International Journal of Engineering Science Invention (IJESI)
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org ||Volume 6 Issue 12|| December 2017 || PP. 46-52

Effect of Crusher Dust as Partial and Fully Replacement of Fine Aggregate on Strength Properties of M25 Grade Concrete

G.Prasanna Kumar[1] & Krupasindhu Biswal[2] & Ch.Mounica[3]
[1]*Assistant Professor, Department of Civil Engineering, AITAM College, Tekkali, Andhra Pradesh, India*
[2]*Assistant Professor ,Department of Civil Engineering, AITAM College, Tekkali, Andhra Pradesh, India*
[3]*Assistant Professor ,Department of Civil Engineering, AITAM College, Tekkali, Andhra Pradesh, India*

Abstract: *Concrete is a building material made from a mixture of broken stone or gravel, sand, cement, and water. The natural sand deposits across the world are over drying up, there is an acute need for a product that matches the properties of natural sand in concrete. In the last 15 years, it has become clear that the availability of good quality natural sand is decreasing. Existing natural sand deposits are being emptied at the same rate as urbanization and new deposits are located either underground, too close to already built-up areas or too far away from the areas where it is needed, that is the towns and cities where the manufacturers of concrete are located. Crushed aggregate, bottom ash, foundry sand and various by-products are replacing natural sand and gravel in most countries. This paper emphasizes on the use of material to be replaced by natural sand which will give new dimension in concrete mix design and if applied on large scale would revolutionize the construction industry by economizing the construction cost and enable us to conserve natural resources. In this project an attempt is made to compare the strength properties on concrete by the replacement of natural sand with by-products and recyclable materials like crusher dust.*

Keywords: *crusher dust, compressive strength, concrete,split tensile strength, workability*.

Date of Submission: 19-12-2017 Date of acceptance: 30-12-2017

I. Introduction

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type; i.e. a soil containing more than 85% sand-sized particles by mass. The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or SiO_2), usually in the form of quartz. The second most common type of sand is calcium carbonate. Sand is a non renewable resource over human timescales, and sand suitable for making concrete is in high demand. The world is resting over a landfill of waste hazardous materials which may substitutes for natural sand. Irrespective of position, location, scale, type of any structure, concrete is the base for the construction activity. In fact, concrete is the second largest consumable material after water, with nearly three tons used annually for each person on the earth. Thus, it is becoming increasingly discomforting for people like common people who talk about greening the industry to have no practical answer to this very critical question. In fact we have been sitting over a landfill of possible substitutes for sand. Industrial waste and by-products from almost all industry, which have been raising hazardous problems both for the environment, agricultural and human health can have major use in construction activity which may be useful for not only from the economy point of view but also to preserve the environment as well. Some of the researchers did the work to find the alternatives for natural sand and they concluded about different industrial waste and their ability to replace the much sought after natural river bed sand. Crusher dust is one of the alternatives for sand especially when some states have already banned the use of river sand for construction. "Crusher dust is a common by-product of mining and quarrying. Rather than being discarded as a waste material however, recycled crusher dust has many practical applications around the home and in construction."

II. Necessity Of Present Study

Conventionally concrete is mixture of cement, sand and aggregates. Properties of aggregates affect the durability and performance of concrete, so fine aggregates is an essential component of concrete. The most commonly used fine aggregates is natural sand or pit sand. Fine and coarse aggregates constitutes about 75% of total volume. It is therefore, important obtain right type and good quality aggregates at site , because the aggregates form the main matrix of concrete or mortar.

The global consumption of natural sand is very high, due to the extensive use of concrete. In general, the demand of natural sand is quite high in developing countries like India facing shortage in good quality natural sand.

In past decade variable cot of natural sand used as fine aggregates in concrete increased the cost of construction. In this research began for inexpensive and easily available alternative material to natural sand. Some alternative materials have already been used as a part of natural sand e.g. Fly ash, Slag lime stone and siliceous stone powder were used in concrete mixtures as a partial replacement of natural sand. On the basis, Crusher dust offers viable alternative. It is purpose made fine aggregates produced by crushing of quarried rock, cobble, boulders or gravels.

