Strength Studies of Concrete with Quarry Dust as Partial Replacement of Sand

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Abstract –

Common Sluice beach is precious due to devilish cost of transportation from natural sources. Also large- scale reduction of these sources creates environmental problems. As environmental transportation and other constraints make the vacuity and use of aqueduct beach less seductive, a cover or relief product for concrete assiduity needs to be found. River beach is most generally used fine total in the product of concrete acts the problem of acute insufficiency in numerous areas. Whose continued use has started posing serious problems with respect to its vacuity, cost and environmental impact.

In such a situation the Chase gemstone dust can be an profitable volition to the aqueduct beach. Quarry Rock Dust can be outlined as remains, rolling or othernon- voluble waste substance after the birth and processing of brilliants to form fine patches lower than4.75 mm. generally, Quarry Rock Dust is used in large scale in the roadways as a face finishing material and also used for manufacturing of concave blocks and featherlight concrete prefabricated rudiments. Use of Quarry gemstone dust as a fine total in concrete draws serious attention of experimenters and investigators

Key Words: Quarry dust, Classification of Concrete, Aggregates,Properties of Cement, Properties of Aggregates etc

1.INTRODUCTION

Mortal mind has shown its excellence in different fields. Talking about the field of civil Engineering, the backbone of this field is construction and the main grade of construction is concrete. The concrete is primarily accepted as a material of construction. Concrete can be defined as the amalgamation of total with cement and water. The chance variation in the mixing of concrete provides different property at different rates. Concrete can be moulded as per the specification and its face can be given any addition in terms of colorandtexture.Concrete is considerably used in construction of foundations, architectural structures and in addition to that concrete is principle part of construction in highways, heads, elevated corridors and foundationsetc.

Compared to multitudinous other engineering paraphernalia analogous as brand, rubber,etc., concrete requires lower energy input for its manufacture. Curently, a large number of material amalgamations, which are desolate products of other industriousness, are being beneficially used in making quality concrete. thus, from the consideration of energy and resource conservation and sustainability and terrain, concrete is the most favored material.

As per the present script, the chance operation of crushed sand from limestone chases in construction is continuously adding. This modification is done in order to neutralize essential difficulties in sluice sand. Chase dust is a fine material attained as a by- product from crushing process during quarrying exertion at chase point. In the growing request, the rate of sluice sand has touched the sky and in addition to that the vacuity of sluice sand has also dropped. So, in order to overcome the problem, there is a need of an volition from surroundings analogous as Artificial waste. In this study, chase dust will be studied as relief material of sluice- sand as a fine aggregate for concrete. Chase dust has been in use for various exertion in the construction sedulity analogous as for road construction and manufacture of structure paraphernalia analogous as feathery aggregates, bricks, ducts and autoclave blocks. These granite fines are constantly appertained as chase or rock

dust, a by- product in the manufacture of concrete aggregates during the crushing procedure of jewels. This residue generally represents lower than 1 of aggregate product. In normal concrete, the prolusion of chase dust to mixes is limited due to its high fineness. The addition chase dust to fresh concrete would raise the water demand and accordingly the cement content for specified malleability and strength conditions. thus, the successful operation of chase dust in concrete could turn this waste material into a precious resource. Another implicit benefit in the operation of chase dust is the cost saving. Obviously, the material costs vary hinging on the root. In this respect, the operation of chase dust could play a part in lowering the force cost of concrete. bedeviled sand is extremely generous in limestone chases and its use could appreciably drop the paraphernalia cost of concrete, annihilate the dust disposal cost, reduces environmental desecrations and decay of natural resources

1.1 LITERATURE REVIEW

The well known literature about the use of Quarry dust (Crusher dust) in concrete carried out in any part of the world has been reviewed and presented as under:

1.1 Quarry dust (SUDHIR S.KAPGATE-2013) Concrete plays an important role in construction and its large quantity is utilized in construction practices. Natural sand, one of the constituent of concrete, is expensive because of the high transportation cost from major sources. Diminution of sources creates environmental problems and to overcome this problem there is a requirement for cost-effective and creative solution materials. This paper deals with the use of quarry dust, a waste obtained during the extraction process, as good filler instead of fine aggregate.M25 concrete mix design with 0%, 20%, 25%, 30% and 35% of quarry dust was used in this paper. In this experimental study different cubes were analysed for compressive strength, flexural strength and split tensile strength for concrete in hard form using quarry dust. Results from this study concludes that increase in quantity of dust up to 30% increases compressive strength of concrete, if the %age of quarry dust is more than 30% thee compressive strength starts decreasing gradually.

