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Theoretical Study on High Frequency Behaviour of Concrete by Replacing Sand with Stone Dust

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I. INTRODUCTION

1.1 GENERAL

To meet the requirements of globalization, in the construction of buildingsand other structures concrete plays the rightful role and a large quantum of concrete isbeing utilized. Cement, sand and aggregate are essential needs for preparation of mortar and concrete as it plays a most important role in mix design. In the construction industry, river sand is used as an important building material, and the world consumption of sand in concrete generation alone is around 1000 million tones per year, making it scarce and limited. Hence the demand of natural sand or river sand is very high in developing countries to satisfy the rapid infrastructure growth. The developing country like India facing shortage of good quality natural sand and particularly in India, natural sand deposits are being used up and causing serious threatto environment as well as the society. The excessive and non-scientific methods of mining sand from the river beds has led to lowering of water table and sinking of bridge piers. Further, it has caused environmental degradation like removal of minerals from top soil due to erosion and change in vegetative properties leading to soil infertility problems thereby affecting agricultural productivity, change in river courses leading to floods, and alteration of river eco-system affecting flora and fauna.Hence, the current focus of construction industry should be to partially or completelyreplace natural sand in concrete by waste material or a material that is obtained throughrecycling, without compromising the quality of the end product.

The heavy-exploitation of river sand for construction purposes in India has led to various harmful problems such as options for various river sand alternatives, suchas quarry dust and filtered sand have also been made. Physical as well as chemical properties of fine aggregate affect the durability, workability and also strength of concrete, so fine aggregate is a most important constituent of concrete and cement mortar. Generally river sand or pit sand is used as fine aggregate in mortar and concrete. Together fine and coarse aggregate make about 75- 80 % of total volume of concreteand hence it is very important to fine suitable type and good quality aggregate nearby site. Recently natural sand is becoming a very costly material because of its demand in the construction industry due to this condition research began for cheap and easily available alternative material to natural sand. Some alternatives materials have alreadybeen used as a replacement of natural sand such as fly-ash, limestone and siliceous

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stone powder, filtered sand, copper slag are used in concrete and mortar mixtures as apartial or full replacement of natural sand. Due to shortage of river sand as well as its high demand the Madras High Court had made restrictions on sand mining in rivers Cauvery and Tamirabharani. The facts like in India is almost same in others countriesalso. So therefore the need to find an alternative concrete and mortar aggregate material to river sand in construction works has assumed greater importance now a days.

Researcher and Engineers have come out with their own ideas to decrease or fully replace the use of river sand and use recent innovations such as M-Sand (manufactured sand), robot silica or sand, filtered sand, treated and sieved silt removed from reservoirs as well as dams besides sand from other water bodies. On the other hand, lack in required quality is the major limitation in some of the above materials. Now a day's sustainable infrastructural growth requires the alternative material that should satisfy technical requisites of fine aggregate as well as it should be available locally with large amount.

About 20 to 25 per cent of the total production in each crusher unit is left out as the waste material quarry dust. The ideal percentage of the replacement of sand with the quarry dust is 55 per cent to 75 per cent in case of compressive strength. It further saysthat if combined with fly ash (another industrial waste), 100 per cent replacement of sand can be achieved. The use of fly ash in concrete is desirable because of benefits such as useful disposal of a byproduct, increased workability, reduction of cement consumption, increased sulfate resistance, increased resistance to alkali-silica reactionand decreased permeability. However, the use of fly ash leads to a reduction in early strength of concrete. Therefore, the concurrent use of quarry dust and fly ash in concrete will lead to the benefits of using such materials being added and some of theundesirable effects being negated.

Quarry dust is a kind of waste material that is generated from the stone crushing industry which is abundantly available to the extent of 200 million tones per annum which has landfill disposal problems and health and environmental hazards. The present study is an attempt to experiment on use of quarry dust to replace sand in concrete.

Theoretical study on High frequency fatigue behavior of concrete by replacing sand with stone dust

1.1 PHYSICAL PROPERTIES FOR QUARRY DUST

The results (Table 1) show that there is an increase in the compressive strength of the concrete which the increment is about 55% to 75% depending on the replacement if the sandwith the quarry dust, for the 100% replacement of the sand the compressive strength is depending on the quarry dust location from where the quarry dust was taken. The workability of the concrete is decreasing when the replacement percentage of the quarry dust is increasing gradually, so as to increase the workability small quantity of the fly-ash is replaced in place of cement to increase the workability. This show that the fly ash and quarrydust replacement showed the desirable results which can suggest the usage of the quarry dustas replacement of sand.

Table 1: Physical properties for quarry dust.

Property	QuarryDust	NaturalSand	Test method
Specific gravity	2.54 -2.60	2.60	IS 2386 (Part III)-1963
Bulk density (kg/m3)	1720- 1810	1460	IS 2386 (Part III)-1963
Absorption (%)	1.20- 1.50	Nil	IS 2386 (Part III)-1963
Fine particles less than 0.075 mm (%)	12-15	6	IS 2386 (Part III)-1963
Sieve analysis	Zone-II	Zone-II	IS 383 – 1970
Moisture Content(%)	Nil	1.50	IS 2386 (Part III)-1963

3.1 Quarry stone dust

The quarry stone dust was obtained from local resource Binnar Stone Crusher, Near Sinnar, Nashik was used in concrete and mortar to cast test cubes, mortar blocks, cylinders and beams. The physical and chemical properties of stone dust obtained by testing the samples as per Indian Standards are listed below. The quarry dust is the by-product which is formed in the processing of the granite stones which broken downs into the coarse aggregates of different sizes.

1.3. ADVANTAGES OF QUARRY DUST:

-The Specific gravitydepends on the nature of the rock from which it is processed andthe variation is less.

1.4 DISADVANTAGES OF QUARRY DUST:

Shrinkage is more in when compared to that of the natural river sand.

Water absorption is present so that increase the water addition to the dry mix.

II. OBJECTIVES:

1) Quarry dust is a kind of waste material that is generated from the stone crushing industry.
2) Which is abundantly available to the extent of 200 million tons per annum.
3) Which has landfill disposal problems and health and environmental hazards.
4) The present study is an attempt to experiment on use of quarry dust to replace sandin concrete.
5) If better quality of quarry stone dust can be used it may give better result in terms of strength. Proper gradation of quarry stone dust can give a better result.
6) The economic value of powder sand is almost zero and generally is treated as waste.If it is used in making of mortar and concrete, cost will be minimized as well as wastewill be reduced.

