	70	30	100	1.5	75
10	100	60	40	100	2	70
11	100	50	50	100	2.5	60

2. Compressive Strength-

(i) As a Partial Replacement of Fine aggregate by Stone Dust

Compressive strength test is performed on 3 cubes of each batch mix for 7 days, 14 days & 28 days. There are 6 batch mixes and each one having 9 cubes. Of these 9 cubes, 3 cubes are tested for 7 days, 14 days & 28 days each. An average of 3 values as formulated in subhead results, are considered for discussions.



Graph-1 Compressive Strength in N/mm² at various age (Days)

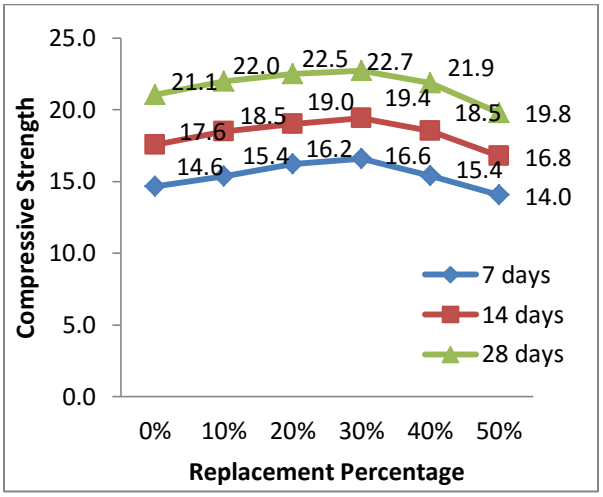
Graph 1 shows variation of compressive strength with respect to % of stone dust measured at 7, 14 and 28 days. It can be seen that 7days compressive strength of the concrete increases by 11.25% at 30% stone dust with fine aggregate.

For 14 days compressive strength value increases up to 10.51% of strength at 30% replacement of stone dust with fine aggregate.

For 28 days compressive strength value increases up to 9.57% of strength at 30% replacement of stone dust with fine aggregate.

(ii) As a Partial Replacement of Fine aggregate by Stone Dust and added steel scrap

Compressive strength test is again performed on 3 cubes of each batch mix for 7 days, 14 days & 28 days. There are 6 batch mixes and each one having 9 cubes. Of these 9 cubes, 3 cubes are tested for 7 days, 14 days & 28 days each. An average of 3 values as formulated in subhead results, are considered for discussions.



Graph-2 Compressive Strength in N/mm² at various age (Days)

Graph 2 shows variation of compressive strength with respect % replacement of stone dust and added steel scrap by weight of concrete measured at 7, 14 and 28 days. It can be seen that 7days compressive strength of the concrete increases by 17.68% at 30% stone dust with fine aggregate and addition of steel scrap by weight of concrete.

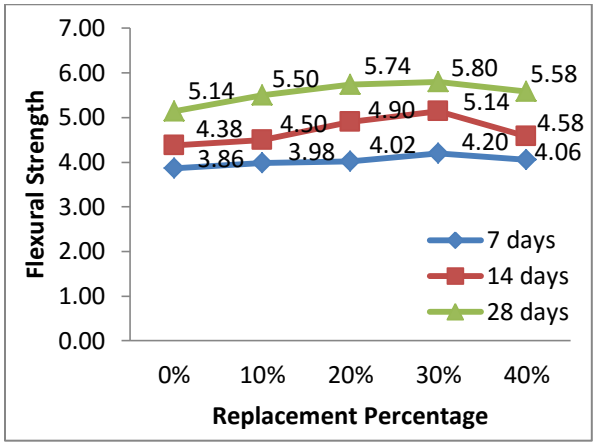
For 14 days compressive strength value increases up to 14.69% of strength at 30% replacement of stone dust with fine aggregate and addition of steel scrap by weight of concrete.

For 28 days compressive strength value increases up to 11.91% of strength at 30% replacement of stone dust with fine aggregate and addition of steel scrap by weight of concrete.

3. Flexural Strength-

(i) As a Partial Replacement of Fine aggregate by Stone Dust

Flexural strength test is performed on 2 beams of each batch mix for 7 days, 14 days & 28 days. There are 6 batch mixes and each one having 6 beams. Of these 6 beams, 2 beams are tested for 7 days, 14 days & 28 days each. An average of 2 values as formulated in subhead results, are considered for discussions.



Graph-3 Flexural Strength in N/mm² at various age (Days)

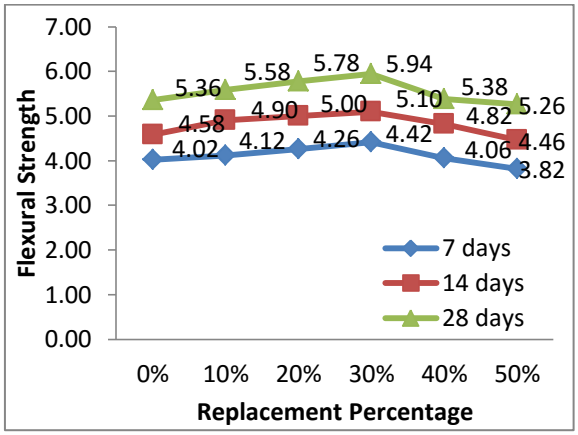
Graph 3 shows variation of flexural strength with respect to % of stone dust measured at 7, 14 and 28 days. It can be seen that 7days compressive strength of the concrete increases by 7.14% at 30% stone dust with fine aggregate.

For 14 days flexural strength value increases up to 11.26% of strength at 30% replacement of stone dust with fine aggregate.

For 28 days flexural strength value increases up to 9.23% of strength at 30% replacement of stone dust with fine aggregate.