- (Dr. P.B.Sakthivel -2013) This papers deals with the replacement of natural sand used in concrete with quarry dust (waste produced from stone quarry industry). In this study, sand has been partially replaced with quarry dust for M35 grade of concrete. Samples has been casted with 0%,10%,20%,30%,40% quarry dust in replacement with sand. On the basis of experiments, the paper concludes that M35 grade concrete shows optimum results on 10% replacement of sand with quarry dust. The authors of this paper had emphasized that this method will help to decrease the usage of natural sand in concrete which will decrease the cost of construction as well as trim down the level of prohibited withdrawal of sand from the river beds. It will definitely help to preserve the natural resources and resolve some sustainability issues.

- (G.Balamurugan -2013) This investigational study presented the deviation in the strength of concrete on use of crusher dust instead of sand from 0% to 100% at intervals of 10%. For this study, M20 and M25 grades of concrete were taken into consideration. Slump was in this study was kept as a 60mm. Concrete cubes were tested after 7 days and 28 days at room temperature for compressive strength. Concrete gains utmost raise in compressive strength at 50% replacement of sand. The %age increase in strength as compare to control concrete was obtained as 24.04 & 6.10 correspondingly for M20 and M25. The outcome gives obvious image that quarry dust can be used in concrete mix as a fine option for natural river sand with larger strength at 50% replacement with quarry dust.

- Lohani T.K-2012)This study deals with utilize of crusher dust in concrete as partial substitute of sand. Utilization of river sand on huge scale produces ecological impact on society. Overall availability of river sand is fine, but it is most commonly used; Cost and environmental impact are the main factors to be considered (Ahmed et.al., 1989). To defeat this crisis, small substitution of sand with quarry dust, according to the study can be an economical option. In this study, M1, M2, M3, M4 and M5 samples had been casted with 0%, 20%, 30%, 40%, 50% replacement of dust for M20 grade concrete design mix for laboratory analysis i.e. the idea is to test them correspondingly for compaction factor test, compressive strength (cubic, cylindrical sample), split tensile strength, flexural strength, water absorption of hardened concrete. Depending on the investigational results of this study, it has been concluded that on adding crusher dust physical and mechanical properties of concrete will improve. Use of 30% of quarry dust content increases the compressive strength of concrete, compressive strength gradually begins to decrease for more than 30% dust material. According to this study, maximum split tensile strength, can be attained at 20% substitution of fine aggregate.

- (Radhikesh P. Nanda-2010) this investigational study is about preparation of paving blocks with erusher dust. Physical and mechanical properties of paving blocks are investigated with sand substituted by various %ages of quarry dust. The analysis results clears that the substitution of sand by quarry dust till 50% by weight has a slight effect on the diminution of any physical, mechanical property where as money can be easily saved till 56%. This also leads to the reduction of discarding crusher dust on earth to reduce the ecological contamination. The study concluded that substitution of sand by quarry dust till 50% by weight will have a negligible effect on the drop of split tensile strength, compressive strength, flexural strength etc. Water absorption is fine lower than the limit according to Indian codes. Also, there is not any sort of variation in durability with use of crusher dust.

2.1 EQUIPMENT AND MATERIAL

Following are the equipments which have been used and will be required for this study:

1. Sieves for Coarse Aggregate and Fine Aggregate
2. Pycnometer
3. Le Chetelier Apparatus
4. Vicat Apparatuus
5. Crushing value apparatus
6. Trowel, shovel etc
7. Flexure testing machine
8. Compression testing machine
9. Hot air oven

2.2 MATERIAL

2..2.1 Concrete

Concrete is an artificial compound with its main component as natural aggregates i.e.sand and gravel, cement and water and admixture if required. Concrete development has evolved over long period of time. It has definite properties in its fresh and hardened state, though fresh concrete is the primary hardened of concrete. state Concrete in hardened form may possibly be well thought-out as non-natural stone

In which the fine aggregates fill the voids of coarse aggregate and cement is used to fill the gaps of fine aggregates. In addition to filling the voids act as a binder hardening fine said cement slurry mixture of water, such as cement, concrete slurry, water particles together into a compact mass of concrete aggregates. Characteristic ratio and thickening of the mixture, its composition is dependent on the nature.

