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PARTIAL REPLACEMENT OF SAND BY QUARRY DUST IN CONSTRUCTION OF BOX CULVERT

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Abstract – *This experimental study focuses specially on the compressive strength of M20 and M25 grades of concrete on partial replacement of sand by Quarry dust by 20%, 30%, 40% and 50%. The compressive strength of concrete cubes are obtained after 7 and 28 days of curing. This experimental study shows that the concrete made with quarry dust might not be as workable as normal concrete but it gives higher strength than the conventional concrete. The result shows that when sand is replaced by 40% it gives strength upto 22.25 Mpa in 7 days and 27.34 Mpa in 28 days for M20 and 24.60 Mpa in 7 days and 32.98 Mpa in 28 days for M25. From the above test result it is clear that Quarry dust can be used as fine aggregate in replacement of sand.*

1. INTRODUCTION

The concept of using Quarry dust as fine aggregate is highlighted nowadays because the demand of river sand is very high. For replacement of sand we needed a reliable material with either same cost or less cost. Since Quarry dust provides the better result and cost efficiency, it can be used as an alternative.

The non-effected workability is obtained on 20% replacement of sand but it gives the same strength as regular concrete. For higher replacement value of sand, workability will surely be affected. Due to high demand the cost of sand is very high. At some point quarry dust can be used as fully or partially fine aggregate. For major construction work it is barely possible to fulfill the required amount of sand. So if we are using quarry dust in replacement of sand it may lead to fulfill the requirement and also save the large amount of cost.

The all reasons are satisfied by Quarry dust only as an alternative material as well as substitute for sand at very low cost. The use of quarry dust in construction also resolves the problem of dumping and hence reduces air and land pollution.

This Experimental study is about testing the properties of concrete before and after setting on each % replacement of sand by quarry dust in M20 and M25 grade of concrete. And to find out if Quarry dust is a suitable replacement of sand or not.

From this experimental result it is obtained that the 40% of sand replaced by quarry dust in concrete gives the maximum strength and then the strength reduces from 50% replacement of sand.

2. MATERIAL TO BE USED

2.1 Cement: - Cement is a binding material, most commonly used in construction work for making concrete and mortar. The property of cement which makes it useful is when it is mixed with water, after it sets it gives really good strength. Cement is a substance used in construction that sets, hardens and adheres to other materials, binding them together. It is found that the cement has the

Cements used in construction are usually lime or calcium silicate based, thus when it reacts with water produces hard binder.

For this experiment the IPC-43 cement is being used.

Specific gravity: 3.05
Initial setting time: 30 min.
Final setting time: 220 min
Fineness: 8 % residue on IS 90 micron sieve

2.2 Sand: - Sand is a natural fine product obtained from river, mostly carrying the particles size varying from 0.075 to gravel size. Sand is a composed material of fine rocks transformed with time. The color, composition and particle size of sand varies from area to area for availability of sand. Sand is a non-renewable resource and nowadays due to heavy construction works the demand of sand is increasing.

For this Experiment sand of size 0.075 mm to 2.36 mm is used.

Specific gravity: 2.53
Fineness modulus: 3.08
Density: 1.63gm/cc
Void ratio: 0.55

2.3 Quarry Dust: - Quarry dust is a byproduct of the crushing process which contains particle size from 0.75 to 5 mm. These stone dust are not usable and dumped for land filling. But for few past years it has been utilized more than dumping to the other works like making concrete blocks and landscaping.

Quarry dust is a great alternative product for Natural river sand also cost efficient at the same time. Since it's a waste product also provides availability. If quarry dust will be used for some construction purpose, the dust release from it will not affect the environment. Therefore, quarry dust should be used in construction works, which will reduce the cost of construction and the mining of river bed will be reduced and hence will not affect aquatic system. Most of the developing countries are under pressure to replace fine aggregate in concrete by an alternate material also to some extent or totally without compromising the quality of concrete.
Specific gravity: 2.57
Fineness modulus: 2.41
Density: 1.85gm/cc
Void ratio: 0.42

Fig. 1:- Quarry Dust

2.4 Coarse Aggregates: - Coarse aggregates are particles greater than 4.75mm, but generally range between 9.5mm to 37.5mm in diameter. Coarse aggregates include gravel and crushed rock. Most commonly used coarse aggregates are crushed stone. Depending upon the type of concrete required the size of aggregate varies.
For this experiment 2.36mm – 20mm size aggregates are used.

Maximum size: 20 mm
Specific gravity: 2.98
Fineness modulus: 6.36
Density: 1.58gm/cc

3. METHODOLOGY

3.1 Concrete mixture proportions

Concrete consists of four materials, i.e. coarse aggregate, fine aggregate, cement and water. Hence in this Experimental study four types of concrete mixtures were taken. The concrete cubes containing 20%, 30%, 40% and 50% replacement of quarry dust in replacement of sand are compared with conventional concrete cube prepared with natural river sand.

