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STUDY ON WORKABILITY AND MECHANICAL PROPERTIES OF CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT BY BARITES

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Abstract— This study represents the behaviour of concrete, having partial replacement of cement with barites. The focus of our project will be strengthening concrete by replacing cement by barites in the most economical way by using the proper grade of concrete for increasing density of concrete. The mineral barite is a cheap and locally available material. Barites is a clean, smooth, naturally unresponsive and inexpensive mineral. It is non-toxic and also chemically and physically uncreative. It is used to make high-density concrete to block x-ray emissions in hospitals, power plants and laboratories. They can help to improve the workability and reduces the heat of hydration. M20 grade concrete was used for which the barites are replaced and an experimental study was carried out and the effect on compressive strength characteristics (0%, 10%, 20% and 30%) was studied. Water-cement ratio is to be kept same as that of normal concrete. The compressive strength of the concrete mixtures has been obtained at 7, 14, 28 and 56 days. The result of the laboratory work showed that replacement of cement with barites increases, up to 10% for compressive strength of concrete.

I. INTRODUCTION

Absolutely the concrete had been a quite unique material for the rapid development. Everything being equal at end, in general the concrete is used as a development in common which can set as a solid for any building material. At that point the blend of bond, sand, totals and water, in this procedure of choosing the reasonable materials and elements of planning concrete their relative Proportion measure of sum with the delivering required cement. This solid is utilized to the development of Multistory structures, dams' street asphalts, tanks, seaward structures, channel lining. In this procedure appropriate materials are delivering the solid required quality and toughness and usefulness as financially conceivable to rely on the blend outline. The compressive quality of solidified cement is for the most part thought to be list of its properties relies on the numerous components. For Eg, The amount total and nature of that total clustering, Water and blending and compaction. The cost of cement is made by expensive materials and great plant and work the variety of cost of materials emerge from that the concrete is a few times of exorbitant than the totals

SCOPE OF THE PRESENT WORK

In the present examination joins blend configuration relies on the rules according to Indian Standard Code IS : 10262 – 2009. At the point when merciful barites will use as admixtures Is entirely denied in the utilizing blend plan. the substitution of the barites and furthermore supplanting of barites of the compressive quality of cement. The water content has been kept steady all through the venture and water content is to offices a superior examination for the diverse examples . In the present venture the compressive quality will be estimated gotten 7 days, 14 days, 28 days and 56 days. At long last conveyed throwing of solid shapes and did the compressive quality. The examination masculine concentrated on the compressive quality of cement. At last did the last consequences of the compressive quality.

OBJECTIVES OF THE PRESENT WORK

The primary targets are said underneath

- To examine to enhance the compressive quality of cement.
- To know the impact of the expansion the barites on the compressive quality of cement.

ORGANIZATION OF THE THESIS

This proposal has been separated in to the five parts as appeared as takes after

Chapter 1: In this part "Introduction" which thought of hypothesis, data on the foundation of this exploration, the significance of the present work, destinations of the investigation and extent of work and so on.

Chapter 2: In this section contains "Review of Literature" takes after the understanding the past creators and diverse works. It is identified with the ebb and flow subject of the examination are talked about.
Chapter 3: Third Chapter: In this part contains "materials" this section to clarify the all materials Properties and test projects and research facility tests can be directed.
Chapter 4: In this section contains functionality and solid tests and their properties , can be clarifiedend extents, relieving and Casting, compressive quality of cement clarified at the present work.
Chapter 6: In this section "results and talk" we directing the undertaking in view of the exploratory program.
Chapter 7: In this section contains the "conclusion" of the last aftereffects of the task and future investigation of the present work.
Chapter 8: Future summery of the present work.