7) One of the ways to improving sustainability is to reduce the human consumption of natural resources.
8) In short in order to protect the natural resources such as river sand, this study has identified quarry dust, which is a waste product from stone crushing industry and available almost free-of-cost, as partial replacement for river sand.

III. EXPERIMENTAL WORK

3.2 Cement

Cement used was ACC cement of OPC 53 grade. The physical properties of cementwere asfollows with respective to IS 12269.

3.1.1 Fineness of cement

Definition: Fineness of cement refers to the size of grains or particle of cement. Lesser thegrain size finer is the cement. So it was important to find the fineness of cement.
To find out fineness of cement there are two methods prescribed in IS codes.
1) Sieve test (IS 4031, Part 1 1996),
2) Air permeability method (IS 4031, Part 2 1999).

Apparatus: IS sieve number 9, weigh machine

As per recommended by IS we use sieve test, and the step by step procedure is asfollow,
1. Weigh 100gm of cement correctly and take it on a standard IS sieve number9, i.e., asieve of size 90 microns.
2. Break down any air-set lumps in the sample with fingers.
3. Continuously sieve the sample giving circular and vertical motion for a periodof15minutes.
4. Weigh the residue left on the sieve.
5. As per IS standard this residue shall not exceed by the limits as given below,

- ✓ For OPC- 10gm
- ✓ For RHC- 5gm

Setting time of cement

3.1.3.1 Initial setting time (IS 4031, Part 5, 1988, 2000)
Definition: - Initial setting time is the time elapsed between the moments when wateris poured in cement to the moment when the cement paste starts losing its plasticity. This test was performed on the Vicat's apparatus, this time the initial setting time needle is attached.

Final setting time (IS 4031, Part 5, 1988, 2000)

Definition:- Final setting time is defined as the time elapsed between the moment when water is added to cement and the moment when the paste has completely lostits plasticity.
Final setting time test is conducted as a continuation of the Initial setting time test andsame mould of cement is used for the test.

3.2.1 Soundness test (IS 4031, Part 3, 1988, 2000)

The soundness test ensures that the cement does not show excessive thermal expansion and if it does, it can be rejected. This test is performed with the LeChatelier's apparatus. It consists of a brass cylinders, cut along its height with two pointers welded along each side of the cut. Due to thermal expansion, the cement in the cylinder expands and this expansion is measured by the pointers attached to the cylinder.

3.2.2 Compressive strength (IS 4031, Part 6, 1988, 2000)

Compressive strength of cement is the most important parameter and hence this test is one of the most important tests. This test could not be performed on neat cement paste due to excessiveshrinkage and subsequent cracking neat cement paste. Instead, a standard mortar is prepared by mixing standard sand conforming to dust.
Quarry stone dust used in the laboratory investigations was procured fromlocal resource Binnar Stone Crusher, Near Sinnar, Nashik. The test was carried to findout the fineness modulus of quarry stone dust. So that we can know the category of quarry stone dust.

3.3 Natural sand
The sand used was obtained by local resource. The physical properties of sand wasas follow,

3.3.1 Particle size distribution of natural sand (IS 2720, Part-4, 1985, 2010)
The test is performed to find out the fineness modulus of sand. So that we can knowthe category of quarry stone dust.

3.4 Coarse aggregate
The coarse aggregate used was obtained by local resources. The physical propertiesof coarse aggregate was as follow:

3.4.1 Aggregate Impact value test (IS 2386, Part-4, 1963)
The test was performed to find out the impact value of aggregate.
The ratio of the weight of fines formed to the total sample weight in each test is to be expressedas a percentage, to the first decimal place. Aggregate impactvalue = (Wa/Wb) x 100.

3.5 Concrete
Concrete is defined as a uniform mixture of cement, sand, aggregate andwater in prescribed proportions, which sets, hardens and acquires strength over a period of time. The concreting operation consists of measuring the ingredients, mixingthem to obtain a uniform mixture, placing the concrete in the moulds, known as formwork, compacting, allowing to set and then curing for appropriate period, generally 28 days, by keeping it constantly moist.

3.5.1 Workability of concrete

Definition: Workability of concrete is defined as the ease with which concrete can be placedin the formwork, fills the formwork completely by flowing and the ease with which it can becompacted.

3.5.2 Determination of workability by slump cone test (IS 516):-
This is the most commonly used test for determination of workability. This method can be used on the site as well as in the laboratory. The apparatus essentially consists of a metallic mould in the form of the frustum of a cone and a metallic tray. The mould is known as slumpcone and its dimensions are as under:

3.5.3 Compaction factor test of concrete
Slump cone test does not give good results in case of stiff or harsh concrete. Hence the compaction factor test is used. In this test, the compaction achieved through a free fall of concrete determines its workability.

IV. TEST SPECIMENS PREPARATION
In order to establish the stone powder produced during stone crushing as an alternative of normal sand a lots of laboratory test are conducted and compared with the same obtained result from the normal sand concrete. The 150 mm size concrete cubes, concrete beams of size 100 mm x 100 mm x 500 mm, mortar blocks of size 70 mm x 70 mm x 70mm and cylinders of diameter 15mm x 300mm height were used as test specimens to determine the compressive strength, flexural strength and split-tensile strength respectively. The specimens were cast for M20 grade, and for coarse aggregates of size 20 mm was used. The workability of fresh concrete was measured in terms of slump values. The ingredients of concrete were thoroughly mixed till uniform consistency was achieved. The cubes, beams, mortar blocks and cylinders were compacted on a vibrating table. As the study focuses on the adequacy of fine aggregate and hence the fineness modulus of stone powder and sand was calculated and rest of sample remained constant. The obtained result is analyzed and then discussion is prepared depending on the result obtained.