III. Experimental Setup

1.Materials

A) Cement: The cement used was Ordinary Portland Cement of 53 Grade available in local market. The cement used has been tested for various properties as per IS: 4031 and found to be confirming to various specifications of I.S 8112- 1989. The specific gravity of cement was 3.12, initial and final settings of OPC 53 grade cement was 50 min and 540 min.

B) Aggregate: Aggregates give body to the concrete, reduce shrinkage effect and make concrete economical. The aggregates occupy around 75% of the volume of concrete, which dominate various characteristics of concrete. Therefore, one of the major contributing factors to the quality of concrete is the quality of the aggregates. In this study only the vital parameters of aggregates have been studied as per the procedures laid down in IS: 2386 (Part 1-8) for testing of aggregates for concrete. Table 1 specifies the experimental values of fine aggregate, coarse aggregate .

Table 1: Physical Properties of Fine Aggregate

S.No	Characteristics	Tested Values of sand	Tested Values of crusher dust
1.	Specific Gravity	2.7	2.8
2.	Fineness Modulus	3.10	2.35
3.	Grading	Zone II(IS 383-1970)	Zone II(IS 383-1970)

Table 2: Physical Properties of Coarse Aggregate

S.No	Characteristics	Tested Values
1.	Specific Gravity	2.68
2.	Fineness Modulus	6.49

2.MIX PROPORTION

Concrete mix proportioning is in fact a process of selecting suitably ingredient of concrete and determining their relative quantities with object of producing, as economically as possible, concrete of certain minimum desired properties, strength and durability etc. Proportions for the mix adopted for this study has been given in the Table 3.

Table 3: Mix Proportion for One Cubic Meter of Concrete for M25 Concrete Mix

S.No.	Constituent	Quantities
1	Cement (kg)	383.2
2	Fine aggregate (kg)	688.53
3	Coarse aggregate (kg)	1090.76
4	Water (Lit.)	191.6
5	w/c ratio	0.5
6	Proportion **C : FA : CA**	**1 : 1.8 : 2.8**

IV. Experimental Investigation And Methodology

Experimental investigation was planned to provide sufficient information about the strength characteristics of Crusher dust concrete and natural sand concrete without using any admixtures and comparing the performance of both types of concrete. Tests were conducted on materials to know their physical properties. Also different tests were performed on crusher dust concrete to study its workability. Results were analyzed to derive useful conclusions regarding the strength characteristics of crusher dust concrete. M25 concrete has been used as reference mix.

The main objective of the present work was to systematically study the effect of percentage replacement of natural sand by crusher dust as 0%. 50%, and 100% respectively on the strength properties of concrete. The study was carried out on M25 grade concrete with 0.5 water cement ratio. Cubes of standard size

150mm*150mm*150mm (length * breadth * depth) were cast and tested for 7, 14 and 28 days compressive strength both Destructive and Non Destructive (Rebound hammer) tests. Standard cylinders of size 150mm*300mm (length * breadth) were cast and tested for 7, 14 and 28 days split tensile strength.

To study the strength characteristics in terms of compressive, split tensile strengths, a total of 3 mixes were tried with different percentages of crusher dust. The relative proportions of cement, coarse aggregates, sand and water are obtained by IS – code method. M25 is considered as the reference mix.

V. Experimental Results And Discussion

1.Workability

The workability of concrete with different proportions of Crusher dust and natural sand is determined by slump cone test and compaction factor test.

