Partial Replacement of Fine Aggregate with Quary Dust & Red Soil in Concrete

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Abstract— In India, construction industries are the fastest expanding industry. The river sand is being extensively used in the construction industry and this has lead to the acute shortage of the sand, which is used as fine aggregate. The cost of producing concrete has been steadily rising for some years, and fine aggregates have become increasingly scarce, exacerbating the problem. The negative consequences of indiscriminately extracting fine aggregate from river bottoms have been repeatedly mentioned as a source of concern. To address this problem, utilization of alternative materials should be done. In this review a thorough assessment is done on the alternatives available for the replacement of fine aggregate. The paper has reviewed the use of red soil and quarry dust as a fine aggregate replacement (partially and completely). Quarry dust is a waste by-product of aggregate processing plants. Red soil is naturally and easily available in Tamil Nadu, parts of Karnataka, south eastern Maharashtra, eastern Andhra Pradesh and Madhya Pradesh, Orissa. Different physical, chemical and mechanical properties of red soil and quarry dust as well as the concrete, containing these materials, were reviewed and comparisons were done between them. A comparative study is also done with the currently used material in the industry which is M-sand (Manufactured sand). It can be observed that in concrete where the sand was replaced by red soil soil and quarry dust exhibits improved strength and durability properties, but the water absorption is also increased significantly. It is deemed that further detailed investigations are needed for the proposed alternatives, and a structure for future research has been proposed in order to achieve reliable, robust, environmentally friendly, and economically viable concrete as the end product.

Keywords: Concrete, Red Soil, Partial Replacement, Fine Aggregate, Coarse Aggregate

I. INTRODUCTION

At present, the construction industry in India is facing a serious shortage of sand due to overexploitation and government banning of river sand mining. In the future, the entire construction industry may come to a halt if there are no alternative sources instead of river sand. Therefore, it is necessary to explore the possibilities for alternative sources to minimize river sand extraction. At present, the identified alternative sources are Red soil and quarry dust. Quarries are operating in many parts of India to supply coarse aggregates for various types of construction, especially for concrete, road construction and foundations of buildings.

The quarry dust, the by-product, was never used in India instead of river sand earlier because of the different quality. Various rock types produce different types or different qualities of quarry dusts due to the inclusion of their fresh minerals. Also, it has non-uniformity and similarity to river sand.

Although now it is used for road works and manufacture of cement bricks the industry people are afraid to use it forconcrete or such strong constructions due to the higher percentages of minerals other than quartz. Therefore, detailed studies on various quarry dusts are needed to find out their suitability.

Red soil is naturally available resources with plenty of quantity. The Red soil is used to increase the compressive strength of concrete. The objective of this paper is to present the mineralogical quality of different common rock types and recommend the suitable rock types for the manufacture of quarry dusts and red soil in the future.

II. LITERATURE REVIEW

James Alexander. , Prof. Antony Godwin, Dr. S. Alexander in their paper "Study on Partial Replacement of Fine Aggregate with Red Soil in Concrete" International Journal for Research in Applied Science & Engineering Technology (IJRASET) Volume 4 Issue V, May 2016 found that the optimum use of red mud is 20% as a partial replacement of cement by Red Mud. The compressive strength for 7 days 10.22% & 28 days 10.24% more than that of conventional concrete after 28-days curing period for 20% Red Mud + 40% Used Foundry Sand.

Chandana Sukesh, Katakam Bala Krishna, P. Sri Lakshmi Sai Teja, S. Kanakambara Rao in "Partial Replacement of Sand with Quarry Dust in concrete" International Journal of Innovative Technology and Exploring Engineering (IJITEE) Volume-2 Issue-6, May 2013 concluded that at 50% replacement showed that the water cement ratio increased to 1.6 at which the slump cone failed completely. The ideal percentage of the replacement of sand with the quarry dust is 55% to 75% in caseof compressive strength.