II. LITERATURE REVIEW

- **P.Meenakshi (2017),** Department of common and auxiliary designing and SCSVMV University Kanchipuram, India. She was distributed paper in inner diary, 2017 walk 10 on the writing survey, she was work done on halfway substitution of bond by utilizing barites and lime powder. We can watch that the main substitution by barites has indicated great outcomes. So the substitution of the two barites and lime are not demonstrated great outcomes not suggested.
- **Akkurt, I. what's more, AkyiIdirim, H. (2012),** He was done, an examination on radiation protecting properties of pumice concrete. It was reasoned that the pumice stone as total in concrete does not given any better outcomes. Pumice stone as a total in concrete. This stone total won't be given any great outcomes as far as gamma radiation protecting properties.
- **Akkurt, I., et al. (2010),** In this concentrated to quantify the direct constriction co-productive for the solid by utilizing Zeolite (Na2AAI2Si310.2H2O) as totals in various focuses (0%, 10%, 20%, 30%, and half). In this procedure the direct constriction co-effective, estimated on four solid squares, diminished with expanded amount of zeolite. It can be inferred that the zeolite was not appropriate for the getting ready radiation protecting cement.
- **Akkurt, I., et al. (2006),** In this examination completed on barite concrete, and their discovering s how that solid with barite (BaSO4). It is a coarse total displays higher linearattenuation co-proficient (both computed and estimated comes about) and these sort of barite – stacked cements would be worthwhile in building development against radiation. It can be utilized high thickness structures.
- **Ahmed S.Ouda(2014),** on Development of overwhelming thickness utilizing distinctive totals for gamma beams protecting and distributed a paper in universal diary 19 June 2014.
- **Sh.Sharifi, R.Bhageri and S.P.Shirmardi,** Department of structural building, Islamic Azad University, Iraq distributed a paper in ELSEVIER diary, 8 sep 2012 on comparision of protecting.
- **Bouzarjomehri, F., et al. (2006),** It was created overwhelming cement in tests utilizing the barite mineral. These examples had made high densities in the scope of 3180-3550 kg/m3, and ended up being great radiation obstructions.
- **Proshin, A.P., et al. (2005),** He was created "Super overwhelming high Strength solid" this solid densities of 3800-4200 kg/m3, it was utilizing waste items o substantial silicate-lead glasses. It was observed to be a decent radiation shield.

III. DETAILS OF MATERIALS AND THEIR PROPERTIES

BARITES: In the present investigation, the barites powder is gathered from the madhavi miniaturized scale minerals close to the R.T.O. Office Kadapa.

Barite is a mineral made out of barium sulfate (BaSO4). This mineral having variety of various hues. Barites having a high particular gravity and high thickness. Barite mineral are boss wellspring of the component barium, these mixes required by numerous enterprises like elastic, materials, oil well boring, radiation protecting and for coating in fired industry. This material is very weak and can be effectively powdered.

Barites Powder

Barites of properties

Sp. gr.	**2.600**
Density	**2160 g/m3**
Colour	**White, grey, blur, rose, etc**
Streak	**White**
Lusture	**Vitrous to pearely**
pH in water	**Neutral**

CEMENT:

In our current project 53grade common Ordinary Portland Cement has used. And we modified these cement according to IS 1229-1987. This concrete brand (Bharati mark) is for the most part utilized as a part of the development business all through India.

Cement

Chemical composition of cement:

Chemical composition of Cement

Chemical Composition	Percentage(%)
CaO	**64.00**
SiO2	**22.00**
Al2O3	**4.10**
Fe2O3	**3.60**
MgO	**1.53**
SO3	**1.90**

FINE AGGREGATE – NATURAL SAND:

Locally accessible Natural sand was utilized as a part of the present work. The sand tests particular gravity and water ingestion must be directed. The sand is having a place with which zone (I to IV), according to IS Code: 383:1970. In 4.75 strainer going through the total is known as fine total or characteristic sand.

Coarse Aggregate

Natural Sand

COARSE AGGREGATE:

In this undertaking 20mm coarse total will be utilized. The total which measure is in excess of 4.75 mm is known as coarse totals. This totals will be locally accessible and the directed tests particular gravity and water assimilation of totals to be checked according to IS Code : 383:1970.

WATER:

In this present work, the convenient water accessible in the lab free from natural substances utilized for the blending for the readied 3D squares and the 3D squares as relieving in the tank. The water bond proportion is the most imperative for the development. The quality of the solid and functionality of solid will be relies on the water-concrete-proportion.

IV. EXPERIMENTIAL TESTS ON THE MATERIALS AND THEIR RESULTS

Collection Of Materials In Project

TESTS ON CEMENT

Specific gravity of cement

We conducted the specific gravity test to the cement as per the procedure and the test outcome is as follows:

Description	Trail no.1	Trail no.2	Average
Mass of empty sp.gr bottle (M_1)in GM	113	113	113
Mass of bottle +1/3rdmass of cement sample (M_2) in GM	263	264	263.5
Mass of bottle + cement + Kerosene (M_3) in GM	480	481	480.5
Mass of bottle+ Kerosene (M_4) in GM	371	371	371
Specific gravity	2.89	2.91	2.9

Fineness of Cement (By sieving method)

We conduct the fineness test to the cement as per conventional procedures and it given satisfied results, the fineness test given the following results:

Description	Unit	Trail no.1	Trail no.2	Average
Mass of sieve (M1)	Gm	284	285	285
Mass of sieve + Cement (M2)	Gm	385	385	385
Mass of Cement (M3) = M2-M1	Gm	100	100	100
Mass of Cement retaining on Sieve (M4)	Gm	3.6	4	3.8
% of Cement retained on Sieve (A) = W4/W5	%	3.6	4	3.8
% Passing (B) = 10-A	%	96.4	96	95.2

Comments: Permissible limits in % of retaining : < 10% only.