Concrete cubes are prepared with the w/c ratio of 0.6 for M20 and 0.5 for M25 grade of concrete. The performance of concrete is observed in all aspects with each % of replacement of sand, and compared with regular concrete cubes.

3.2 Method

For M20 grade of concrete cement: sand: quarry dust: coarse aggregate on 20%, 30% and 40% replacement is 1:3/10:7:10:3, 1:9/20:11/20:3 and 1:2/5:3/5:3.

For M25 grade of concrete cement: sand: quarry dust: coarse aggregate on 20%, 30% and 40% replacement is 1:1/5:4/5:2 , 1:3/10:7/10:2 and 1:2/5:3/5:2.

Concrete is mixed in proportion above given with w/c ratio 0.6 for M20 and 0.5 for M25.

Slump test is done for each % replacement of sand.
6-6 concrete cubes are made in mould of 150x150x150 mm for each % replacement for both M20 and M25 Grade Concrete.

After 24 hrs. of drying, curing is done for 7 day for testing. After testing for compressive strength curing is done again for 28 day then the result is obtained for each concrete cube.

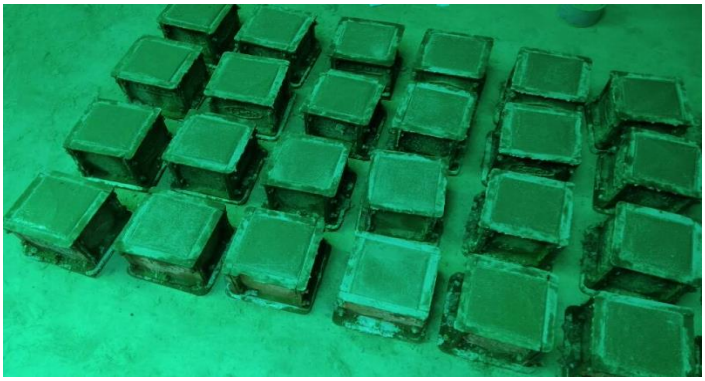


Fig. 2: - Concrete Cubes ready for curing

4. TEST ON FRESH CONCRETE

4.1 Slump Test

Slum test is done to measure the Workability of Concrete. Workability defines the ease of laying of concrete at the site that for how long concrete can be used without changing its properties. Higher the slump value, higher the workability. Lower the slump value, lower the workability.

The slump cone with 300 mm height, 200 mm bottom opening and 100 mm top opening is used for Slump value. The concrete mixture is filled in the cone from the top and

tamped using tamping rod. The slump test is performed on freshly mixed concrete.

Since Quarry Dust is partially used as the fine aggregate, due to containing very fine particles it absorbs more water hence decreases the Workability. With use of some Superplasticizer this problem can be resolved.

Result -

Table 1:- Slump value.

Fine aggregate Sand: Quarry dust	Slump (mm)	
	M20 with w/c ratio 0.6	M25 with w/c ratio 0.5
100:00	16	15
80:20	12	12
70:30	11	10
60:40	10	9
50:50	8	6

5. TEST ON HARD CONCRETE

5.1 Compression Test

The compressive strength of concrete can be define as the bearable amount of load applied on a particular area. Which may be applied to a concrete structure. Thus before using any grade of concrete the compression test is done for checking of required strength.
Depending upon different structure type different shapes of concrete blocks are made.
The table given below shows the compressive strength observed in 7 and 28 days on concrete cubes. It was found that on replacement of 40% concrete gives the highest strength.
The following Test results are taken at the failure of cubes.

Fig.3: - Compression testing of cubes

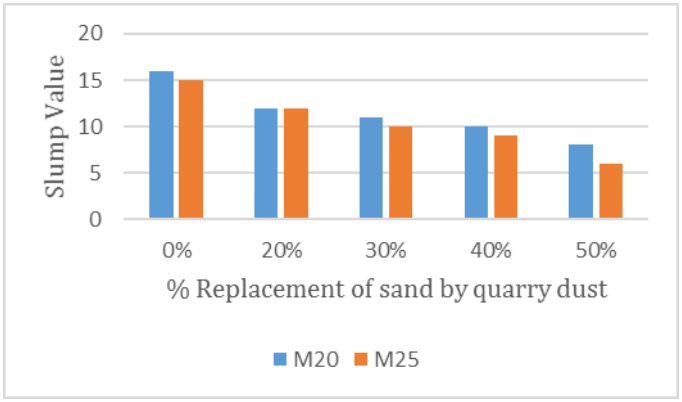
Result -

Table 2:- Compressive strength of concrete (in MPa)