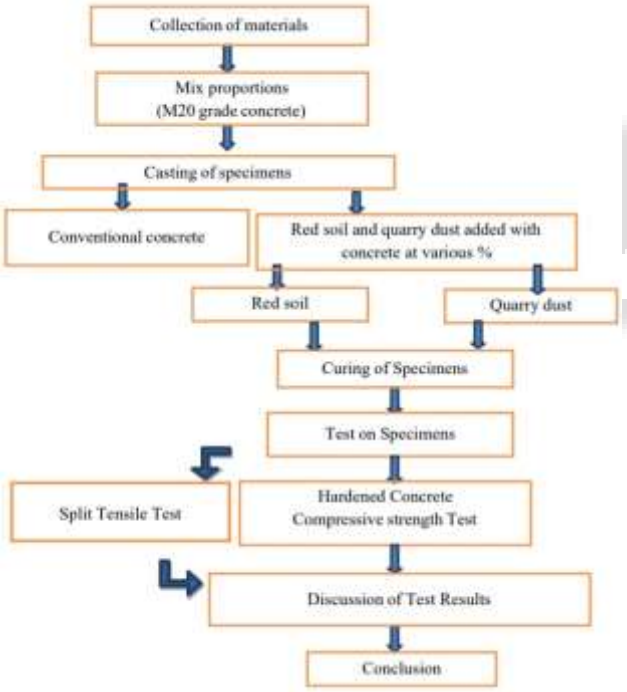
Sumit L. Chauhan, Raju A. Bondre in their research "Partial Replacement of Sand by Quarry Dust in Concrete." Published in International Journal of Scientific and Research Publications, Volume 5, Issue 7, July 2015 concluded that the addition of quarry dust as fine aggregate ratio of 30%, 40% and 50% was found to enhance the compressive properties. And as the percentage of Quarry Dust gradually increases, the Compressive strength of concrete will also increase with condition that percentage of Quarry Dust should not exceed 50%. The investigation proposes that the stone dust can be replaced up to 50% without any effect on mechanical and physical properties and the economical saving will be 56% also as discussed by Nanda (2015).

Biju Mathew, Dr. Freeda Christy C in "Study on Strength of Concrete by Partial Replacement of Fine Aggregate with M-Sand and Laterite with Super plasticizers"

International Journal of Engineering Trendsand Technology (IJETT) – Volume 38 Number 8- August 2016 concluded that Concrete mixes containing0,10,20,30, 40% sand replacement levels were cast, with super plasticizer. Results show maximum of 20% replacement levels of sand by laterite attained workable concrete with satisfactory strength beyond that lateritic concrete is not workable And 40% replacement of sand by manufactured sand shows maximum strength.

K. Shyam Prakash1 and Ch. Hanumantha Rao 2016 in Study on" Compressive Strength of Quarry Dust as Fine Aggregate in Concrete" Quarry dust satisfies the reason behind the alternative material as a substitute for sand at very low cost. It even causes burden to dump the crusher dust at one place which causes environmental pollution. From the results of experimental investigations conducted, it is concluded that the quarry dust can be used as a replacement for fine aggregate. It is found that 40% replacement of fine aggregate by quarry dust gives maximum result in strength than normal concrete and then decreases from 50%. The compressive strength is quantified for varying percentage and grades of concrete by replacement of sand with quarry dust.

III. METHODOLOGY



IV. MATERIAL

1) Cement: The cement used in this study was Portland pozzolona cement.
2) Fine Aggregate: Fine aggregate of 10mm fine m-sand is used.
3) Coarse Aggregate: Coarse aggregate used in this are size of 15cm.
4) Red Soil: 10 mm fine red soil is been used.

V. MIX DESIGN AND SAMPLE PREPARATION

The concrete mixture have been made with 100 % replacement of fine aggregate with quary dust and red soil in concrete as 0%, 20% and 30%. First the constituents are weight according to the M20 mix ratio in separate bucket. Over all time take for mixing the concrete was about 5 min. The mix was been completely tamped in specimen and filled with tamping rod. The specimen were remolded after 24 hrs cured in water and then tested in room temperature at required ages. Mix design is known as the selection of mix ingredients and their proportions required in a concrete mix.

The mix design involves calculations of the amount of cement, fine aggregate and coarse aggregate in addition to other related parameters. The mix design calculations are dependent on the properties of the constituent materials.