Cement Normal Consistency

We conducted the normal consistency test to the cement as per conventional procedures. the result is as follows:

S.NO	Properties	Remarks
1.	Description of sample	OPC 53 Grade
2.	Normal consistency	27%
3.	Time zone: Morning/Evening	Morning
4.	Specific Gravity	2.9
5	Room temperature	27.5^0
6	Initial setting time	35min
7	Final setting time	355min

Comment: The depth of Penetration requires: 33-35mm from top of mould Mix time is within: 3-5min.

Vicat's Apperatures

Initial and Final setting of Cement

S.NO	Weight of Cement In Gms	Percentage of water Added	Depth of penetration
1	300	25	9
2	300	27	5

TESTS ON FINE AGGREGATE

Bulking Of Sand

We can found that at the 2% of moisture content, the bulking of sand is maximum.

And we can observe that, at 33% maximum bulking of sand occurred.

Comment:

It can be observe that by increasing the water content, the volume of sand bulking is increasing up to certain limit, further that the bulking is decreased.

Sp. gr. of Fine aggregate:

Description	Trail no.1	Trail no.2	Average
Mass of empty pycnometer (M1) in Gm	610	610	610
Mass of pycnometer+ dry sand (M2) in Gm	1110	1111	1110.5
Mass of pycnometer+sand +water(M3) in Gm	1780	1784	1781.5
Mass of pycnometer + water(M4) in Gm	1470	1473	1481.5
Specific gravity	2.62	2.64	2.63

Result:

Now we have considered the fine aggregate sp.gr. = 2.63

Pycnometer

TESTS ON COARSE AGGREGATE

Specific gravity and water absorption of Coarse aggregate:

We conducted the water absorption test and specific gravity test to coarse aggregate also, the test procedures are followed as per conventional rules and the result of the water absorption and specific gravity of the coarse aggregate is as follows:

S.NO	Description	Trail no.1
1.	Wt. of saturated aggregate and basket in water (W1) gms	2009
2.	Basket weight in water(W2) gms	741
3.	Saturated surface dry aggregates in air weight (W3) in gms	1989
4.	Wt. of oven dried aggregate in air (W4) in gms	1980
5.	Specific gravity	2.75
6.	Water absorption	0.5

Result:

Coarse aggregate Specific gravity is = 2.75
Coarse aggregate Water absorption = 0.5%

Sp. Gr. And Water Absorption Test

TESTS ON BARITES

Specific gravity of BARITES
Description of sample: Barites

Description	**Units**	**Trail no. 1**	**Trail no. 2**	**Average**
Empty Sp.gr bottle mass (M_1)	GM	113	113	113
Mass of bottle +1/3rd mass of the Barites sample (M_2)	GM	263	263	263
Mass of bottle + cement + Kerosene (M_3)	GM	475	474	474.5
Mass of bottle + Kerosene (M_4)	GM	371	369	370
Specific gravity	GM	2.57	2.63	2.60

Specific gravity of Barites= 2.60

TESTS ON CONCRETE

Slump cone test values for using % of barites:

S.NO	**% OF BARITES**	**SLUMP VALUE (MM)**
1.	0	70
2.	10	100
3.	20	120
4.	30	150

Slump Cone Test

Compaction factor test

Compaction factor for Concrete mix		
s.no	**% of Replacement**	**Compaction factor**
1.	**0%**	0.94
2.	**10%**	0.88
3.	**20%**	0.90
4.	**30%**	0.93
5.	**40%**	0.93

The compaction factor= $\frac{Wt.of\ partially\ compacted\ concrete}{Wt.of\ fully\ compacted concrete}$

Compaction Factor Test

V. METHODOLOGY

Expermential Procedure:

In this present work the barites and fly powder will be utilized. The barites powder is fine powder with dim shading is to be 80 to 100 microns ought to be utilized. These barites remains powders are gathered from MADHAVI MICRO MINERALS KADAPA. In this venture three trails were led by varying the barites blending amount. The amounts of barites were shifted by 0%, 10%, 20% and 30% and another clump of barites ought to be led. The analyses were intended to M20 review blend. The shape sizes 150x150x150mm was thrown and tried. The above squares were throwing and tried for 7, 14, 28 long periods of restoring. we conducted compressive strength test to assess the compression quality of our concrete cubes.