4.1 Mix Design for M20-Grade Concrete

A) Stipulation for proportion

Grade of concrete	**M20**
Cement	OPC 53 grade
Size of aggregate	20mm
Minimum cement	300 Kg/m3

Maximum water-cement ratio	0.55
Workability	70mm
Exposure condition	Mild

B) Test data

Particulars	**Properties**
Specific gravity of cement	3.12
Specific gravity of	
1. Coarse aggregate	2.72
2. Fine aggregate	2.68
3. Stone dust	2.90
Water absorption	
1. Coarse aggregate	0.7 %
2. Fine aggregate	1.0 %
3. Stone dust	1.1 %

Table 2: Mix proportion of ingredients or 1m3

Cement	350 kg/m3
Water	185 kg/m3
Fine aggregate	760 kg/m3
Coarse aggregate	1157 kg/m3
Water-cement ratio	0.52

a. Preparation of testing specimen:

4.2.1 Casting of the specimens:

The present experimental work includes casting and testing of specimensto know the compressive strength and flexural strength of mortar blocks, cylinder, concrete blocks and beams. These mortar blocks, cylinder, concrete cubes and beamsare casted and tested as per IS 516-1959 specifications. To find out whether the powder sand can be uses with sand as a fine aggregate a certain amount of laboratoryexperiments have been conducted. The sand and powder sand was mixed with variousratios to prepare mortar and concrete and their strengths were compared with each other. For this purpose 70mm x 70mm mortar block, concrete cylinder of 150mm diameter x 300mm height, concrete block of 150mm x 150mm x 150mm and beams of 100mm x 100mm x 500mm has been tested.

The specimens are casted for the following:

1. M20 grade concrete with OPC+NATURAL SAND
2. M20 grade concrete with OPC + (NATURAL SAND+QUARRY STONEDUST)
3. M20 grade concrete with OPC + QUARRY STONE DUST

The ratios those are used for the mortar are shown in tabular form below,

Table 3: Mixing ratios used for preparation of mortar

Cement : sand + quarry stone dust	**Cement : sand + quarry stone dust**
1 : (3 + 0)	1 : (2 + 0)
1 : (1.5 + 1.5)	1 : (1 + 1)
1 : (0 + 3)	1 : (0 + 2)

The mixing ratios those are used for concrete blocks, cylinder and beams are shownin a tabular form below.

Table 4: Mixing ratios used for the preparation of concrete

Cement : (sand + quarry stone dust) :coarse aggregate
1 : (1.5+0) : 3
1 : (0.75+0.75) : 3
1 : (0 + 1.5) : 3

4.2.2 Compaction of concrete:

Compaction of concrete is the process adopted for expelling the entrapped airfrom the concrete. In the process of placing and mixing of concrete, airis likely to get entrapped in the concrete. If air is not removed fully, the concrete loses strength considerably. In order to achieve full compaction and maximum density Table vibrator isused in this experiment.

4.2.3 Curing of specimens:

The mortar blocks, beams, concrete blocks and concrete cylinders were preparedby standard procedure. After preparation, the mortar blocks, beams, concrete blocks and cylinder specimens were stored undisturbed for 24 hours. After 24 hours those specimens werereleased from the mould and were further cured in water. After specific days the specimens were taken out from the water and dried for half an hour. The specimens were tested to determine the crushing strength, flexural strength and tensile flexural strength by using compressive testing machine and universal testing machine. The peak load and strength was obtained from the machine and the obtained result is analyzed and compared to each other. Depending comparison of the results discussion was prepared.

4.2.3 Schedule of testing:

Date of work	**Name of work**
24-04-2023	Casting of specimen
25-04-2023	Removal of mould
25-04-2023	Date of curing
29-04-2023	Testing after 3 days
03-05-2023	Testing after 7 days
10-05-2023	Testing after 14 days
17-05-2023	Testing after 21days
24-05-2023	Testing after 28 days

V. RESULTS AND DISCUSSION

In order to study the strength behavior of the concrete made with partial replacement and full replacement of sand with quarry stone dust the tests are conducted. Results so obtained for the tests conducted on cubes, mortar blocks, cylinder and beams for M20 grades of concrete at 7 days 21 days and 28 days were tabulated. The results were compared for concretes with natural sand to that of quarry stone dust as fine aggregate.

5.1 Fineness of cement

The fineness of cement is observed as 8gm, which is in limits given by (IS 4031, part1, 1996).

5.2 Standard consistency of cementObservation table:

Table 5: Percentage of water for normal consistency

Sr. No.	Weight ofcement (gms)	Percentagebyweight of dry cement	Amount of water added (ml)	penetration
1.	500gms	25%	125ml	38

2.	500gms	23.5%	118ml	36
3.	500gms	22%	110ml	33.8

The percentage of water for normal consistency for the given sample of ACCcement of 53 grade is 22%.

5.3 Soundness test (IS 4031, Part 3, 1988, 2000)Observations:

I. Quantity of cement = 100gm

II. Water for standard consistency = 0.78P

III. Quantity of water to be added = 18ml

Sr. No.	Expansion of cement
1.	8.5mm

The soundness of cement is found to be 8.5mm.

5.4 Setting time of cement

5.4.1 Initial setting time (IS 4031, Part 5, 1988, 2000)

Observations:

I. Quantity of cement = 500gm

II. Water for standard consistency = 0.85P

Where, P is water percentage required for standard consistency,P=22%

= 0.85 x (22/100)

III. Quantity of water to be added = 93.5mlObservation table:

Table 6: Initial setting time of the cement

Sr. No.	Initial setting time(min)	Depth of penetration(mm)
1	28 min	34.4
2	27min 30sec	34.6
3	26min 58sec	34.8

The initial setting time of the cement sample is found to be 26min 58sec.

5.4.2 Final setting time (IS 4031, Part 5, 1988, 2000)

Observations:

I. Quantity of cement = 500gm

II. Water for standard consistency = 085P

III. Quantity of water to be added = 93.5ml

Sr. No.	Final setting time (min)
1.	580min

The final setting time of the cement sample is found to be 580mins.

5.5 Compressive strength of cement (IS 4031, Part 6, 1988, 2000)Observation table:

Table 7: Compressive strength of cement in N/mm2

Sr. No.	Grade	3 days strength N/mm2	7 days strength N/mm2	28 days strength N/mm2
1.	1:3	16.5	22.8	32.8
2.	1:3	15.9	23.5	33.4
3.	1:3	17.2	23.9	33.9
4.	1:3	16.7	23.1	33.1
Average	1:3	16.58	23.33	33.3

The compressive strength of cement is found to be fori. 3 days -16.58N/mm2,

ii. 7 days – 23.33N/mm2

iii. 28 days – 33.3N/mm2.

Fig.12: compressive strength of cement in (N/mm2)

5.6 Particle size distribution of stone dust (IS 2720, Part-4, 1985, 2010)Observation table:

Weight of stone dust = 1000gm= 1kg

Table 8: Particle size distribution of stone dust.