(ii) As a Partial Replacement of Fine aggregate by Stone Dust and added steel scrap

Flexural strength test is performed on 2 beams of each batch mix for 7 days, 14 days & 28 days. There are 6 batch mixes and each one having 6 beams. Of these 6 beams, 2 beams are tested for 7 days, 14 days & 28 days each. An average of 2 values as formulated in subhead results, are considered for discussions.



Graph-4 Flexural Strength in N/mm² at various age (Days)

Graph 4 shows variation of flexural strength with respect to % of stone dust measured at 7, 14 and 28 days. It can be seen that 7days compressive strength of the concrete increases by 12.61% at 30% stone dust with fine aggregate and addition of steel scrap by weight of concrete.

For 14 days flexural strength value increases up to 12.61% of strength at 30% replacement of stone dust with fine aggregate and addition of steel scrap by weight of concrete.

For 28 days flexural strength value increases up to 10.38% of strength at 30% replacement of stone dust with fine aggregate and addition of steel scrap by weight of concrete.

V. CONCLUSION

The following conclusions are made from the detailed experimental investigations conducted on the behavior of normal grade conventional concrete.

- As fine aggregate is replaced by stone dust slump getting reduce after all by adding steel scrap by weight of concrete slump getting reduce, so that workability also reduce. Maximum slump observed 85mm which is for conventional concrete.
- Stone dust plays a significant role in increasing the compressive strength of normal concrete by up to 9.57% and 11.91% respectively as compared to conventional concrete at 28 days.
- The experiment on concrete beams shows that improvement in flexural strength. Flexural strength is increased by 9.23% and 10.38% respectively as compare to conventional concrete mix at 28 days.
- Based on results it can be concluded that stone dust and steel scrap can be used as concrete ingredient.

VI. REFERENCES

1) Patel Ashish , Jaiswal SK "Effect of stone dust on strength of concrete" Received 8th April 2017 revised 2nd September 2017, accepted 20th September 2017 ISSN 2278 – 9472 Vol. 6(8), 18-20, September (2017) Res. J. Engineering Sci.

2) NURUZAMAN MD., SAIFUL ISLAM MD., SALAUDDIN M., SAIFUL ISLAM MD. "Strength aspect of concrete using stone dust as a partial replacement of fine aggregate" ISSN 2319-5347, Vol. 04, No. 04, October 2015 International Journal of Advanced Structures and Geotechnical Engineering

3) Prakash K. Shyam , Rao Ch. Hanumantha "Study on Compressive Strength of Quarry Dust as Fine Aggregate in Concrete" Received 10 April 2016; Revised 27 May 2016; Accepted 30 June 2016 Article ID 1742769 Volume 2016,

4) Singh Amit, Srivastava Vikas, Agarwal V.C. "Stone Dust In Concrete Effect on compressive strength" ISSN: 2321-0869 (O) 2454-4698 (P), Volume-3, Issue-8, August 2015 International Journal of Engineering and Technical Research (IJETR)

5) Suribabu A., Rangaraju Dr U., Ravindra Krishna Dr. M. "Behaviour of Concrete on Replacement of Fine aggregate with Quaries Stone Dust as Fine Aggregate" (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 1, January 2015 International Journal of Innovative Research in Science, Engineering and Technology

6) Dr. A.D., Quadri Syed "Effective Utilization of Curshing Dust in Concrete Using Portland pozolana Cement" ISSN 2250-3153 Volume 3, Issue 8, August 2013 International Journal of Scientific and Research Publications.

7) Balamurugn G.,Perumal Dr. P. " Use of Quarry Dust to Replace Fine aggregate in Concrete –An Experimental Study" ISSN 2250-3153 , Volume 3, Issue 12, December 2013 International Journal of Scientific and Research

8) Suman Brajesh, Srivastava Vikas "Utilization of Stone Dust as Fine Aggregate Replacement in Concrete" ISSN: 3159-0040 Vol. 2 Issue 4, April– 2015 Journal of Multidisciplinary Engineering Science and Technology (JMEST)

9) Cheruiyot Joffrey, Abuodha Sylvester, Kabubo Charles "Use of Stone Dust in the Design of High Performance Concrete" Received 18 July 2014;

10) Patel Ankit, Prof. Pitroda Jayeshkumar "AN EXPLORATION STUDY ON STONE WASTE AS FOREGOING ALTERNATIVES FOR GREEN CONCRETE" E-ISSN2249–8974 International Journal of Advanced Engineering Research and Studies

11) Mahzuz H. M. A., Ahmed A. A. M., Yusuf M. A. "Use of stone powder in concrete and mortar as an alternative of fine aggregate" Accepted 6 December, 2010 ISSN 1996-0786 Vol. 5(5), pp. 381-388, May 2011 African Journal of Environmental Science and Technology (AJEST).

12) Syam V., Krishnan Dhanya, Jeenu G. "INFLUENCE OF FINE STONE DUST ON HIGH STRENGTH CONCRETE"

13) C. V Saranya "Experimental Investigation On Standard Concrete By Using Lathe Industry Waste & Waste Flux SheeL" 3221 5687, (P) 3221 568X Vol 4 Issue 11 November -2016 International Journal of Science and Engineering Research (IJ0SER),

14) Shrivastava Puja, Dr. Joshib Y.p. "Innovative Use of Waste Steel Scrap in Rigid Pavements" ISSN 2224-5790 (Paper) ISSN 2225-0514 Vol.6, No.7, 2014 Civil and Environmental Research

15) THIRUMURUGAN A., SIVARAJA M. "STRENGTH AND FRACTURE PROPERTIES OF HYBRID FIBER REINFORCED CONCRETE" The Islamic Republic of Iran, 2015 Vol. 39, No. C1, pp 93-102 IJST, Transactions of Civil Engineering,