Mix Design:

We followed the IS code book provisions (IS10262-2009) in the present mix design of M20. The stipulations for design and data for our mix proportions is discussed below sessions.

Mix Proportioning For Target Strength:

f'ck = fck + (1.65 x S)

Where, f'ck = at 28th day average target compression strength,

f'ck = at 28th day characteristic compression strength, and

S = standard deviation.

we know As per table 1, standard deviation

S = 5N/mm2

Therefore, at 28th day average target strength;

Target = 20 + 1.65 x 5 = 26.60N/mm2

Calculation Of Cement Content:

Water cement ratio = 0.5

per cubic meter the concrete volume is = 186/0.5= 394kg/m3

As per Table 5, IS 456

If the exposure of cement is 'mild' the minimum cement content is = 300 kg/m3

394 kg/m^3 > 300 kg/m^3, hence, O.K.

Volume Proportion For Coarse Aggregate And Fine Aggregate:

As per Table 3, if the size of the aggregate is 20mm then the coarse aggregate volume and fine aggregate volume is taken from the (Zone 1) and water cement ratio of 0.5-0.6

In our current project the water cement ratio is taken as 0.5

coarse aggregate volume is = 0.60m3

fine aggregate volume is = 1 - 0.60 = 0.40m3

Computations Of Mix:

1. The concrete Volume = 1 m3
2. The cement volume = (The entire Total cement Mass / cement Sp. gr.) x (1/1000) = (394.32/2.9) x (1/1000) = 0.136 m3
3. The water Volume = (The entire water Mass /water Sp. gr.) x (1/1000) = (197/1) x (1/1000) = 0.197 m3
4. The entire total aggregates volume = [1- (b+c)] = [1- (0.136+0.197)] = 0.667 m3
5. The entire coarse aggregates volume = d * Coarse Aggregate volume X Coarse Aggregate sp. gr. X 1000 = 0.667 X 0.60 X 2.75 X 1000 = 1100.55 kgs/m3
6. The entire fine aggregates Volume = d * Fine Aggregate volume X Coarse Aggregate Sp. Gr. X 1000 = 0.667 X 0.40 X 2.63 X 1000 = 701.684 kgs/m3

Actual Quantities

Adjustments for water absorption, Water absorption for coarse aggregates = mass of coarse aggregates x0.5/100= 1100.55 x 0.5/100=5.5

Water absorption for fine aggregates = mass of coarse aggregates x0.8/100= 701.684 x 0.8/100 = 5.5

Final mass of coarse aggregates = mass of coarse aggregates –water absorption of coarse aggregates

1100.55 -5.5 =1095.05 kg

Fine aggregates final mass= fine aggregate mass, fine aggregates water absorption is 701.68-5.6=696.084.

Final mass of water= mass of water –water absorption of coarse aggregates and fine aggregates

197.16+5.5+5.6=208.26 kg

Concrete Mix Proportion For Trail Number 1:

Cement = 394.32kg/m3
Water = 208.26kg/m3
Fine aggregate = 696.084kg/m3
Coarse aggregate = 1195.05kg/m3
W/C = 0.52

Mix Design Calculations

Cement	Fine aggregate	Coarse aggregate	Water
394 kg/m^3	696 kg/m^3	1195 kg/m^3	208 kg/m^3

Therefore, the mix proportion of Cement, F.A , C.A and Water is as shown below

Cement	Fine aggregate	Coarse aggregate	Water
1	1.765	2.78	0.52

For a cube of dimensions 150mm x 150mm x 150mm the material proportion is taken as below

Size of cube = 0.150x0.150x0.150 = $\underline{3.375x10^{-3}}$ m^3.

size of mould

Therefore, the proportion for six cubes of size 150mm x 150mm x 150mm is

No. of cubes required = 9

= $3.375x10^{-3}$ X 9

= $\underline{0.030}$

Cement required for 9 ubes = 0.030 x 394.32 x 1.1= $\underline{13.175}$ Kg.