2.2.2Cement

The main raw material for the production of cement is clinker. Clinker is an artificial rock made by heating limestone and other raw materials in specific quantities to a very high temperature in a specially made kiln. Portland cement is hydraulic cement made by finely pulverizing the clinker produced by calcining to incipient fusion a mixture of argillaceous and calcareous materials. It is the fine grey powder that is the moist important ingredients of concrete; hence the name cements concrete. Cement undergoes a chemical reaction with water and sets and hardens when in contact with air or underwater. The typical raw materials used for making cement are limestone ($CaCO3$), sand ($Si02$), stale clay ($Si02$, $A1203$, or $Fe203$), and iron ore ($Fe203$). Thus the chemical components of cement are calcium (Ca), silicon (Si), aluminum (Al), and iron (Fe). The calcareous component, lime ($Ca0$), is derived from limestone, chalk, marble etc. The argillaceous component ($Si02$, $A1203$, or $Fe203$), is derived from clay, shale. Cement selected for current study is Ordinary Portland Cement of 43 grade.

2.2.3Aggregates

Aggregates are the materials basically used as filler with binding material in the production of mortar and concrete. They are derived from igneous, sedimentary and metamorphic rocks or manufactured from blast furnace slag, etc. Aggregates form the body of the concrete, reduce the shrinkage and effect economy. They occupy 70-80 per cent of the volume and have considerable influence on the properties of the concrete. It is therefore significantly important to obtain ight type and quality of aggregates at site. They should be clean, hard, strong, and durable and graded in size to achieve utmost economy from the paste. Earlier aggregates were considered to be chemically inert but the latest research has revealed that some of them are chemically active and also that certain types exhibit chemical bond at the interface of aggregates and cement paste. To increase the bulk density of concrete aggregates are used in two markedly different sizes-the bigger ones known to be coarse aggregate (grit) and the smaller ones fine aggregate (sand).

2.2.4 Fine aggregates and quarry dust

Fine Aggregate: The fine aggregate which has been used for this study is natural sand. Aggregates that pass through a sieve of size 4.75 mm are considered as fine aggregates. Natural sand confirming to Zone-III as per IS383-1970 has been used.

Quarry Dust: Quarry dust is a type of waste material which is produced in stone crushing industry and is available in large amount. The problems like landfill disposal, apart from the problem like health and environmental hazards have been observed with per annum of 200 million tonnes quarry dust. Quarry rock dust confirming to zone III as per IS 383 -1970 has been used in this study.

2.2.5 Coarse aggregate

Aggregate which cannot pass through 4.75 mm sieve are recognized as a coarse aggregate. They are obtained by natural breakdown or by non-natural crushing of rocks. 80 mm can be the utmost size of aggregate. In this study, 10mm and 20mm size of coarse aggregates confirming to zone III are used as per IS 383-1970.

2.2.6Water

Potable water confirming to IS: 456-2000 is used in this study for casting and curing of cubes, cylinders and beams. The purpose of using water with cement is to cause hydration of the cement. Water in excess of that required for hydration acts as a lubricant between coarse and fine aggregates and produces a workable and economical concrete. There is a definite optimum water requirement for a particular concrete and mortar. In case of excess water, the cement along with water comes to the surface by capillary action and forms a thin layer over surface known as laitance. This weakens bond between the successive lifts of concrete. The excess water may leak through the form work, resulting in honeycombed concrete and on evaporation makes the concrete porous. On the other hand lesser water makes it difficult to work with concrete and because of non uniform mixing the resultant concrete is weaker in strength. The amount of water must therefore be limited to produce concrete of the quality required for a job. Water is also used for washing aggregates and curing.

3.REASEARCH METHODOLOGY

If's planned to execute various tasks in order to come up with trustworthy data and these tasks contain:

