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Study of Advancement of M30 Grade Concrete by Using Red Mud and Iron Ore Slickens

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***Abstract:** India is a developing country and in various developing countries like India economical construction along with economical construction material plays a vital role in the development of country. Waste material in construction can play tremendous role to make it economical and durable due to some of its specific properties relevant to construction materials. This dissertation shows comparative and experimental study on utilization of Red Mud and Iron Ore Slickens by replacement of Cement and fine aggregates in concrete. In this project Red mud and Iron ore slickens are added in concrete by weight of cement and fine aggregate in the proportion of 1%, 2%, 3%, 4% & 10%, 20%, 30%, 40% respectively. Workability and compressive strength test are performed on concrete and their results are being evaluated and compared.*
***Keywords:** Red Mud, Iron ore slickens, Fine Aggregates, Workability and Compressive Strength.*

I. INTRODUCTION

Concrete is one of the major materials used in construction industry and also most important materials used in public works and structural construction project. Concrete is used in construction since ages now which implies that we have used tons of concrete and also will continue to use it. As concrete is widely used construction material but at the same time also it is not environment friendly material as it destroys and uses abundant quantity of natural resources and also it also has a environmental impact as after its use it is deposited in land as a filler material.

Concrete is the basic construction material used all around the globe and most commonly used in all kinds of civil engineering works and it is a manmade product, which is made u of cement, aggregate, admixtures and water. In spite of being the most used and most economical construction material concrete has various shortcomings such as embedded energy and is also one of the main reasons of greenhouse gas effect. However, the production of cement of leads to the dissipation of large amounts of carbon dioxide and greenhouse gas emission. One ton of Portland cement clinker production produces one ton of carbon dioxide and other greenhouse gases. For reducing the emission of carbon dioxide because of the production of cement, we should reduce the use of cement, and therefore the total demand of Portland cement. Which is why, there is a need to check for alternatives of cement. The carbon dioxide emissions related to the manufacturing of Portland cement can be reduced in a large amount by decreasing the production of current clinker.

A. Red Mud

In the Bayer's process for Alumina production Caustic and Bauxite are the main raw materials for Alumina production which generates Red mud which does not have wider industrial applications practically and it is generally dumped in the backyards of a Alumina Refinery called as Red Mud yard as a non value by product. Red mud is the largest amount of industrial waste generated in the production of alumina. Depending on the amount of bauxite and the type process during the production of each 1-ton alumina 1.2 to 1.3 –ton dry red mud is generated. Because of the complex physical and chemical properties of red mud, it is quite a challenging task for the designers to find out the economical utilization and safe disposal of red mud. Disposal of this waste was the initial major problem encountered by the alumina industry after the adoption of the Bayer process. Red mud is a by-product of the Bayer's process, which is obtained from the production of alumina from bauxite ore. Bauxite ore is washed and crushed and it is treated with hydroxide solution at high pressure and temperature. This process provides all the reusable alumina from bauxite ore into solution and the by- product is known as red mud. For every by-product of alumina produced by this process, make some part of red mud as a waste. In all countries, about 45 million tons of Red mud is produced on an yearly basis. Due to its hazards nature, it affects environment majorly. Red mud is the iron rich residue produced from the digestion of bauxite. It is one of major solid waste obtained from Bayer process of alumina production. In general, about 2-4 tons of bauxite is required for production of each tone of alumina (Al2O3) and about one tone red mud is generated. Since the red mud is generated in large quantities, it has to be stored in large confined and impervious ponds, therefore the bauxite refining is gradually encircled by the storage ponds. At present about 60 million tons of red mud is produced on an annual basis worldwide which is not being disposed or recycled satisfactorily.

B. Iron Ore Slickens

The challenge for the civil engineering community with the concept of sustainable development involves the use of waste materials and by-products at a reasonable cost with lowest possible environmental impacts. Rapid increase in consumption of river sand because of increase in construction activity means that sand mining exploration increased in which the river bed is over exploited. Other environmental issues of Sand mining are depletion of virgin deposits, collapsing of river banks, water table lowering and water pollution. The solution for these impacts is the use of waste material as alternatives to river sand. Increase in the production of iron ore for economic development worldwide has created massive amount of iron ore tailing, which are frequently being discarded as wastes. This has led to very serious environmental deterioration. A statistical survey has shown that 5 to 7 billion tonnes of iron ore tailings were produced yearly worldwide. In spite of such huge amount of iron ore tailings stockpiled as waste, its safe disposal or utilization has remained a major unsolved and challenging task for iron ore industries.

India is one of the biggest iron ore producers and exporter in the world. Mining plays an important role in harnessing natural ore, but during this operation a lot of waste is generated. Proper waste management and disposal of this waste is need of the hour so that it can cause minimal damage to the environment. Iron ore tailings (IOT) are such waste produced during mining of iron from its ore. The rapid growth in the surface mines led the production of Iron Ore tailings which remains as overburden. In future, the proportion of iron ore wastes produced is likely to increase due to higher demand for iron ore. Moreover, dumping leads to loss of valuable land.

In recent years, steel production has increased manifolds to meet the construction industry demands. This has resulted in the generation of huge amount of iron ore tailings (IOT) which are disposed of as waste in landfills, quarries, rivers, oceans, etc. Malaysia produces millions of tons of IOT. A statistical survey on one of the iron ore mining industries in southern Malaysia confirmed that it produces about 625,000 tons of IOT every year.

Iron Ore Slickens Natural Sand

Figure 1: Comparison between natural sand and Iron Ore Slickens

II. MATERIAL AND METHODS

A. Cement

Portland cement is the most well-known kind of concrete when all is said in done use. It is an essential element of concrete, mortar and numerous mortars. English stone work specialist Joseph Aspdin licensed Portland concrete in 1824. It was named due to the similitude of its shading to Portland limestone, quarried from the English Isle of Portland and utilized broadly as a part of London design. It comprises of a blend of calcium silicates (alite, belite), aluminates and ferrites - mixes which consolidate calcium, silicon, aluminum and iron in structures which will respond with water. Portland bond and comparative materials are made by warming limestone (a wellspring of calcium) with earth and/or shale (a wellspring of silicon, aluminum and iron) and granulating this item (called clinker) with a wellspring of sulfate (most normally gypsum).