IS SIEVESIZE (mm)	WEIGTH RETAINED (gms)	PERCENTAGERETAINED (gms)	CUMMULATIVEPERCENTAGE RETAINED
4.75	20	2	2
2.36	92	9.2	11.2
1.18	109	10.9	22.1
0.6	173	17.3	39.4
0.3	323	32.3	71.7
0.15	202	20.2	91.9
Pan	81	8.1	-
Sum =	1000	100	238.3

Fineness modulus of stone dust = 238.3/100 =2.383 Therefore, the sand isfine sand.

Figur 13: Sieve analysis of quarry stone dust used in laboratory experiment

5.7 Particle size distribution of natural sand (IS 2720, Part-4, 1985, 2010)Observation table:

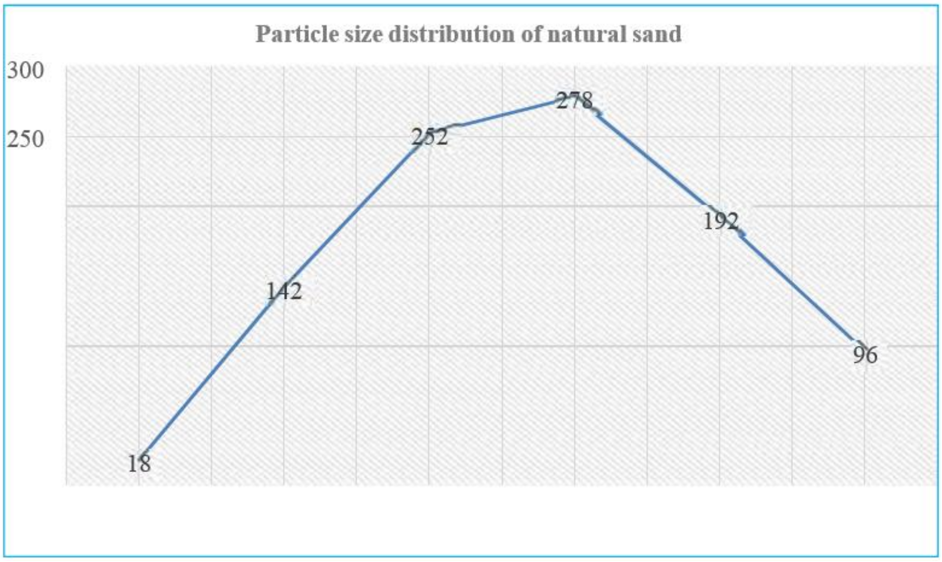
Weight of natural sand = 1000gm= 1kg

Table 9: Particle size distribution of natural sand i.e., river sand.

IS SIEVESIZE (mm)	WEIGTH RETAINED (gms)	PERCENTAGERETAINED (gms)	CUMMULATIV EPERCENTAGERETAINED
4.75	18	1.8	1.8
2.36	142	14.2	16
1.18	252	25.2	41.2
0.6	278	27.8	69
0.3	192	19.2	88.2
0.15	96	9.6	97.8
Pan	22	2.2	-

Sum =	1000	100	314

Fineness modulus of sand = 314/100 =3.14 Therefore, the sand iscoarse sand.



5.8 Aggregate Impact value test (IS 2386, Part-4, 1963)Observations:

I. Weight of mould = W1 = 1670gm

II. Weight of mould + aggregate = 2290gm

III. Weight of aggregate = W2 = 620gm

IV. Weight of aggregate passing through2.36mm IS sieve = W3 = 120g

V. Weight of sample retained = W4 = 500gm

5.9 Workability of concreteObservations:

I. Proportion of mix = M20

II. Water cement ratio = 0.52

III. Weight of cement = 6.65 kg/m3

IV. Weight of water added = 3.5 liters

V. Weight of sand = 14.44 kg/m3

VI. Weight of coarse aggregate = 22 kg/m3

VII. Height of concrete before slump subsidence = 30cm

VIII. Slump height = 15cm

The slump value of given concrete mix is found to be 150mm

5.1 Compaction factor test of concreteObservation

Weight of cement 6.65 kg/m3Weight of sand = 14.44 kg/m3
Weight of coarse aggregate = 22 kg/m3Water cement ratio= 0.52

5.2 COMPRESSIVE STRENGHTS:

Compressive strength of mortar blocks:

Form the laboratory experiment we found compressive strength of mortar blocks (70mm x 70mm x 70mm) for 1:3 and 1:2 for various mixing ratio made with natural sand and those made with quarry stone dust as fine aggregate are tested under compression testing machine and results are tabulated in table shown below

a) Mortar blocks of ratio (1:3):

Table 10: Comparison of stresses (N/mm2) of mortar cube (70mm x 70 mm) forratio 1:3

Mix ratio (cement :sand +stone powder)	7 days				21 days				28 days			
	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean
1 : (3+0)	16.8	17.2	16.3	16.77	26.1	25.9	25.7	25.9	28.3	28.2	28.1	28.2
1 : (2+1)	16.9	16.8	16.7	16.8	26.2	26.4	26.17	26.25	28.5	28.2	28.1	28.27
1 : (1+2)	16.7	17.2	16.6	16.83	26.8	26.2	26.6	26.53	28.5	28.1	28.3	28.3
1 : (0+3)	16.7	16.9	17.1	16.9	26.2	26.9	26.7	26.6	28.6	28.5	28.1	28.4

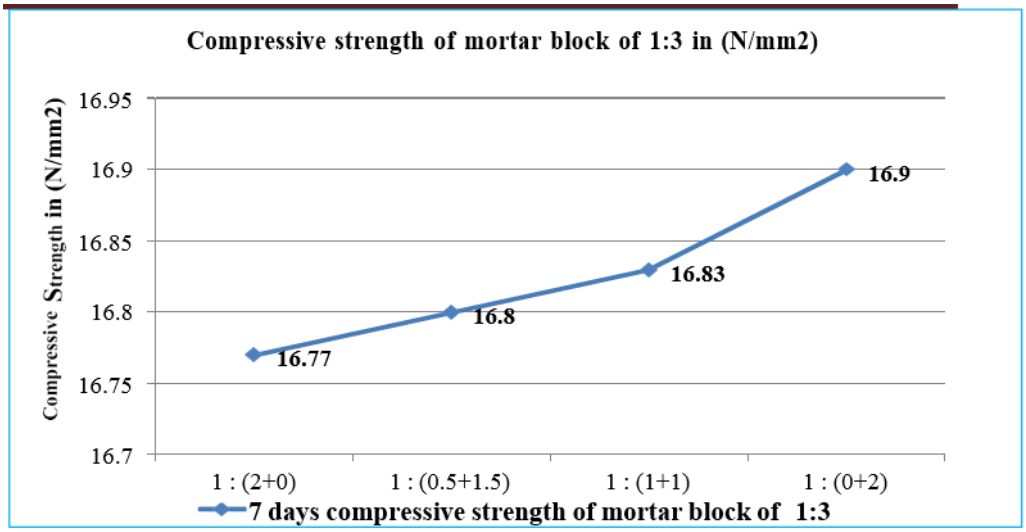


Figure 15:7 days compressive strength of mortar block of 1:3 in (N/mm2)