Fine aggregate for 9 cubes = 0.020 x 694.084 x 1.1= 21.08 Kg.
Coarse aggregate for 9 cubes = 0.020 x 1195.05 x 1.1= 33.262 Kg.
Water required for 9 cubes = 0.020 x 208.26 x 1.1= 6.325 lit.
Which is also called as control mix

Calculation of Quantity of Materials for 9 Cubes:
For each percentage 4 sets of cubes to be casted i.e. For 7 days ,14 days, 28 days and 56 days

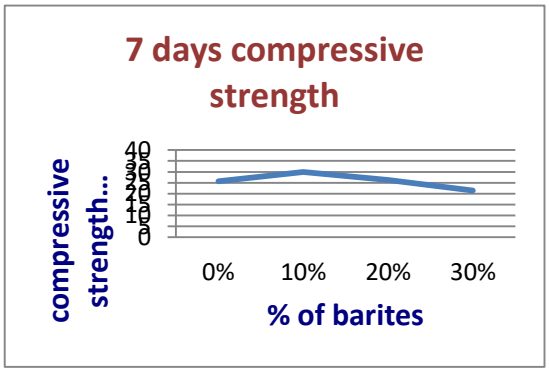
S.NO	Quantity for 9 cubes in kgs	0%	10%	20%	30%	40%
1.	Cement	13.175	11.857	1.540	9.222	7.905
2.	Barites	-	1.317	2.635	3.952	5.270
3.	Fine aggregate	21.08	21.08	21.08	21.08	21.08
4.	Coarse aggregate	33.262	33.262	33.262	33.262	33.262
5.	Water (in Lit)	6.325	6.325	6.325	6.325	6.325

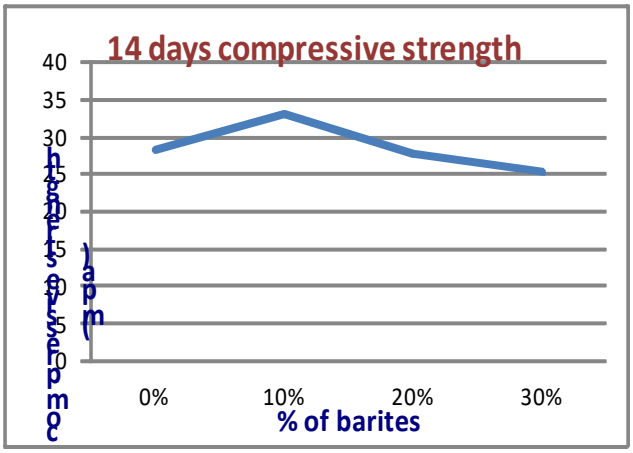
V. RESULTS AND DISCUSSIONS

Concrete Compressive Strength
Compressive Strength Of Cubes For 7 Days

S.NO	% Of Barites	Compressive Strength For 7 Days	Average Compressive Strength
1.	0	24.95	25.75
		25.06	
		27.24	
2	**10**	**28.88**	**28.96**
		30.88	
		27.11	
3	20	25.55	**26.24**
		27.11	
		26.05	
4	30	21.11	21.43
		21.11	
		22.08	

Graph of Concrete Compressive Strength At The Day 7





from the above fig. the maximum compressive strength **28.98** mpa obtained at 10% replacement of barites at the day 7.

Concrete Compressive strength at the day 14

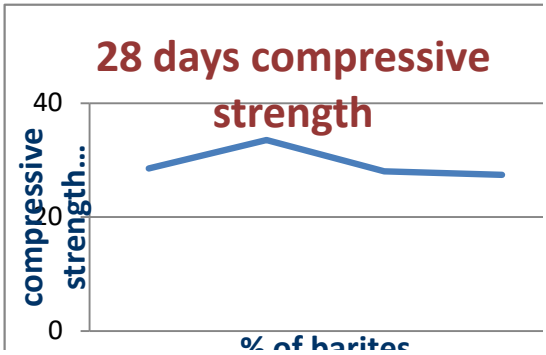
Graph of Concrete Compressive Strength at the day 14
From the previous plot of graph we can culminate that the maximum compressive strength **33.21** mpa obtained at 10% replacement of barites at 14 day.