Table 1: Properties of Cement

S. NO	Property	Value
1	Fineness	3.82%
2	Initial Setting Time	41 min
3	Final Setting Time	197 min
4	Specific Gravity	3.14
5	Soundness	2 mm
6	Compressive Strength	7 Days – 24.56 MPa
		28 Days – 37.84 MPa

B. Water

Consolidating water with a cementitious material a structural bond is developed by the procedure of hydration. The concrete glue ties the total together, fills voids inside of it, and makes it workable. A lower water-to-bond proportion yields more grounded, tougher cement, while more water gives workable cement with a higher droop. Tainted water used to make cement can bring about issues when setting or in creating untimely disappointment of the structure. Hydration includes various responses, frequently happening in the meantime. As the responses continue, the results of the concrete hydration handle slowly bond together the individual sand and rock particles and different segments of the solid to shape a strong mass. Water used for concrete should be free from injurious amount of oils, acids, alkalis, salts, sugar, organic materials or other substances. Water which is used in this project is confirming to the specification of IS 456: 2000.

C. Coarse Aggregates

Natural aggregates used in the manufacture of concrete should meet the requirements for aggregates for concrete given in IS 383. Aggregates from natural sources are used in this project. In this project crushed stone which passes from 20 mm IS sieve and retained on 4.75 mm IS sieve is used. Coarse aggregate which is used in this project is tested in laboratory for their properties and their results are given in table

Table 2: Properties of Coarse Aggregate

S. No.	Property	Value	
1	Crushing Value	14.90%	
2	Impact Value	11.32%	
3	Abrasion Value	12.54%	
4	Specific Gravity	2.62	
5	Water Absorption	0.64%	
6	Bulk Density	1680 Kg/m3	
7	Flakiness and Elongation Index	11.86%	
8	Gradation	Sieve No.	Percentage Passing
		40 mm	100
		20 mm	92.25
		10 mm	9.64
		4.75 mm	1.23

D. Fine Aggregates

Aggregates which passes from 4.75 mm IS sieve are termed as fine aggregate, natural river sand is used in the project which passes from 4.75 mm IS sieve and retained on 70 microns IS sieve. Fine aggregate which is used in this project is tested in laboratory for their properties and their results are given in table 3.

Table 3: Properties of Fine Aggregates

S. No.	Property	Value	
1	Specific Gravity	2.60	
2	Bulking	30.21%	
3	Water Absorption	0.92%	
4	Bulk Density	1590 Kg/m3	
5	Gradation	Sieve No.	Percentage Passing
		10 mm	100.00
		4.75 mm	100.00
		2.36 mm	97.32
		1.18 mm	78.57
		600 microns	69.88
		300 microns.	16.40
		150 microns	0.32
		Conforming to grading zone II of IS 383-1997	

E. Red Mud

Red mud is the composed of a mixture of solid and metallic oxide-bearing impurities, and presents one of the aluminium industry's most import disposal problems the red mud caused by the oxidized iron present which can make up to 60% of the mass of the red mud. In-addition to iron the other dominant include silica unleashed residual aluminium, and titanium oxide. Red mud cannot be disposed of easily. As a waste product of the Bayer process the mud is highly basic with a pH ranging from 10 to 13. The following is the composition of the dry red mud of Renukoot Alumina, Uttar Pradesh (HINDALCO). It was passed through 600 Micron Is sieve and it was mixed in concrete with replacement of cement by 1%, 2%, 3% and 4%.it was tested in the laboratory for their properties and their results are given in table 4.

Table 4: Properties of Red Mud

S. No.	Property	Value
1	Specific Gravity	2.83
2	Ph	11.5
3	Fineness	4.10%
Composition of Red mud		
S. No.	Components	Weight%
1	Al_2O_3	21-23
2	Fe_2O_3	38-43
3	SiO_2	12-17
4	TiO_2	1.5-2
5	CaO	1.5-2
6	Na_2O	3-5

F. Iron Ore Slickens

Iron ore slickens is the waste left over after the beneficiation process of separating the valuable portion from the useless fraction of an iron ore. These were obtained from a manufacturing factory located in Jabalpur, Madhya Pradesh. It was mixed in concrete with replacement of Sand by 10%, 20%, 30% and 40%. The following are the properties of the iron ore slickens.

Table 5: Properties of Iron Ore Slickens

S. No.	Property	Value
1	Specific Gravity	2.62
2	Relative density	1.24 gm/cc
3	Fineness Modulus	1.15
4	Water Absorption	10%

1) Mix design according to IS 10262: 2009 I. Target Mean Strength for Mix Proportion

= f_{ck}+ 1.65*standard deviation

Standard deviation is 5 according to table 1 IS 10262: 2009

= 30 + 1.65*5 = 38.25 MPa

2) Selection of Water Cement Ratio

As per IS 456, table 5 maximum water cement ratio for M 40 is 0.45. so selected water cement ratio is 0.45.

3) Selection of Water Content

From table 2, IS 10262: 2009, maximum water content for 20 mm aggregates is 186 liters for 50 mm slump.
Aggregate is angular so 30 liters of water is reduced.
Therefore, 156 liters of water is used for 50 mm slump and it is increased to 170 liters for 100 mm slump.

a) Calculation of Cement Content

Water – cement ratio = 0.45

Cement Content = 170/0.45 = 378 kg/m^3 378kg/m^3> 320 kg/m^3 hence O.K.

b) Proportions of Volume of Course and Fine Aggregates

Form table 3, IS 10262: 2009, Volume of coarse aggregate is 0.62
Correction for workability - +0.02
Final volume of Coarse aggregate = 0.64 Volume of fine Aggregate = 0.36

- *Mix Calculations*

a) Volume of mix 1 m^3

b) Volume of cement

$$\frac{378}{3.14} * \frac{1}{1000} = 0.12$$

c) Volume of water

$$\frac{170}{1} * \frac{1}{1000} = 0.170$$

d) Volume of aggregates

= a-(b+c)

=0.710

e) Mass of Coarse Aggregate
= 0.710 * 0.64 * 2.62 * 1000
= 1190.52 kg
= 1190 kg

f) Volume of Fine Aggregate
= 0.710 * 0.36 * 2.60 * 1000
= 664.56 kg
= 665 kg

- *Final Mix Proportion*

Cement	=	378 kg/m^3
Water	=	170 kg/m^3
Fine Aggregate	=	665 kg/m^3
Coarse Aggregate	=	1190 kg/m^3

Red mud and iron ore slickens are added to the mix from 1% to 4% and 10 to 40% by weight of cement and fine aggregate respectively. Mix designation is given in table 6 and mix proportions in table 7.