Table 4: Workability Characteristics Of M25 Grade Concrete

S.No	Mix Description	Slump(mm)	Compaction factor
1.	M25+0% CRUSHER DUST	120	0.96
2.	M25+50% CRUSHER DUST	50	0.87
3.	M25+100% CRUSHER DUST	0	0.88

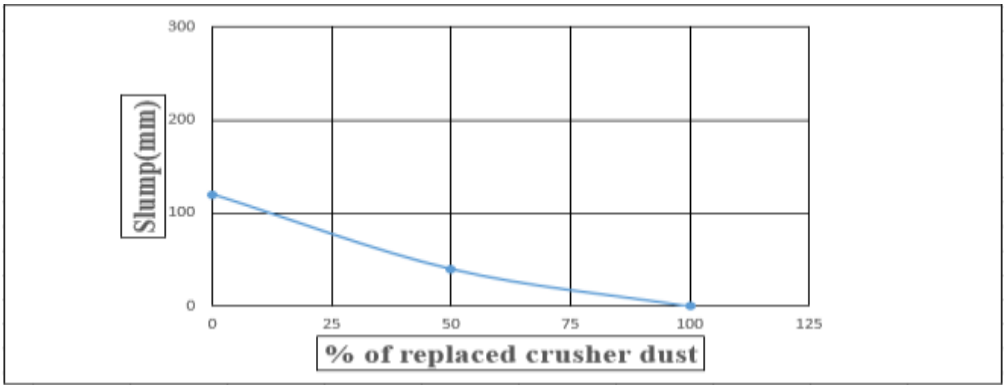

Figure 1: Variation of slump with % of replacement of crusher dust for M25 grade concrete.

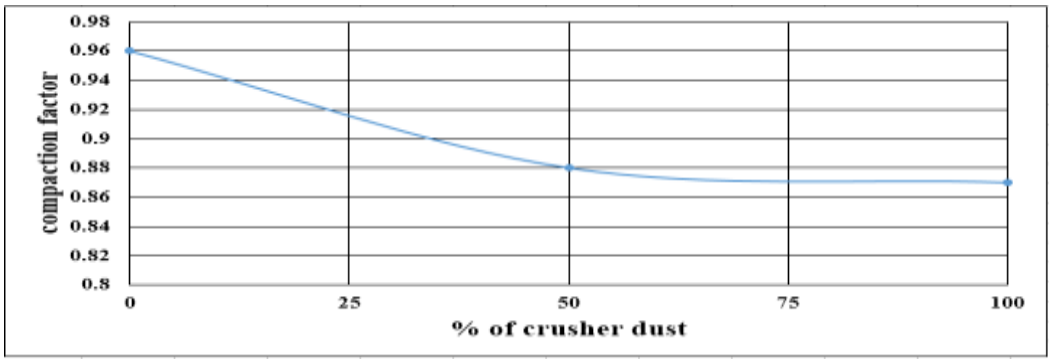

Figure 2: Variation of compaction factor with % of replacement of crusher dust for M25 grade concrete.

VI. Destructive Testing

2.1 Compressive Strength

Table 5: Values of compressive strength(N/mm^2) of M25 grade concrete with different proportions of crusher dust.

S.No	Mix Description	7 Days	14 Days	28 Days
1.	M25+0% CRUSHER DUST	40.35	40.71	42.57
2.	M25+50% CRUSHER DUST	41.96	42.51	44.03
3.	M25+100% CRUSHER DUST	47.43	47.49	48.32

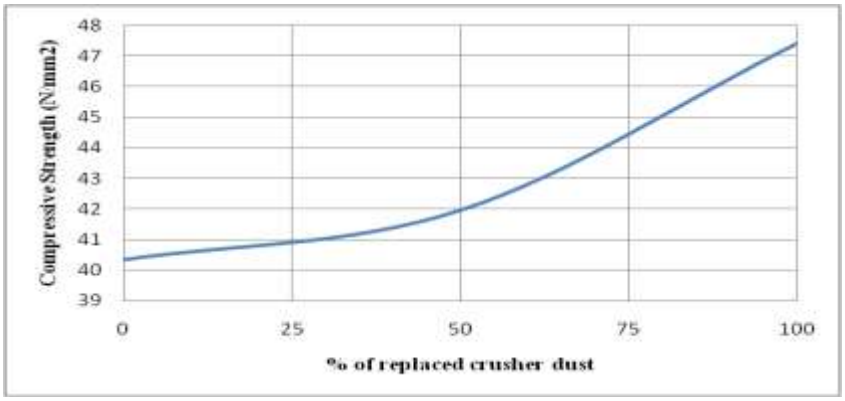

Figure 3: Variation of compressive strength of M25 grade concrete with different proportions of % crusher dust at 7 days**.**