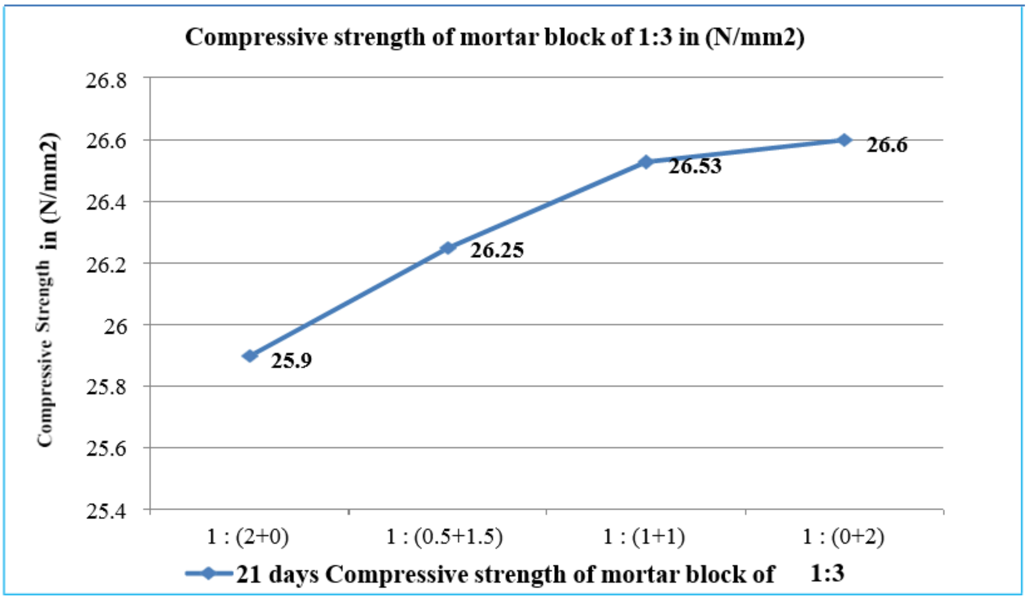


Figure16:21 days compressive strength of mortar block of 1:3 in (N/mm2)

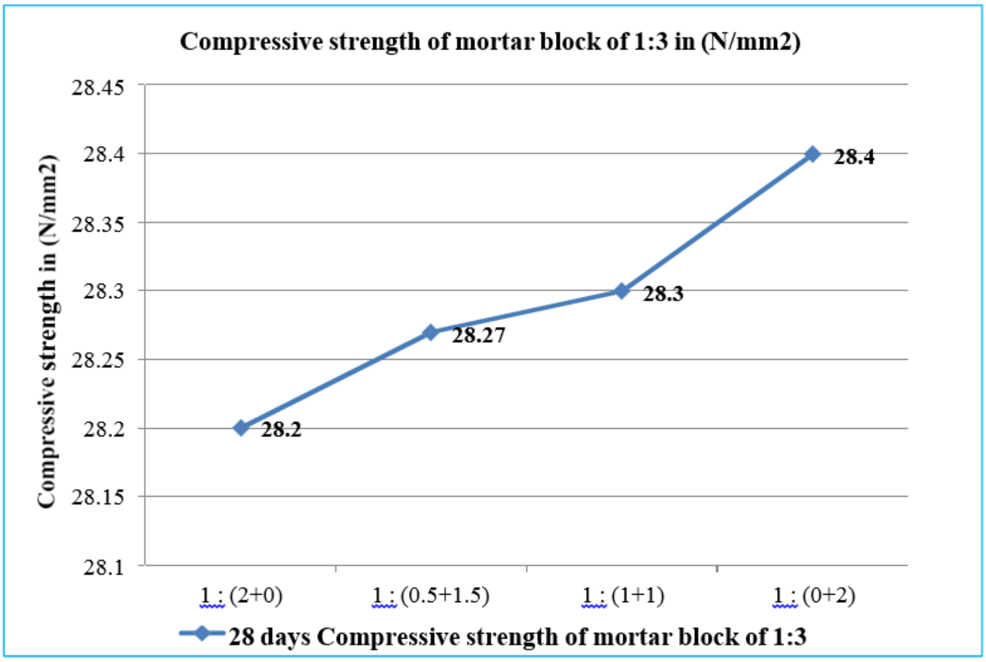


Figure17:28 days compressive strength ofmortar block of 1:3 in (N/mm2)

b) Mortar blocks of ratio (1:2):

Table 11: Comparison of stresses (N/mm2) of mortar cube (70mm x 70 mm) forratio 1:2

Mix ratio (cement :sand +stone powder)	7 days				21 days				28 days			
	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean
1 : (2+0)	18.5	17.9	18.4	18.27	27.2	27.9	27.6	27.57	29.3	30.9	30.2	30.13
1 :(0.5+1.5)	18.6	18.3	18.7	18.53	27.6	28.2	27.6	27.8	29.8	30.5	30.7	30.33
1 : (1+1)	18.8	18.7	18.9	18.8	28.1	28.2	27.9	28.07	30.8	31.1	30.7	30.87
1 : (0+2)	18.1	18.9	17.9	18.3	27.5	27.7	27.9	27.7	29.9	30.7	30.5	30.37

Compressive strength of mortar block of 1:2 in (N/mm2)