Table 6: Mix Designation of Concrete

Material	Red Mud Content	Iron ore slickens content	Mix Name
Plane concrete	--	--	CC
Red Mud + iron ore slickens	1% (3.78 Kg)	10% (66.5 Kg)	RM11
	1% (3.78 Kg)	20% (133 Kg)	RM12
	1% (3.78 Kg)	30% (199.5 Kg)	RM13
	1% (3.78 Kg)	40% (266 Kg)	RM14
	2% (7.56 Kg)	10% (66.5 Kg)	RM21
	2% (7.56 Kg)	20% (133 Kg)	RM22
	2% (7.56 Kg)	30% (199.5 Kg)	RM23
	2% (7.56 Kg)	40% (266 Kg)	RM24
	3% (11.34 Kg)	10% (66.5 Kg)	RM31
	3% (11.34 Kg)	20% (133 Kg)	RM32
	3% (11.34 Kg)	30% (199.5 Kg)	RM33
	3% (11.34 Kg)	40% (266 Kg)	RM34
	4% (15.12 Kg)	10% (66.5 Kg)	RM41
	4% (15.12 Kg)	20% (133 Kg)	RM42
	4% (15.12 Kg)	30% (199.5 Kg)	RM43
	4% (15.12 Kg)	40% (266 Kg)	RM44

Table 7: Mix Proportion of Concrete Mix

Cement	378 kg/m^3
Water	170 liters
Fine Aggregate	665 kg/m^3
Coarse Aggregate	1190 kg/m^3

G. *Mixing*

In this project hand mixing is preferred; the mix of the materials, including water, cement, aggregates and electronic waste is mixed by weighted. The quantity of cement, aggregate, electronic waste and water for each batch shall be determined by weight, to an accuracy of 0.1% of the total weight of the batch. The concrete shall be mixed by hand or preferably in a laboratory batch mixer, in such a manner as to avoid loss of water or other materials. For hand mixing the concrete batch shall be mixed on a water tight, non-absorbent platform with a shovel, trowel or similar suitable implement, procedure adopted for mixing is, cement and fine aggregate shall be mixed dry until the mix give uniform color. coarse aggregated is added and mixed with the cement and fine aggregate until the coarse aggregate is uniformly distributed throughout the batch, and then water is added and the entire batch mixed until the concrete appears to be homogeneous and has the desired consistency.

H. *Casting*

For this project casting is done in 15 * 15 * 15 cm cube moulds. Casting is done as per the specification given under IS 516: 1959. According to 516:1959, the height of the mould and the distance between opposite faces shall be the specified size + 0.2mm. The angle between adjacent internal faces and between internal faces and top and bottom planes of the mould shall be 90^o = 0.5^o. The interior faces of the mould should be plane surface with a permissible variation of 0.03mm. Each mould should be provided with a metal base plate consisting of a plane surface. While assembling the mould for use, the joints between the sections of mould must be thinly coated with mould oil and a similar coating of mould oil should be applied between the contact surfaces of the bottom of the mould and the base plate in order to insure that no water escape during the filling. The interior surfaces of the assembled mould must be thinly coated with mould oil to prevent adhesion of the concrete. In casting all materials should be conveyed to room temperature, ideally 27^o+ 3^oc preceding beginning the outcome. The concrete specimens, on landing in the research center, might be completely mixed dry other by hand or in a suitable mixer in such a way right now the best conceivable mixing and consistency in the material, consideration is being taken to evade Intrusion of the outside matter. The concrete might than be put away in a dry spot, ideally in seal shut metal compartments. Tests of materials for every group of cement might be of the fancied evaluating and should be in an air dried condition. When all is said in done, the total might be isolated into fine and coarse division and recombined for every solid clump in such a way at this very moment the wanted evaluating. Is strainer 480 should be regularly utilized for isolating the fine and coarse portions, however where extraordinary reviewing is being examined, both flame and coarse divisions might be further isolated into diverse sizes.

I. *Compaction*

In this project as per IS: 516:1959 compaction is done, the test specimen shall be made as soon as practicable after mixing and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance. The concrete shall be filled in to the mould in layers approximately 5cm deep. In placing each scoopful of concrete, the scoop shall be moved around the top edge of the mould as the concrete slides from it, in order to insure a symmetrical distribution of the concrete within the mould. Each layer must be compacted either by hand or by vibration as described below. After the top layer has been compacted, the surface of the concrete must be finished level with the top of the mould, using a trowel, and covered with a glass or metal plate to prevent evaporation. When compacting is done the standard tamping bar shall be used and the stroke of the bar shall be distributed in a uniform manner over the cross section of the mould. The number of the strokes per layer required to produce specified conditions will vary according to the type of concrete. For cubical specimens, in no case should the concrete be subjected to less than 35 strokes per layer for 15cm cubes or 25 strokes per layer for 10cm cubes. The strokes must penetrate into the underlying layer and the bottom layer shall be rodded throughout its depth. Where voids are left by tamping bar, the sides of the mould shall be tapped to close the voids. When compacting by vibration is done, each layer shall be vibrated by means of an electric or pneumatic hammer or vibrator or by means of a suitable vibrating table until the specified condition is attained.

As per IS: 7246-1974 and IS: 11389-1985, this standard deals with the use of vibrating tables for the consolidation of concrete and gives recommendations regarding placing of concrete and its consolidation by vibration.

J. Curing

In this project curing of specimen is done by the specification given under IS 516: 1959. As with all concrete products, the quality of concrete is improved by water curing. However, it is not practicable to apply significant amounts of water onto newly mounded concrete blocks or subsequently to subject them to water sprays or immersion in water. After mounding and on drying, soluble calcium hydroxide may migrate to the surface of the block, particularly if it is porous. Here the calcium hydroxide combines with carbon dioxide from the atmosphere to form less soluble calcium carbonate which is white in color. Known as lime bloom, it is particularly noticeable on colored pavers. Other than for aesthetic reason, lime bloom is not a problem and would disappear with time by normal weathering and the action of rainwater which is mildly acidic. It can also be removed by chemical treatment. Unfortunately, the severity of lime bloom increases with effectiveness of wet curing. For this project concrete cubes is immersed in water at room temperature, water should be cleaned and free from suspended impurities.