I. Collecting samples of fine aggregates

a) Natural sand

b) Quarry fines

II Gradation for the fine aggregate and coarse aggregates

I. **Testing of cement so as to know its different properties Fineness**

(i) Initial and final setting time

(ii) Specific gravity

(iii) Consistency Test

III. Testing of different characteristics of fine aggregates

Sieve analysis

Specific gravity

Water absorption

IV.. **Testing of different properties of coarse aggregates**

i) Sieve analysis

(i)Specific gravity

(ii) Water absorption

V.Preparation of design mix

VI. Perform slump test for workability

VII. Perform compaction factor test

VII Casting of samples i.e. cubes and cylinders

VIII. **Testing of prepared samples for different properties**

(i)Compressive strength

(ii)Split tensile strength

(iii)Flexural strength

4. RESULTS

4.1 Results on properties of fresh conerete

4.1.1 Workability (slump value) The measured slump

values of quarry dust with constant water/cement ratio i.e. w/c ratio (0.45) are 75, 78, 79, 81, 82 and 84 mm for different mixes such as M1 (0% quarry dust), M2 (10% quarry dust), M3 (20% quarry dust), M4 (30% quarry dust), M5 (35% quarry dust), M6(40% quarry dust) respectively. It should be noted that slump was maintained between 75 -85 mm with the addition of Plasticizer (Sikament 2002 NS). Plasticizer was added to mix in order to make it workable. Plasticizer was added in certain amount effective with the weight of cement as shown below. The variations of slump value with quarry dust percentage are also shown below. It is observed that the percentage of plasticizer decreases with the increase in percentage of quarry dust and this is because the workability increases with the increase in percentage of quarry dust.

TABLE N0 1: DETAILS OF ADMIXTURE AND SLUMP MEASUREMENT

REPLACEMENT	% OF ADMIXTURE	SLUMP (mm)
M1	0.59 % of cement	75
M2	0.54 % of cement	78
M3	0.47 % of cement	79
M4	0.40 % of cement	80
M5	0.35 % of cement	81
M6	0.32 % of cement	82

Repl.	No ; Of Spl.	CRUSHING LOAD (kn)	COMPRESSIVE STRENGTH (MPa)
M1	 Spl 1 Spl 2 Spl3	7 days 28 Days 716.8 1039 884 1072 810.3 1055	7 Days 28 Days 31.85 46.18 39.28 35.7 47.64 46.9 36.01 46.88
M2	Spl 1 Spl 2 Spl 3	914 1139.1 1005.6 1102.8 907.7 1099.6	40.62 50.63 44.69 42.81 49.01 49.50 43.13 48.87
M3	Spl 1 Spl 2 Spl 3	937 1079 980.3 1150.5 998.6 1141.6	41.64 47.95 43.57 43.20 51.13 49.94 44.38 50.74
M4	Spl 1 Spl 2 Spl 3	924 938.1 896.6 947.6 960 965	41.06 41.09 39.85 41.20 42.11 42.23 42.70 42.88
M5	Spl 1 Spl 2 Spl 3	728 687 764.5 782 705.9 794	32.35 30.53 33.97 32.56 34.75 33.87 31.37 33.52
M6	Spl 1 Spl 2 Spl 3	660.5 729.2 642.7 730.8 685 696.1	29.35 32.41 28.56 29.45 32.48 31.94 30.44 30.94

4.2.1 Compressive strength

The results of compressive strength of cubes for (7, 28) days curing are shown in table. It should be noted that in mix M1, M2 and M3 compressive strength increases as the days of curing are increased from 7days to 28 days. But as the percentage replacement of quarry dust reaches the value 30%, compressive strength in mix M4, M5, M6 starts decreasing with the increase in days of curing from 7 days to 28 days. Further is illustrated in chart below

4.2.2 Split tensile strength

The results of split tensile strength of cylinders for (7, 28) days curing are shown in table. It should be noted that in mix M1 split tensile strength decreases as the days of curing are increased from 7days to 28 days. But as the percentage replacement of quarry dust reaches the value 10%, split tensile strength in mix M2, M3, M4, M5, M6 starts increasing with the increase in days of curing from 7 days to 28 days. Further is illustrated in graph below.

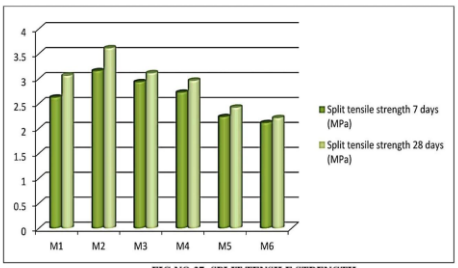

FIG.NO 27: SPLIT TENSILE STRENGTH

5. CONCLUSIONS

All the experimental data shows that the addition of the industrial wastes improves the physical and mechanical properties. These results are of great importance because this kind of innovative concrete requires large amount of fine particles. Due to high fines of quarry dust it is found to be very effective in assuring very good cohesiveness of concrete. From the above study it is concluded that the quarry dust may be used as a replacement material for fine aggregate. Quarry dust has been used for different activities in the construction industry suchas for road construction

1. Non availability of sand at reasonable cost as finer aggregate in cement conerete for various reasons, search for alternative material stone crusher dust qualifies itself as a suitable substitute for sand at very low cost.