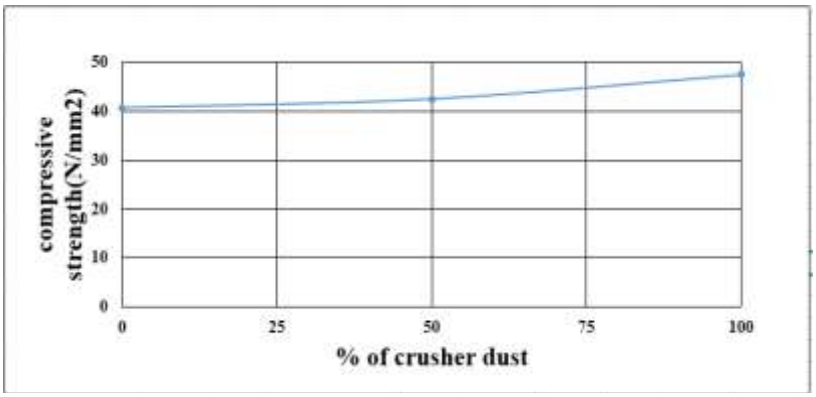

Figure 4: Variation of compressive strength of M25 grade concrete with different proportions of % crusher dust at 14 days**.**

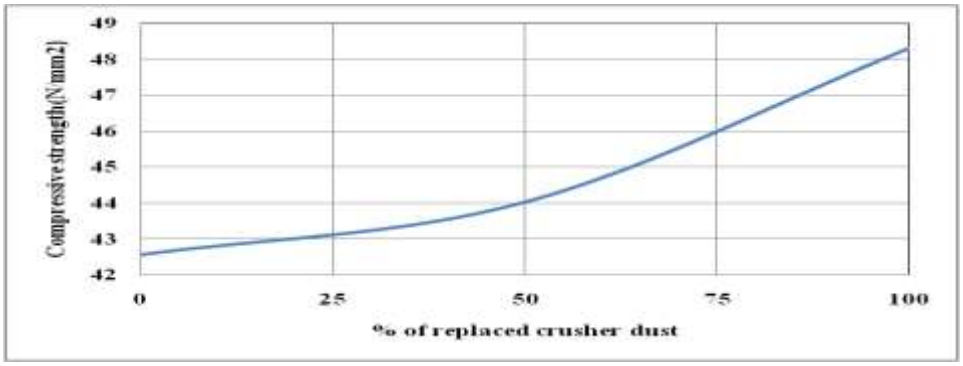

Figure 5: Variation of compressive strength of M25 grade concrete with different proportions of % crusher dust at 28 days**.**

From the curves, it can be observed that 100% replacement of crusher dust has shown more compressive strength than normal concrete and 50% crusher dust concrete. It can also be observed that 100% replacement of crusher dust has shown more compressive strength than normal concrete and 50% crusher dust concrete as well as it is gradually increasing form initial day of curing to final day of curing i.e., up to 28 days of curing.

2.2 SPLIT TENSILE STRENGTH FOR CYLINDERS:

Table 6 : Values of split tensile strength(N/mm^2) of M25 grade concrete with different proportions of Crusher dust.