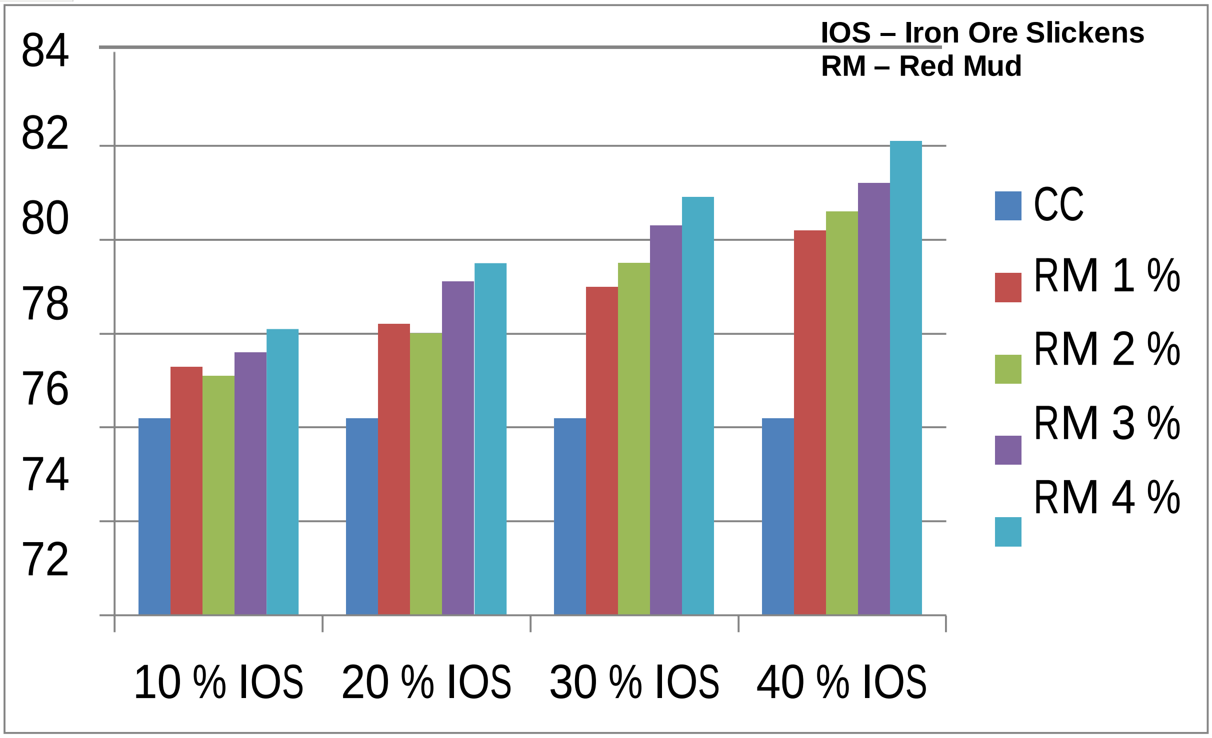
II. EXPERIMENTS AND RESULTS

A. Workability of mix Concrete

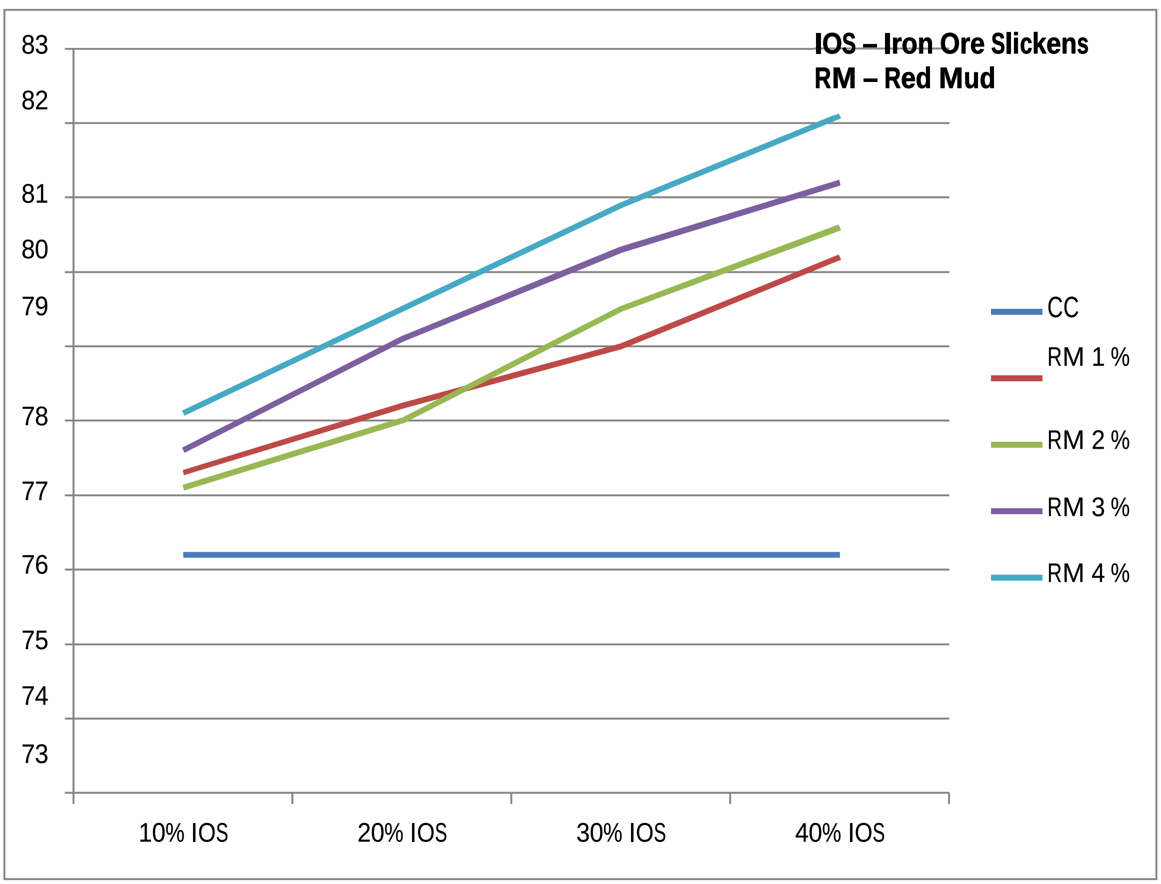
Table 8 and graph 1-2 shows, workability of the mix concrete, and it has been observed that adding red mud and iron ore slickens in concrete is increases its workability, control mix concrete gives 77 mm slump and its mix RM44 which contains 4% + 40% red mud and iron ore slickens gives 82 mm slump.