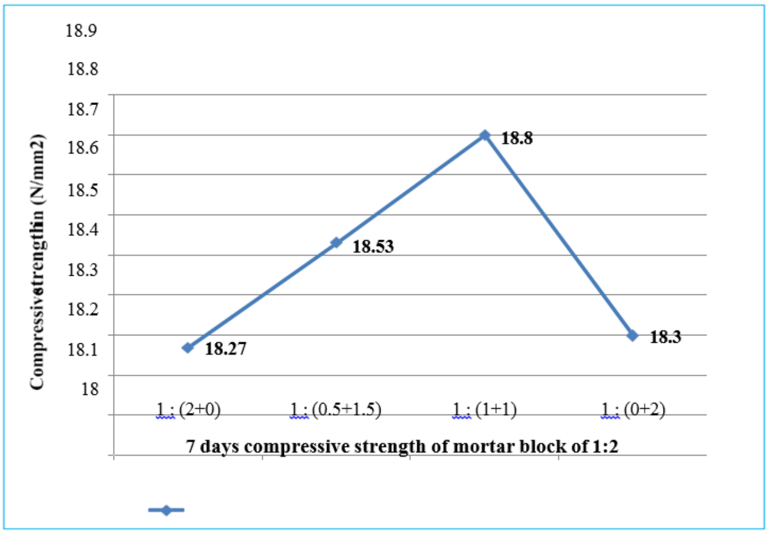


Figure18: 7 days compressive strength of mortar block of 1:2 in (N/mm2)

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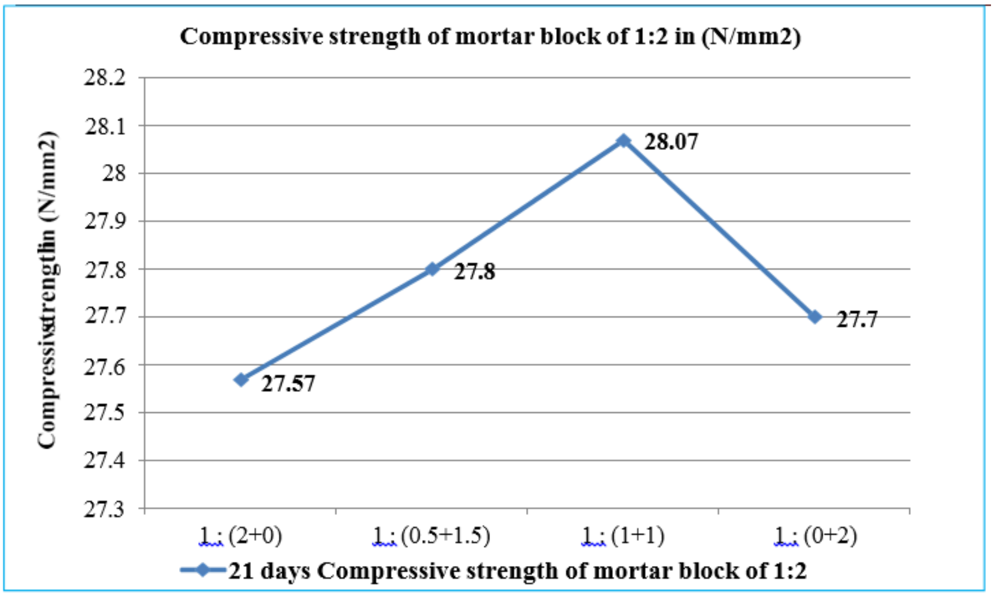

Figure20:28 days compressive strength of mortar block of 1:2 in (N/mm2)

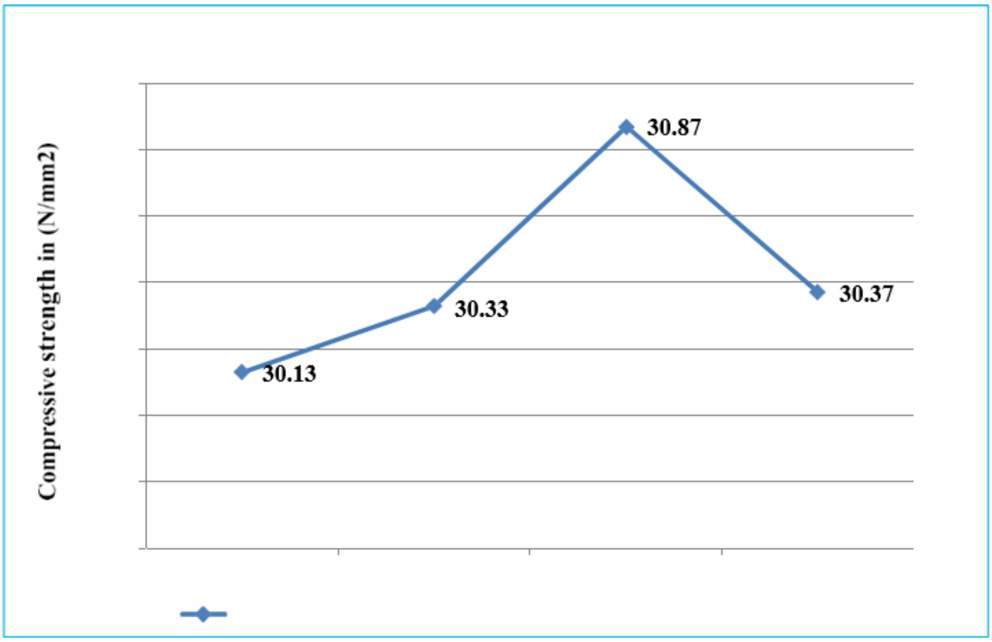

Figure19:21 days compressive strength of mortar block of 1:2 in (N/mm2)

Compressive strength of concrete cubes:
Form the laboratory experiment we found compressive strength of concrete cubes (150mm x 150mm x 150mm) for M20 grade for various mixing ratio made with natural sand and those made with quarry stone dust as fine aggregate are tested under compression testing machine and results are tabulated in table shown below,

Table 12: Comparison of stresses (N/mm2) of concrete cube (150mm x150 mmx150mm) for M20.