S.No	Age in days	M25+0% CRUSHER DUST	M25+50% CRUSHER DUST	M25+100% CRUSHER DUST
1.	7 Days	10.97	9.76	9.32
2.	14 Days	11.56	13.97	9.43
3.	28 Days	12.03	14.41	12.54

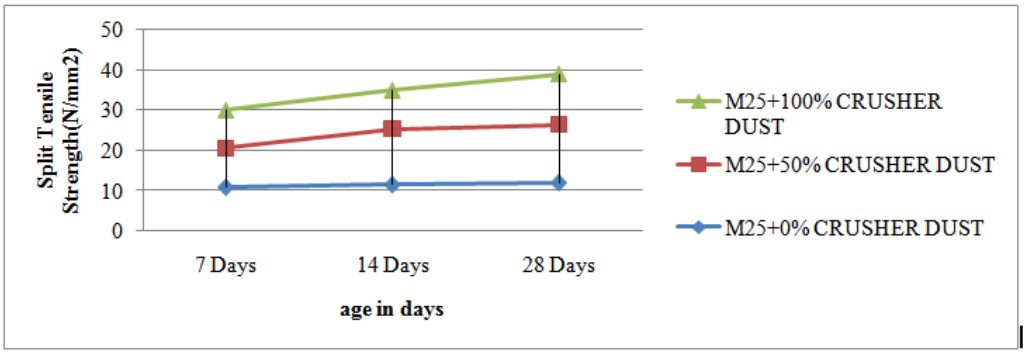

Figure 6: Variation of split tensile strength of M25 grade concrete with 0%,50% and 100% crusher dust with ages at 7, 14 and 28 days.

The split tensile strength for cylinders has been decreasing for 7 days and for 14 and 28 days the strength is increasing up to 50% replacement and then decreased for 100% replacement. The individual strengths for different proportions of crusher dust has been increasing for 7, 14 and 28 days.

VII. Non-Destructive Testing

3.1 Compressive Strength –Rebound Hammer Test

Table 7: Values of compressive strength of M25 grade concrete with different proportions of Crusher dust using Rebound hammer**.**

S.No	Age in days	M25+0% CRUSHER DUST	M25+50% CRUSHER DUST	M25+100% CRUSHER DUST
1.	**7 Days**	15.93	20.9	22
2.	**14 Days**	37.66	23.15	25.9
3.	**28 Days**	39.52	28	29.5

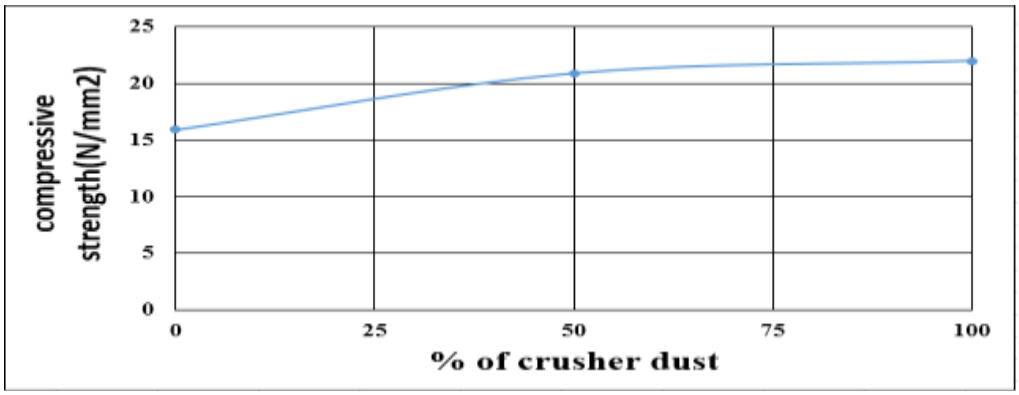

Figure 7: Variation of 7 days compressive strength with different proportions of crusher dust for M25 grade concrete.