Table 8: Workability of mix Concrete

S. No.	Mix ratio (Red Mud + Iron Ore Slickens)	Mix Name	Slump (mm)
1	0% + 0%	CC	76.2
2	1% + 10%	RM11	77.3
3	1% +20%	RM12	78.2
4	1% +30%	RM13	79
5	1% + 40%	RM14	80.2
6	2% + 10%	RM21	77.1
7	2% + 20%	RM22	78
8	2% + 30 %	RM23	79.5
9	2% +40%	RM24	80.6
10	3% +10%	RM31	77.6
11	3% +20%	RM32	79.1
12	3% +30%	RM33	80.3
13	3% + 40%	RM34	81.2
14	4% + 10%	RM41	78.1
15	4% + 20%	RM42	79.5
16	4% + 30 %	RM43	80.9
17	4% + 40 %	RM44	82.1



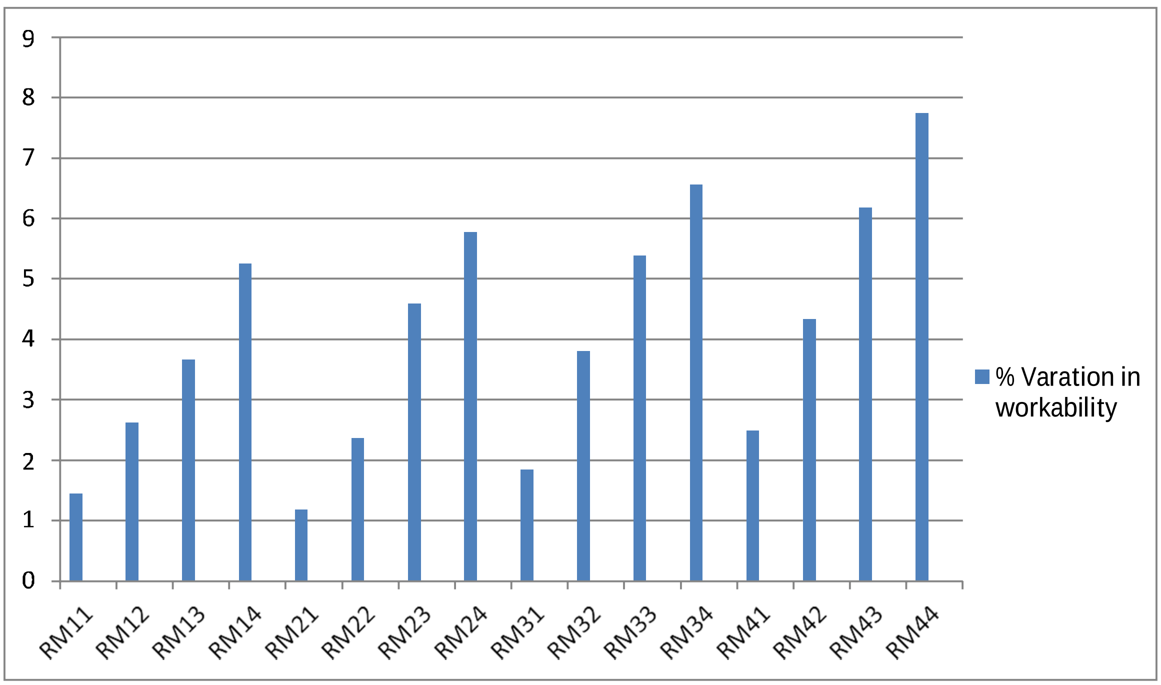
Graph 1: Workability of Mix Concrete (Bar Graph)



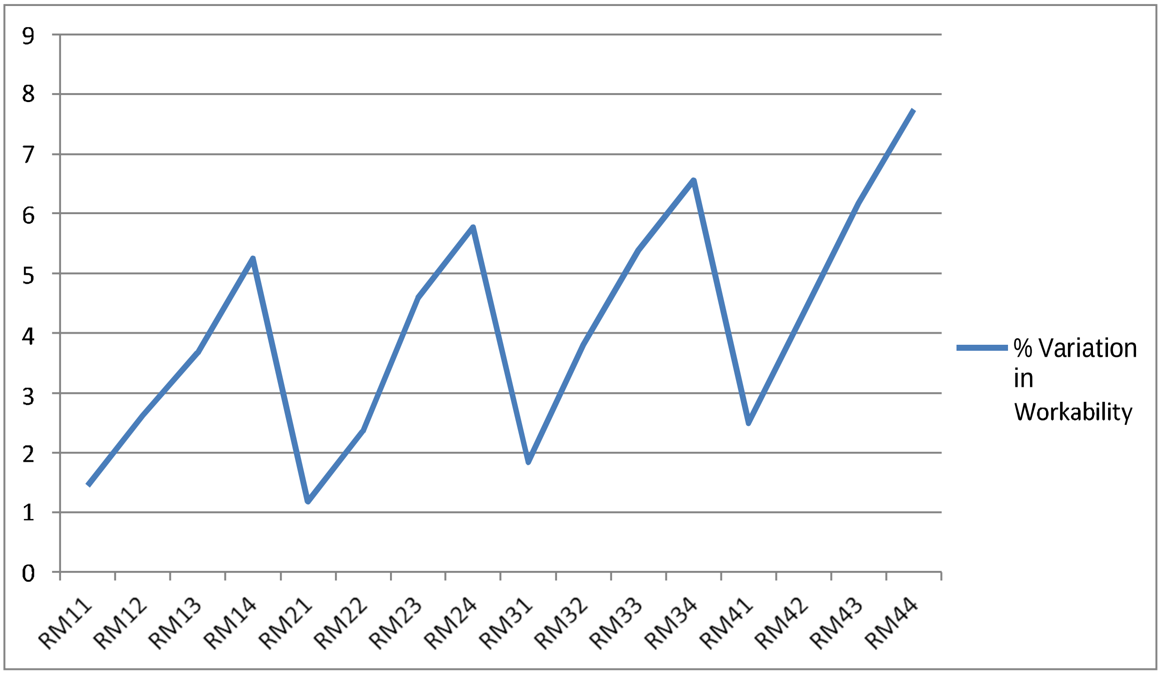
Graph 2: Workability of Mix Concrete (Line Graph)

Table 9: Variation in Workability of mix Concrete

S. No.	Mix ratio (Red Mud + Iron Ore Slickens)	Mix Name	Slump (mm)	% Variation
1	0% + 0%	CC	76.2	0%
2	1% + 10%	RM11	77.3	1.44
3	1% +20%	RM12	78.2	2.62
4	1% +30%	RM13	79	3.67
5	1% + 40%	RM14	80.2	5.25
6	2% + 10%	RM21	77.1	1.18
7	2% + 20%	RM22	78	2.36
8	2% + 30 %	RM23	79.5	4.59
9	2% +40%	RM24	80.6	5.77
10	3% +10%	RM31	77.6	1.84
11	3% +20%	RM32	79.1	3.8
12	3% +30%	RM33	80.3	5.38
13	3% + 40%	RM34	81.2	6.56
14	4% + 10%	RM41	78.1	2.49
15	4% + 20%	RM42	79.5	4.33
16	4% + 30 %	RM43	80.9	6.17
17	4% + 40 %	RM44	82.1	7.74