Mix ratio(cement : sand + stone powder : coarse aggregate)	7 days				14 days				28 days			
	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean
1:(1.5+0):3	17.5	17.6	17.3	17.47	23.8	24.1	23.9	23.93	27.3	26.8	27.2	27.1
1:(0.75+0.75):3	17.3	17.6	17.7	17.53	24.1	24.0	23.9	24.0	26.6	27.1	27.3	27.0
1:(1.5+0):3	17.7	17.5	17.6	17.6	24.2	24.1	24.0	24.1	27.2	27.1	27.3	27.2

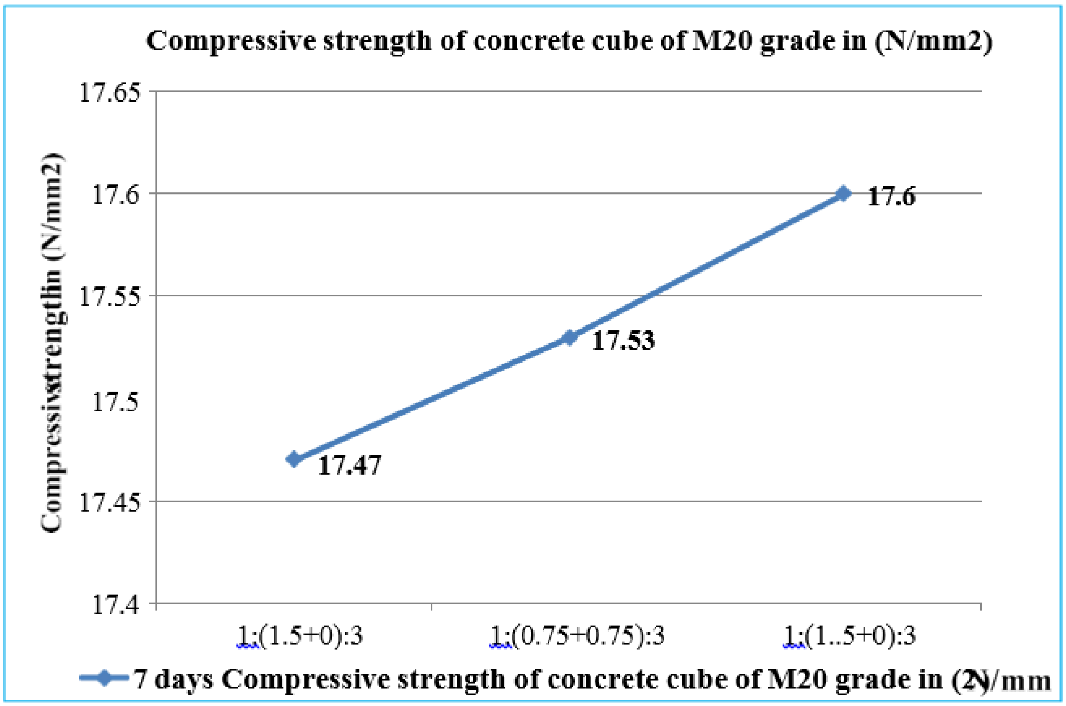

Figure21: 7 days compressive strength ocfoncrete cube of M20 i(nN/mm2)

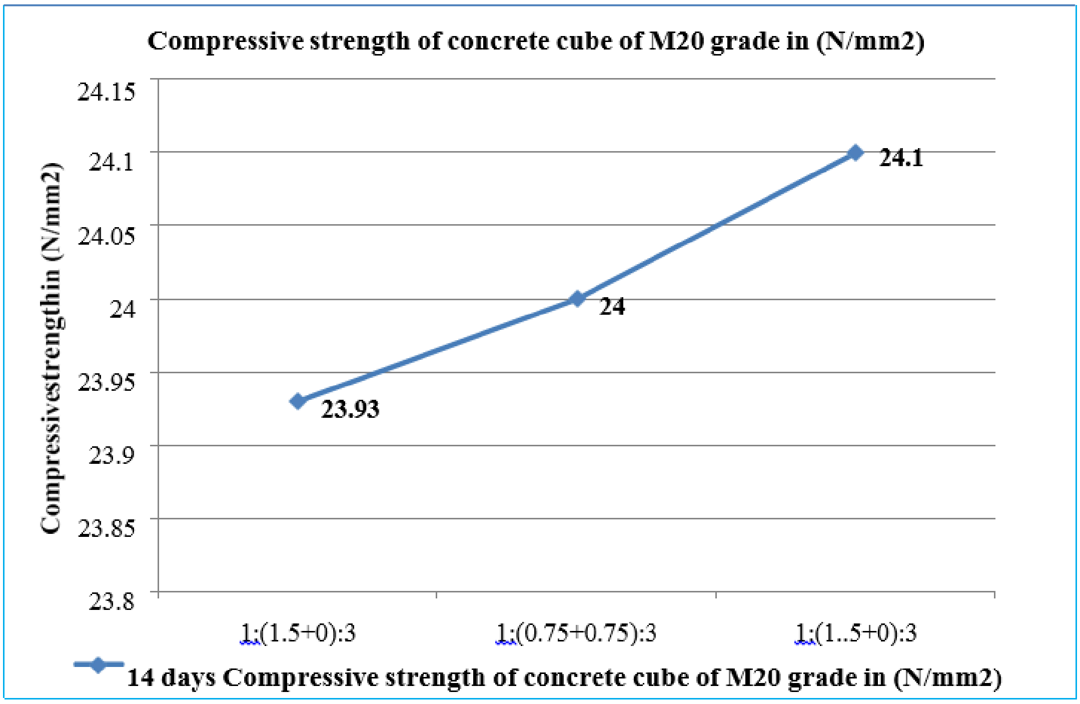

Figure 22: 14 days compressive strength of concrete cube of M20 in (N/mm2)