VI. DESIGN STIPULATIONS: M 20

1) For M20 grade of concrete characteristic strength at 28 days:20Mpa
2) Maximum nominal size of aggregate:20mm
3) Degree of quality control: Good
4) Type of exposure: Moderate

VII. MATERIAL USED

1) Type of Cement: OPC (53 grade)
2) Specific Gravity of Cement: 3.15
3) Specific Gravity of Fine Aggregate: 2.61
4) Specific Gravity of Coarse Aggregate: 2.76

VIII. COMPRESSIVE STRENGTH TEST

The hardened concrete sample were tested for strength determination as per IS 516-1959 "METHODS FOR TEST FOR STRENGTH OF CONCRETE". Concrete cubes of size 150 mm × 150 mm × 150 mm were cast with and without granite dust and steel slag. After 24 hours, the specimens were demoulded and subjected to curing for 7, 14, 28 days in portable water. Aftercuring, the specimens were tested for compressive strength using universal testing machine. The maximum load at failure was taken. The average compressive strength of concrete specimens was calculated by using the following equation.

Fig. 1: Compressive Strenght Testing

A. Compressive Strength for Conventional Concrete

S.No.	Days	Load (P) KN	Compressive strength (N/mm2)
1	7	450	20
2	7	455.4	20.24
3	7	448.2	19.92

Table 1: Average compressive strength for 7 days – 20.05 N/mm2

S.No.	Days	Load (P) KN	Compressive strength (N/mm2)
1	28	630	28
2	28	620	27.55
3	28	628	27.91

Table 2: Average compressive strength for 28 days – 27.82 N/mm2

B. Compressive Strength of Red Soil (30%) and Quarry Dust (20%) Concrete For 7 Days and 28days.

S.No.	Days	Load (P) KN	Compressive strength (N/mm2)
1	7	720.9	32.04
2	7	767.12	37.83
3	7	742.23	32.98

Table 3: Average compressive strength for 7 days – 33.03 N/mm2

S.No.	Days	Load (P) KN	Compressive strength (N/mm2)
1	28	842.27	37.43
2	28	851.31	37.83
3	28	878.13	39.02

Table 4: Average compressive strength for 28 days – 38.09 N/mm2

IX. SPLIT TENSILE STRENGTH TEST

The hardened concrete sample were tested for strength determination as per IS 516-1959 "METHODS FOR TEST FOR STRENGTH OF CONCRETE".

Concrete cylinders of size 150 mm diameter and 300mm length were cast with incorporating copper slag as partial replacement of sand and cement. During casting, the cylinders were mechanically vibrated usinga table vibrator. After 24 hours, the specimens were demoulded and subjected to curing for 28 days in portable water. After curing, the cylindrical specimens were tested for split tensile strength using compression testing machine of 2000 kN capacity. The ultimate load was taken and the average split tensile strength was calculated using the equation.

Split tensile strength (N/mm^2) = $2P/(\pi LD)$ Where, P=Ultimate load at failure (N) L=Length of cylindrical specimen (mm), D=Diameter of cylindrical specimen (mm).

Fig. 2: Split tensil strength testing

A. Split Tensile Strength for Conventional Concrete

S.No.	Days	Load (P) KN	Compressive strength (N/mm2)
1	7	197.92	2.80
2	7	189.43	2.68

Table 5: Average compressive strength for 7 days – 2.74 N/mm2

S.No.	Days	Load (P) KN	Compressive strength (N/mm2)
1	28	258	3.65
2	28	243.86	3.45

Table 6: Average compressive strength for 28 days – 3.55 N/mm2

B. Split Tensile Strength of Red Soil (30%) and Quarry Dust (20%) Concrete For 7 Days and 28days.

S.No.	Days	Load (P) KN	Split Tensile strength (N/mm2)
1	7	192.97	2.73
2	7	202.86	2.87

Table 7: Average Split Tensile strength for 7 days – 2.80 N/mm2

S.No.	Days	Load (P) KN	Split Tensile strength (N/mm2)
1	28	272.14	3.85
2	28	265.70	3.76

Table 8: Average Split Tensile strength for 28 days – 3.81 N/mm2

X. CONCLUSION

- Higher compressive strength is obtained for 30% red soil and 20% for quarry dust added concrete.
- Compressive strength increases about 15.42% compared to conventional concrete while adding 30% red soil and 20% quarry dust.
- The annual sand demand for the construction industry in India is nearly 8 million cubic meters and all is obtained from major rivers. This present demand is expected to be 10 million cubic meters within next three years.
- As a part of preliminary work, the various material needed to be used for the further study, were obtained and their physical properties were determined.
- A review of literature was done which was helpful in getting a better idea on the topic.
- The various percentage of partial replacement of quarry dust + red soil concrete and testing method on concrete has been discussed in this my project.

REFERENCES

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