Graph 3: Variation in Workability of Mix Concrete (Bar Graph)



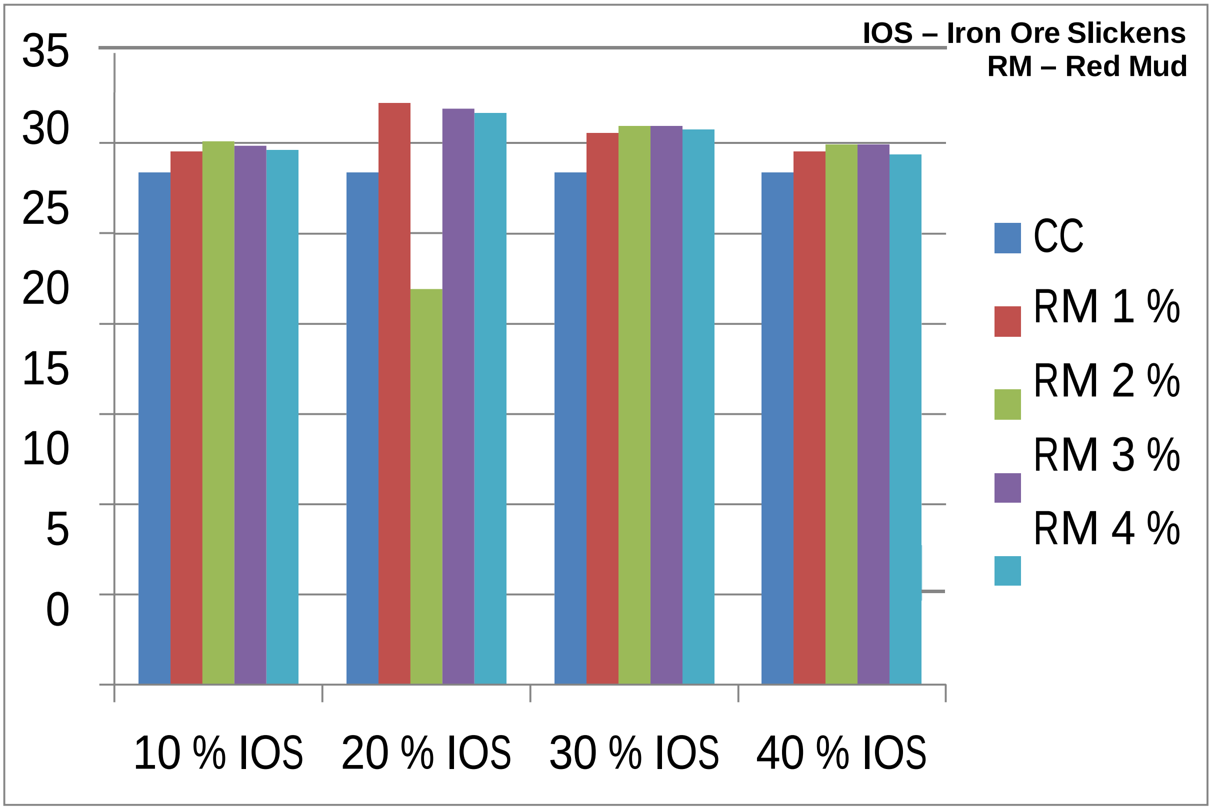
Graph 4: Variation in Workability of Mix Concrete (Line Graph)

B. Compressive Strength of Mix Concrete

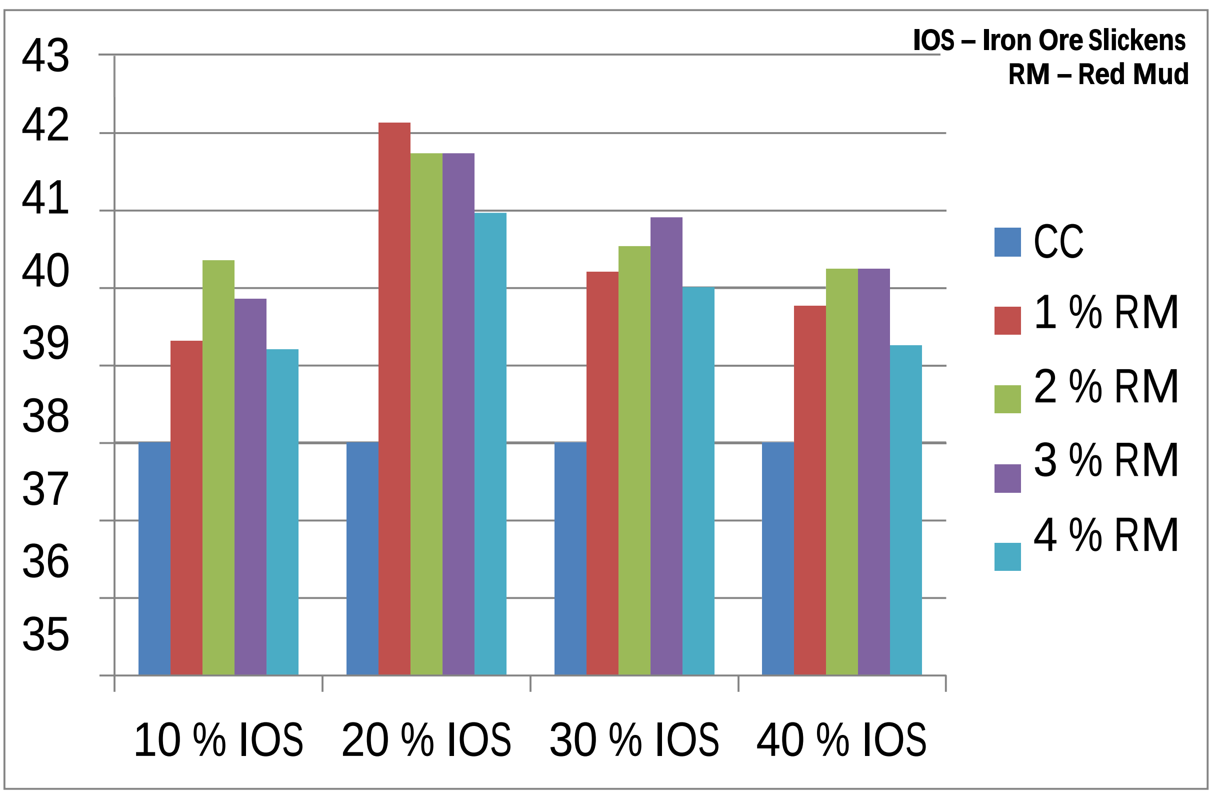
Table 10,11 and Graphs 5, 6, 7, 8 shows the compressive strength of concrete when it is mixed with red mud and iron ore slickens and it has been observed that introduction of red mud and iron ore slickens in concrete compressive strength first increases then decreases. Table 11 and graph 7,8 shows variation in compressive strength of concrete using red mud and iron ore slickens.