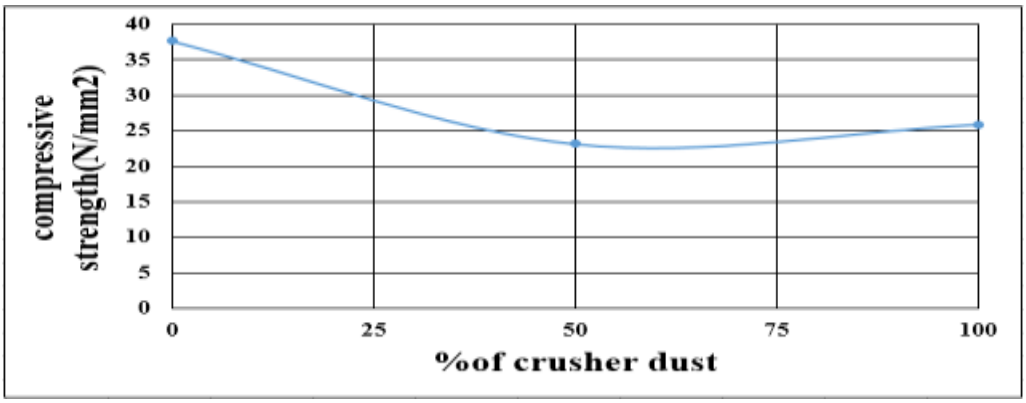

Figure 8: Variation of 14 days compressive strength with different proportions of crusher dust for M25 grade concrete.

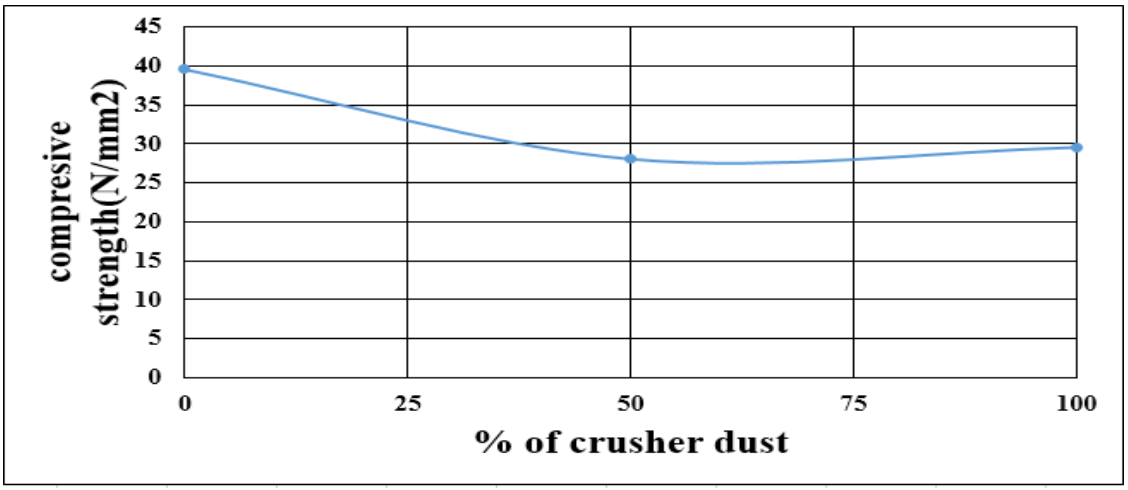

Figure 9: Variation of 28 days compressive strength with different proportions of crusher dust for M25 grade concrete.

VIII. Conclusions And Recommendations

The following conclusions are drawn from the results considering the workability, strength characteristics of concrete made with the replacement of natural sand with crusher dust in different proportions for M25 grade.

1. Crusher dust is a good alternative for natural sand as fine aggregates and gives more strength depending upon the percentage replacement which helps in maintaining the environment as well as economical balance. The crusher dust found to have good gradation and nice finish which was lacking in natural sand. This results very good cohesive concrete. Hence Crusher dust is considered as an ideal material for concrete.
2. From various tests conducted, it can be concluded that the properties of manufactured sand is as good as the regular river sand and the investigation has proved that it can be used as fine aggregate in the production of concrete as a substitute in the place of river sand because its availability has become scarce and also expensive now a days.
3. The workability of concrete measured from slump cone and compaction factor tests is decreased as the percentage replacement of natural sand by crusher dust.
4. Increase in strength is observed for all % replacement of natural sand by crusher dust at all stages.
5. The compressive strength of concrete with 100% replacement of natural sand by crusher dust is maximum.
6. The split tensile strength acquires high value at 50% replacement of natural sand by crusher dust.
7. The values of compressive strength obtained based on Non Destructive Test like Rebound Hammer are found to be satisfying the requirements.