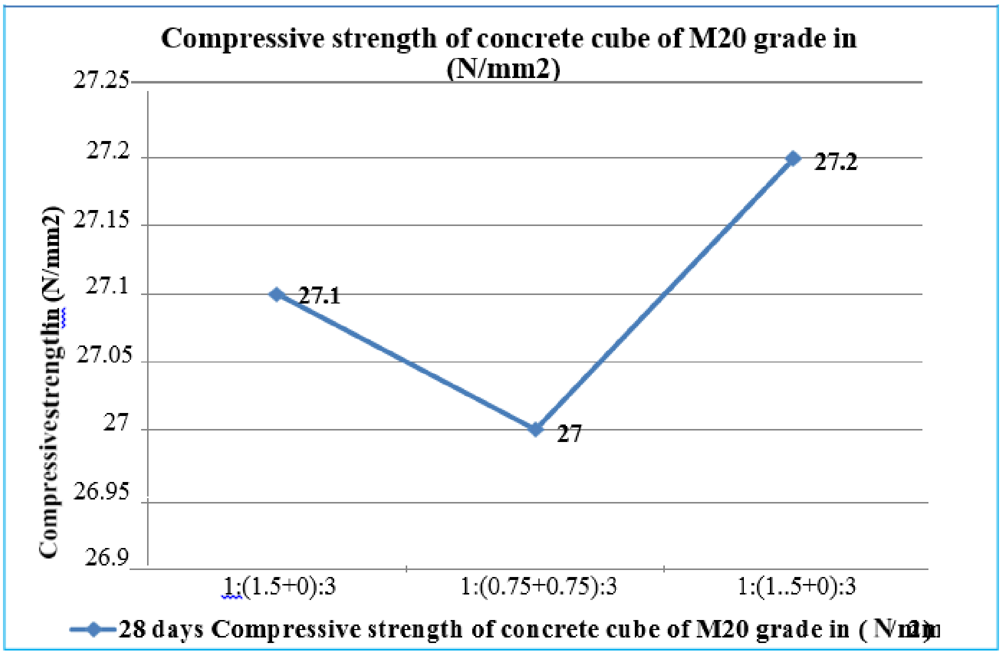

Figure23: 28 days compressive strength ofconcrete cube of M20 in(N/mm2)

Split tensile test of cylinder:

For the preparation of concrete, crushed stone was used as coarse aggregate and natural sand and quarry stone dust was used as fine aggregate. The testswere made by changing the ratios of sand and powder under the mixing ratio of 1:1.5:3. The result obtained from the laboratory experiment shown in tabular form below.

Splitting tensile (Fct) = (2 P/ 3.14 x L x d)

where, P = maximum load in Newton's applied to thespecimen, L = length of the specimen (mm)
d = cross sectional dimensions of the specimen (mm)

Table 13: Split tensile strength (N/mm2) of concrete cylinder (300mm x 150 mm)for ratio M20.

Mix ratio	28 days		
(cement : sand + stone dust : coarse aggregate)	1	2	Mean
1 : (1.5+0) : 3	2.13	2.19	2.16
1 : (0.75+0.75) :3	2.26	2.33	2.295
1 : (0+3) : 3	2.37	2.40	2.385

VI. CONCLUSION

- The physical and chemical properties of natural sand are satisfied by the quarry stone dust.
- Natural river sand, if replaced by hundred percent quarry stone dust from crushingactivities of stones in aggregate, may sometimes give equal or better strength thanthe reference concrete made with natural sand, in terms of compressive and flexuralstrength studies.
- Studies reported here and elsewhere have shown that the strength of quarry stone dust concrete is comparatively 10-12 percent more than that of similar mix of conventional concrete.
- However, it is advisable to carry out trial casting with quarry stone dust proposed to be used, in order to arrive at the water content and mix proportion to suit the required workability levels and strength requirement.
- More research studies are being made on quarry stone dust concrete necessary for the practical application of quarry stone dust as fine aggregate.
- The Replacement of the sand with quarry dust shows an improved in the compressive strength of the concrete.
- Therefore, the results of this study provide a strong support for the use of quarry stone dust as fine aggregate in concrete manufacturing. Thus, it can be concluded that the replacement of natural sand with quarry

stone dust, as full replacement in concrete is possible.

Theoretical study on High frequency fatigue behavior of concrete by replacing sand with stone dust

REFERENCE

[1]. Ilangovana.R, Mahendrana.N and Nagamani.k. "Strength and durability properties of concrete containing quarry rock dust as fine aggregate". ARPN Journal of Engineering andApplied Sciences. Vol.3, no.5, October 2008.
[2]. [2]H. M. A. Mahzuz, A. A. M. Ahmed and M. A. Yusuf, "Use of stone powder in concrete and mortar as an alternative of sand", African Journal of Environmental Science and Technology, 2011, Vol. 5, 381-388.
[3]. [3] Dr. P.B.Sakthivel, C.Ramya, M.Raja, "An Innovative Method of Replacing River Sand by Quarry Dust Waste in Concrete for Sustainability", International Journal of Scientific & Engineering Research, Volume 4, Issue 5, May-2013.
[4]. [4]A. Suribabu, Dr U.Rangaraju, Dr.M. Ravindra Krishna, "Behaviour of Concrete onReplacement of Sand with Quaries Stone Dust as Fine Aggregate", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Issue1, January 2015.
[5]. Mohaiminul Haque, Sourav Ray, H. M. A. Mahzuz, "Use of Stone Powder with Sand in Concrete and Mortar: A Waste Utilization Approach", ARPN Journal of Science and Technology, VOL. 2, NO. 7, August 2012.
[6]. IS: 383-1970. Specification for Coarse and Fine Aggregates from natural sources for concrete. Bureau of Indian standards, New Delhi.
[7]. IS 12269-1987, Specification for 53 Grade Ordinary Portland cement, September 1993, Bureau of Indian Standards, New Delhi, India.
[8]. IS: 2386-1963 Part 1 to VIII. Indian Standard Methods of Test for Aggregate for concrete. Bureau of Indian Standards, New Delhi.
[9]. IS: 516-1959. Indian Standard Methods of Test for Strength of concrete. Bureau of Indian Standards, New Delhi.
[10]. IS 10262:2009, Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, India.
[11]. IS 2386 (Part 3) 1963, Indian Standard Code of Practice for methods of test for aggregates for concrete
[12]. IS 456:2000, Plain and Reinforced Concrete Code of Practice, Fourth Revision, Bureau of Indian Standards, New Delhi, India

SAMPLE CALCULATION

- Mix calculation

The mix calculations per unit volume of concrete shall be as follows;

1. Volume of concrete = 1 m3

2. Volume of cement = ((mass of cement/specific gravity of cement) X (1/1000))

= ((350/3.15) x (1/1000))

= 0.111m3

3. Volume of water = ((mass of water/specific gravity of water) x (1/1000))

= ((185/1) x (1/1000))

= 0.185m3

4. Volume of all in aggregate = (1-(volume of cement + volume of water))

= (1-(0.111 + 0.185)

= (1-(0.296))

= 0.704m3

5. Mass of coarse aggregate = (volume of all in aggregate x volume of coarse xSpecific gravity of coarse aggregate x 1000)
6. Mass of fine aggregate = (volume of all in aggregate x volume of coarse xSpecific gravity of fine aggregate x 1000)

- MIX PROPORTION

*Mix proportion of ingredients or 1m3

1) Cement 350 kg/m3

2) Water 185 kg/m3

3) Fine aggregate 760 kg/m3

4) Coarse aggregate 1157 kg/m3

5) Water-cement ratio 0.52