2. Aggregates with higher surface area are requiring more water in the mixture to wet the particle surfaces adequately and to maintain a specific workability. Obviously increasing in water content in the mixture will adversely affect the quality of concrete.

3. The measured slump values of quarry dust with constant water/cement ratio i.e. w/c ratio (0.45) are 75, 80, 78, 80, 79 and 75 mm for different mixes such as M1 (0% quarry dust), M2 (10% quary dust), M3 (20% quarry dust), M4 (30% quarry dust), M5 (35% quarry dust), M6 (40% quarry dust) respectively. It should be noted that slump was maintained between 75 -80 mm with the addition of Plasticizer (Sikament 2002 NS). Plasticizer was added to mix in order to make it workable. Plasticizer was added in certain amount effective with the weight of cement as shown below. The variations of slump value with quarry dust percentage are also shown below. It is observed that the percentage off plasticizer decreases with the increase in percentage of quarry dust and this is because the workability increases with the increase in percentage of quarry dust.

4. It should be noted that in mix M1, M2, M3, M4, M5 and M6 compressive strength increases as the days of curing are increased from 7days to 28 days. But as the percentage replacement of quarry dust reaches the value 20%, compressive strength shows maximum value and then starts decreasing as we move ahead in replacement.

6. It should be noted that split tensile strength increases as we replace the fine aggregate up to 10% and shows maximum strength in M2 mix. Then split tensile strength decreases as percentage replacements are increased further. It is also observed that split tensile strength in mix M1, M2, M3, M4, M5, M6 increases with the increase in days of curing from 7 days to 28 days.

7. It should be noted that flexural strength increases as we replace the fine aggregate up to 10% and shows maximum strength in M2 mix. Then flexural strength decreases as percentage replacements are increased further. It is also observed that flexural strength in mix.

M1, M2, M3, M4, M5, M6 increases with the increase in days of curing from 7 days to 28 days.

REFERENCES

1. Book

Concrete technology by M. L. Gambhir

2. IS Codes

1. Indian Standard Specification for coarse and fine aggregates from natural sources for concrete- IS 383-1970.

2. Indian Standard Recommended guidelines for concrete mix design -IS 10262-1982.

3. Specification for 43grade ordinary Portland cement-IS 12269-1987

04. Indian standard methods of Sampling and Analysis of concrete, IS 1199-1959.

3. Research papers

1. SUDHIR S.KAPGATE AND s.R.SATONE "DUST AS PARTIAL REPLACEMENT OF SAND IN CONCRETE" Indian Streams Research Journal Volume 3, Issue. 5, June. 2013.

2. Dr. P.B.Sakthivel, C.Ramya, M.Raja(May 2013) " AN INNOVATIVE METHOD OF REPLACINGRIVER SAND BY QUARRY DUST WASTE IN CONCRETE FOR SUSTAINABILITY" International Journal of Scientific & Engineering Research Volume 4, Issue 5,

3. Chandana Sukesh, Katakam Bala Krishn. P.Sri Lakshmi Sai Teja, S.Kanakambara "PARTIAL REPLACEMENT OF SAND WITH QUARRY DUST IN CONCRETE International Journal of Innovative Technology and Exploring Engineering (JITEE) ISSN: 2278-3075, Volume-2, Issue-6,

4. G.Balamurugan, Dr.P.Perumal(December 2013)"USE OF QUARRY DUST TO REPLACE SAND IN CONCRETE - AN EXPERIMENTAL STUDY International Journal of Scientific and Research Publications, Volume 3, Issue 12, December 2013,ISSN 2250-3153

5. Lohani T.K., Padhi M., Dash K.P., Jena S. (2012) OPTIMUM UTILIZATION OF QUARRY DUST AS PARTIAL REPLACEMENT OF SAND IN CONCRETE Int. Journal of Applied Sciences and Engineering Research, Vol. 1, No. 2, 2012

6. Joseph 0. Ukpata, Maurice E. Ephraim and Godwin A. Akeke (JANUARY 2012 COMPRESSIVE STRENGTH OF CONCRETE USING LATERITIC SAND AND QUARRY DUST AS FINE AGGREGATE" ARPN Journal of Engineering and Applied Sciences, VOL. 7, NO. 1, JANUARY 2012, ISSN 1819-6608

7. Radhikesh P. Nanda, Amiya K. Das, Moharana.N. C (2010) "STONE CRUSHER DUST AS A FINE AGGREGATE IN CONCRETE FOR PAVING BLOCKS" International Journal Of Civil And Structural Engineering VOL. 1, 2010, ISSN 0976- 439