Table 10: Compressive Strength of Mix Concrete

S. No.	Mix ratio (Red Mud + Iron Ore Slickens)	Mix Name	7 Days Strength (Mpa)	28 Days Strength (Mpa)
1	0% + 0%	CC	28.37	38.01
2	1% + 10%	RM11	29.53	39.32
3	1% +20%	RM12	32.23	42.14
4	1% +30%	RM13	30.57	40.21
5	1% + 40%	RM14	29.55	39.77
6	2% + 10%	RM21	30.12	40.36
7	2% + 20%	RM22	31.93	41.54
8	2% + 30 %	RM23	30.97	40.91
9	2% +40%	RM24	29.92	40.25
10	3% +10%	RM31	29.86	39.87
11	3% +20%	RM32	31.93	41.74
12	3% +30%	RM33	30.97	40.91
13	3% + 40%	RM34	29.92	40.25
14	4% + 10%	RM41	29.61	39.21
15	4% + 20%	RM42	31.67	40.97
16	4% + 30 %	RM43	30.74	40.01
17	4% + 40 %	RM44	29.37	39.26



Graph 5: 7 Days Compressive strength of mix Concrete (Bar Graph)



Graph 6: 28 Days Compressive strength of mix Concrete (Bar Graph)

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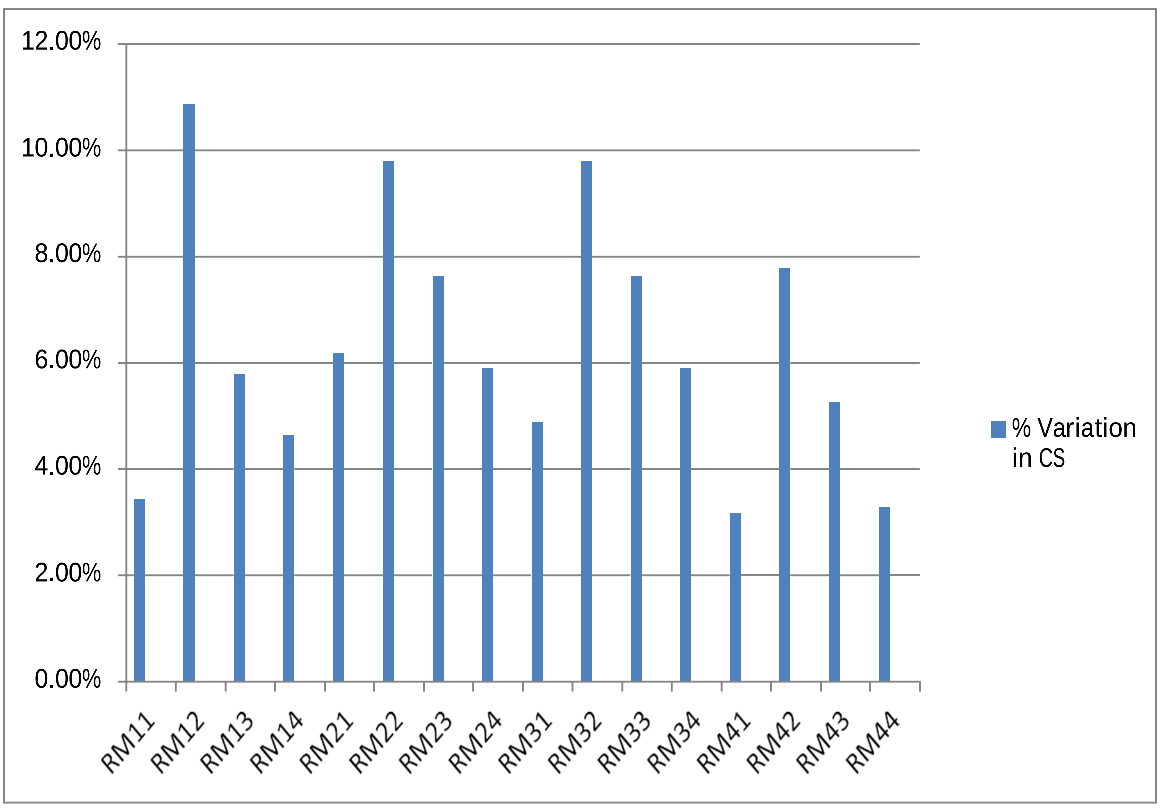
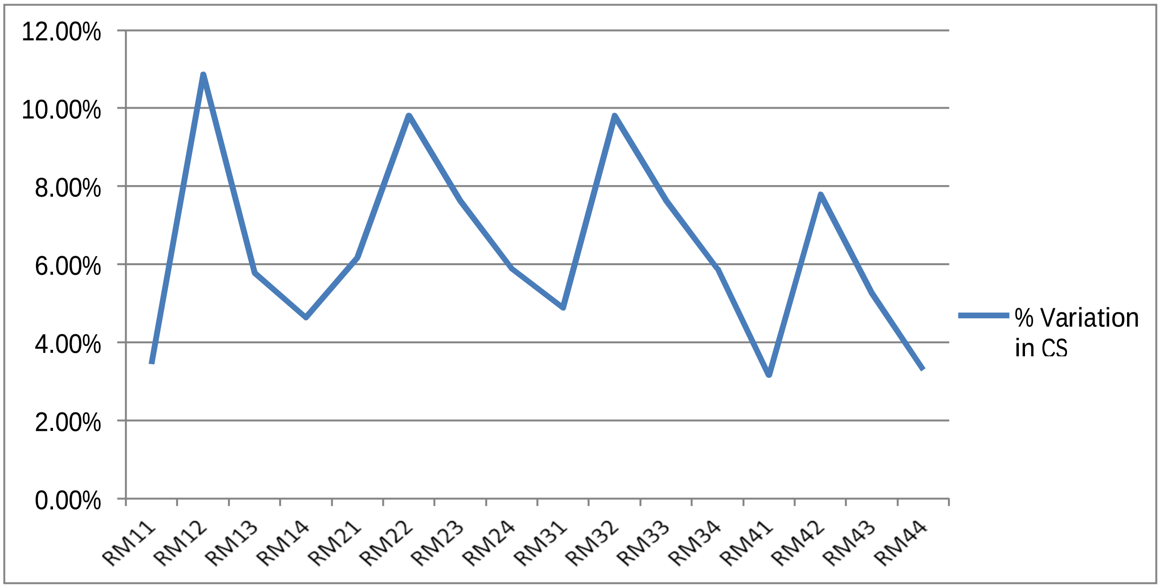
Table 11: Variation in compressive strength of mix concrete