References

[1]. Babu K.K., Radhakrishnan R. and Nambiar E.K.K. 1997. Compressive Strength of Brick Masonry with Alternative - Aggregate Mortar. CE and CR Journal, New Delhi. pp. 25-29.
[2]. Hudson B.P. 1997. Manufactured sand for Concrete. The Indian Concrete Journal. pp. 237-240.
[3]. IS: 8112-1989. Specification for 43 Grade ordinary Portland Cement. Bureau of Indian Standards, New Delhi.
[4]. IS: 383-1970. Specification for coarse and Fine Aggregates from natural sources for concrete. Bureau of Indian standards, New Delhi.
[5]. IS: 2386-1963 Part 1 to VIII. Indian Standard Methods of Test for Aggregate for concrete. Bureau of Indian Standards, New Delhi.
[6]. IS: 1199-1959. Indian Standard Methods of Sampling and analysis of concrete. Bureau of Indian Standards, New Delhi.
[7]. IS: 516-1959. Indian Standard Methods of Test for Strength of concrete. Bureau of Indian Standards, New Delhi.
[8]. IS: 10262-1982 and SP 23:1982. Recommended Guidelines for concrete Mix. Bureau of Indian Standards, New Delhi.
[9]. IS: 4031 (Part 10) 1988. Indian Standard Method of Physical test for Hydraulic Cement. Determination of Drying and Shrinkage. Bureau of Indian Standards, New Delhi.
[10]. IS: 4032-1968. Indian Standard Method of Chemical Analysis of Hydraulic cement. Bureau of Indian Standards, New Delhi.
[11]. Nagaraj T.S. and Zahida Banu. 1996. Efficient Utilization of rock dust and pebbles as Aggregates in Portland Cement Concrete. The Indian Concrete Journal. pp. 53-56.
[12]. Nagaraj T.S. 2000. Proportioning Concrete Mix with Rock Dust as Fine Aggregate. CE and CR Journal. pp. 27-31.
[13]. Narasimhan C., Patil B.T. and Sankar H. Sanni. 1999. Performance of Concrete with Quarry Dust as Fine Aggregate-An Experimental Study. CE and CR Journal.. pp. 19-24. 60
[14]. Sahu A.K., Sunil Kumar and Sachan A.K. 2003. Quarry Stone Waste as Fine aggregate for concrete. The Indian Concrete Journal. pp. 845-848.
[15]. Ilangovan R. and Nagamani K. 2006. Studies on Strength and Behavior of Concrete by using Quarry Dust as Fine Aggregate. CE and CR Journal, New Delhi. October. pp. 40-42.

[16]. Ilangovan R. and Nagamani K. 2006. Application of quarry Rock dust as fine aggregate in concrete construction. National Journal on construction Management: NICMR. Pune. December. pp. 5-13.
[17]. M.F.M. Zain, S.N. Raman and M. Safiuddin, "Influence of partial replacement of sand with quarry dust on the properties of fresh high performance concrete (in Malay)", Jurnal Kejuruteraan 12, pp. 21-30, 2000.

International Journal of Engineering Science Invention (IJESI) is UGC approved Journal with Sl. No. 3822, Journal no. 43302.

G.Prasanna Kumar" Effect of Crusher Dust as Partial and Fully Replacement of Fine Aggregate on Strength Properties of M25 Grade Concrete." International Journal Of Engineering Science Invention(IJESI, Vol. 6, No. 12, 2017, Pp. 46-52.