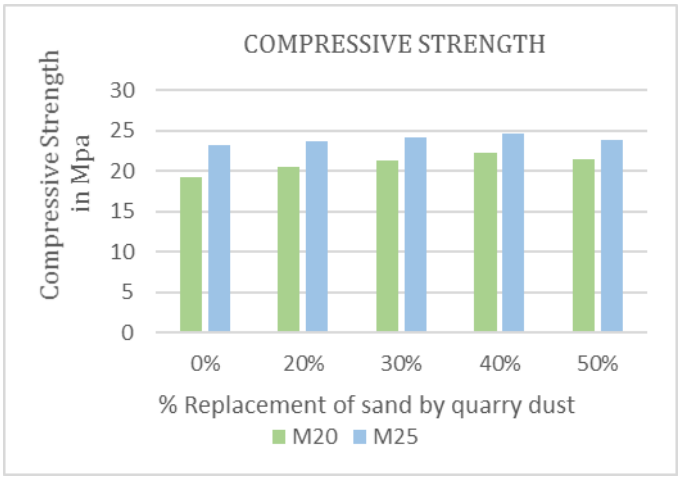
Fine aggregate Sand: Quarry dust	M20		M25	
	7 days	28 days	7 days	28 days
100:00	19.25	22.22	23.21	31.03
80:20	20.46	23.90	23.64	31.62
70:30	21.27	25.71	24.08	32.23
60:40	22.25	27.34	24.60	32.98
50:50	21.44	25.56	23.85	31.75

6. ANALYSIS

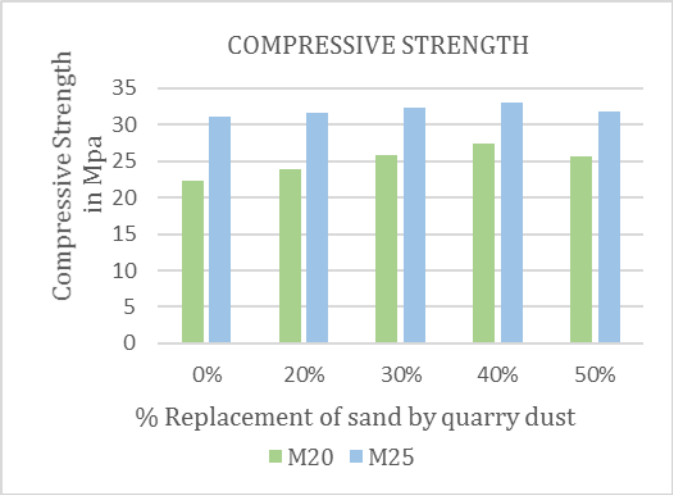
Slump Test –



Compressive strength is 7 Days –



Compressive strength is 28 Days –



6. BOX CULVERT

To allow the flow of water under roadways or railways from one side to another Box Culverts are used. Box culverts are commonly made of Reinforced Cement Concrete with M25 grade. These box culverts are also available in precast form.

The idea of using Box Culvert as an experimental subject for this project is because we preferably use M-25 grade of concrete for constructing Box Culverts and this project also accommodate testing the properties of M-20 & M-25 concrete on partial replacement of sand by Quarry dust.

This Experimental Study is applicable not only for Box Culverts but any other concrete works as well.

7. CONCLUSION

From the experiment result it is concluded that the use of Quarry dust as fine aggregate gives better result in compressive strength. The previous study also shows the optimum use of quarry dust with a better strength.

The concept of replacement of natural fine aggregate (sand) by quarry dust may help in many ways rather than reducing construction cost. The Erosion of river bank might stopped and the waste quarry material (Quarry Dust) can be utilize, which is helpful to control environment pollution.

Since sand is much costlier due to reduction of sources as natural fine aggregate, we need to find a replacement product with less cost. Quarry dust is one of the Suitable and available product in the market, which also provides the benefit of less cost.

The conclusion from the above results is found that 40% of replacement of sand by quarry dust gives the highest strength and then it reduces from the 50% replacement.

Due to high quantity of dust particles, the workability of concrete is affected but it can be resolved by Superplasticizer.

REFERENCES

1. M.S. Shetty, Concrete Technology Theory and Practice, 5thedition, S.Chand & Co. Ltd., New Delhi

2. Sivakumar and Prakash M. Characteristic studies on the mechanical properties of quarry dust addition in conventional concrete in the Journal of Civil Engineering and Construction Technology Vol. 2(10)

3. IS 456: 2000, Plain and Reinforced Concrete code of practice.

4. B. Muhit, M. T. Raihan, and M. Nuruzzaman, "Determination of mortar strength using stone dust as a partially replaced material for cement and sand," Advances in Concrete Construction.

5. J. O. Ukpata and M. E. Ephraim, "Flexural and tensile strength properties of concrete using lateristic sand and quarry dust," ARPN Journal of Engineering and Applied Sciences, vol. 7.

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