S. No.	Mix ratio (Red Mud + Iron Ore Slickens)	Mix Name	28 Days Strength (Mpa)	% variation in CS in 28 Days
1	0% + 0%	CC	38.01	0%
2	1% + 10%	RM11	39.32	3.44%
3	1% +20%	RM12	42.14	10.87%
4	1% +30%	RM13	40.21	5.79%
5	1% + 40%	RM14	39.77	4.63%
6	2% + 10%	RM21	40.36	6.18%
7	2% + 20%	RM22	41.54	9.29%
8	2% + 30 %	RM23	40.91	7.63%
9	2% +40%	RM24	40.25	5.89%
10	3% +10%	RM31	39.87	4.89%
11	3% +20%	RM32	41.74	9.81%
12	3% +30%	RM33	40.91	7.63%
13	3% + 40%	RM34	40.25	5.89%
14	4% + 10%	RM41	39.21	3.16%
15	4% + 20%	RM42	40.97	7.79%
16	4% + 30 %	RM43	40.01	5.26%
17	4% + 40 %	RM44	39.26	3.29%



Graph 7: Variation in Compressive strength of Mix Concrete (Bar Graph)



Graph 8: Variation in Compressive strength of Mix Concrete (Line Graph)

III. CONCLUSION AND FUTURE SCOPE

A. *Conclusion*

- When concrete is mixed with Red mud and Iron ore slickens it has been observed that there is an increase in both compressive strength and workability of concrete.
- It is observed that compressive strength first increases upto 20 % iron ore slicken mix afterwards it starts decreasing.
- By this study it is concluded that all the mix are usable but highest compressive strength is observed in RM32 mix.
- It can also be concluded that all the mix ratios containing 20 % iron ore slickens are optimum.
- By this study it is concluded that all mix are useable, but RM22, RM32 mixes gives better compressive strength. It is also concluded that RM32 is the optimum value for mix.
- It is safe to say that red mud and iron ore slickens both can be used in concrete for replacement upto a certain limit.

B. *Future Scope*

- There is also a scope of replacing cement with red mud in a higher percentage which can be taken into consideration.
- There is a scope of using red mud with iron ore slickens for ground brick manufacturing.

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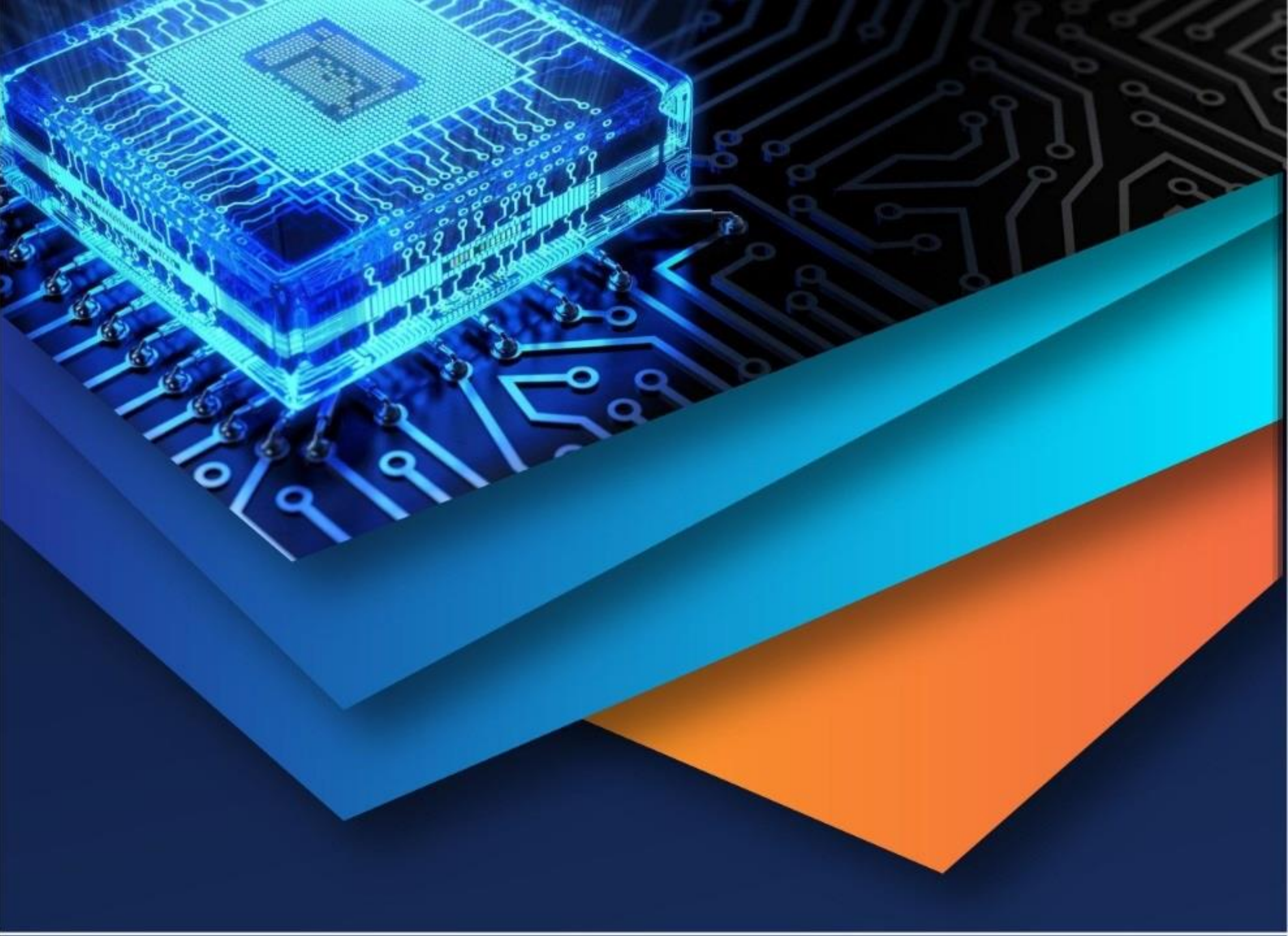

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