Compressive strength of cubes for 28 days

S.No	% Of Barites	Compressive Strength For 28 Days	Average Compressive Strength
.	0	29.89	28.56
		28.78	
		27.00	
	10	**33.48**	**33.52**
		34.00	
		33.09	
3	20	27.21	28.05
		27.98	
		28.97	
4	30	26.55	27.41
		28.34	
		27.34	

Concrete Compressive Strength at the day 28

S.No	% Of Barites	Compressive Strength For 14 Days	Average Compressive Strength
1.	0	29.11	28.41
		28.22	
		27.89	
2.	**10**	**32.66**	**33.21**
		33.55	
		33.41	
3.	20	27.77	27.85
		27.77	
		28.01	
4.	30	26.50	25.34
		25.44	
		24.08	



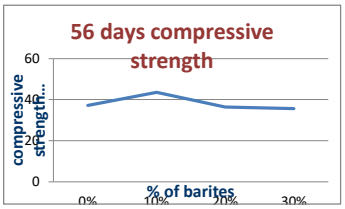
Cocrete Compressive Strength at the day 28

From the previous plot histogram we can culminate that the maximum compressive strength **33.52** mpa obtained at 10% replacement of barites at day 28

Compressive strength of cubes for 56 days

S.NO	% OF BARITES	COMPRESSIVE STRENGTH FOR 56 DAYS	AVERAGE COMPRESSIVE STRENGTH
1.	0	38.86	37.13
		37.44	
		35.10	
2	**10**	**43.52**	**43.58**
		44.20	
		43.02	
3	20	35.37	36.47
		36.37	
		37.66	
4	30	34.52	35.63
		36.84	
		35.54	

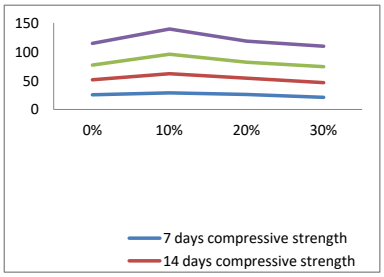
Compressive Strength of Concrete at 56 days



Compressive Strength of Concrete at 56 days

From the previous graph shows that the maximum compressive strength **43.58** mpa obtained at 10% replacement of barites at 56 days.

Analogy of concrete compressive strength for days 7, 14, 28 and 56



Analogy of concrete compressive strength for days 7, 14, 28 and 56

cement is replaced partially by Barites with different percentages for days 7, 14, 28 and 56. By the above histogram, we can culminate that the maximum strength in compression has obtained at 10%. The aloft graphs shows that analogy of concrete compressive strength when the

Average Cubes-Densities after de-mould

Sl. No.	% of barites	Weight of cube(gm)	Mass of cube(gm)	Volume of cube(cm3)	Density of cube(gm/cm3)	Average density (gm/cm3)
1.	10%	8540	870.5	3375	0.258	0.256
		8520	868.5		0.257	
		8360	852.2		0.253	
2.	20%	8550	871.6	3375	0.258	0.256
		8610	877.7		0.260	
		8340	850.2		0.252	
3.	30%	8460	862.4	3375	0.256	0.256
		8490	865.4		0.256	
		8500	866.5		0.257	

VII. CONCLUSIONS

The culmination that we had obtained is, we had conducted several number of experiments on the concrete cubes which are casted by partially replacing the OPC with powdered barites to assess the workability and mechanical properties. The percentages that we had replaced is 0, 10, 20 and 30 percentages. And we had casted here with this replacement the M20 grade concrete by following the recommendations followed by IS code book. Based on the study and test results obtained from this project the following conclusion can be drawn.

1. Here we can observe that by replacing the cement, we actually reducing the cement content, so the barite can help in reducing the content of cement in concrete.
2. We can also observe that the value of slump cone has been increasing, this increase in slump was due to the absorption of some quantity of mixing water by barites particles. because the barites have the less area of surface so the absorption of water molecules also less attracted. this cause to growth in workability of concrete.
3. And also we can observe that the concrete strength had increased for 28 days and 56 days at the 10% replacement of barites powder.
4. The increase in 28days compressive strength at 10% replacement was found to be **33.52**Mpa.
5. The increase in 56days compressive strength at 10% replacement was found to be **43.58**Mpa.
6. The difference between normal concrete and 10% replacement barites powder concrete for 28days and 56days is 4.96Mpa and 6.45Mpa respectively.
7. The average density of concrete remains constant for any percentage of barites.
8. The strength of the concrete has slightly more when compare to normal concrete.
9. The surface area of the barites powder is less and is liable to high water absorption. and its results in high workable to work easy.
10. Also the good workability of our concrete that we obtain at the percentage of 10% replacement with barites.
11. The total study conclude that only 10% of the replacement given good and best results in workability and strength related issues after that range the strength will again decreased.

VIII. REFERENCES

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