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Study on Partial Replacement of Fine Aggregate by Quarry Rock Flyash

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Abstract: **Fly ash is one of the residues generated from thermal power plants. Fly Ash can be used as a low cost mineral admixture in concrete. The addition of fly ash in cement resulted in great benefits such as reduction in heat of hydration, resistance to corrosion, reduction of cement consumption and decreased permeability. M 25 grade of concrete is prepared with high volume fly ash in concrete with various proportions as a partial replacement of cement 0%, 10%, 20%, 30%, 40%, 50% of opc and quarry rock dust is used as partial replacement of fine aggregates 0%, 10%, 20%, 30%, 40%, 50% by river sand. To study the Mechanical properties of high volume fly ash concrete and fine aggregate replaced concrete compressive strength, split tensile strength and flexural strength at different ages of concrete such as 7, 28, 56 days are studied. The result shows that the optimum replacement of fly ash and quarry rock dust are at 30%.**

Keywords: - Concrete, Quarry Rock Dust, Fly Ash, Mechanical Properties.

INTRODUCTION:

Present days construction industries needs faster development and also require high strength of concrete to facilitate the fast construction and economical construction. For that purpose we used high early strength of cement, to gain early strength of concrete. This demand of high early strength gain of concrete put for the use of low w/c ratio. But when Use of fly ash in concrete imparts several environmental benefits along with low w/c ratio and thus it is ecofriendly. It saves the cement requirements for the same strength thus saving of raw materials such as limestone, coal etc required for manufacture of cement. Fly ash is a pozzolonic material & it improves the properties of concrete like compressive strength and durability.

Quarry dust is a waste material obtained from stone quarries while crushing stones, stone crusher dust, which is available abundantly from crusher units at a low cost in many areas, provides a viable alternative for river sand in concrete. Earlier investigation indicates that stone crusher dust has a good potential as fine aggregate in concrete construction. Crusher dust not only reduces the cost of construction but also helps to reduce the impact on environment by consuming the material generally considered as a waste product with few applications

LITERATURE SURVEY

Mini Soman, Sobha. K [1] aims at developing a concrete by replacement of Ordinary Portland Cement (OPC) with 50% Fly Ash by mass. The fresh and hardened properties of High Volume Fly Ash Concrete (HVFAC) with 50% replacement of cement and Ordinary Portland Cement Concrete (OPCC) are studied. The study discloses that high volume of Fly Ash in concrete reduces the water demand and improves the workability. Study also reveals that the OPCC and HVFAC exhibit similar hardened properties. Comparison of flexural response of beams made with OPCC and HVFAC with different percentage of reinforcement are also studied. It is observed that HVFAC beams have shown notable improvement in the deflection, cracking behaviour and load carrying capacity.

Sigrun Bremseth [2] focused on the use of ASTM Class F fly ash in concrete, as a part of blended cement or used directly into concrete mixer. There were many articles that highlight the good properties of the use of fly ash, but few with the connection between fly ash blended cement and fly ash blended concrete and field construction. The study takes up both the advances and the drawbacks with use of fly ash cement.

Jo Jacob Raju, Jino John [3] studied the mechanical properties of High Volume Fly-Ash Concrete with addition of fibres at 0.1, 0.2, and 0.3% of cement and with 60% fly ash replacement with cement. It is found that fibre additions have increased its strength characteristics considerably over the ordinary cement concrete. A mathematical model was developed using SPSS 20 for the strength parameters of HVFAC with fibres. The major parameter that affected strength was total binders and water-binder ratio.

Swapnil B. Cholekar, Subrahmanyam Raikar [4] focussed on high volume fly ash concrete mixes incorporating foundry as fine aggregate. In this study, the strength and durability properties with partial replacement of cement with fly ash with different levels of replacement (0%, 25%, 50%, 75%, and 100%) of river sand with foundry sand are evaluated. The present study will address the disposal related problem of fly ash and foundry sand, thus reducing environmental hazards and also will lead to the conservation of natural fine aggregate for future.

Dr.vijayakumar, k.revathi [1], studied the strength and durability of concrete by using quarry dust as partial replacement of fine aggregate replacements varies as 0,25,50,75% of riversand. The study explains that quarry dust has required properties of fine aggregate and 50% of quarry dust can be replaced in sand to produce optimum strength of concrete. 25% replacement of quarrydust with fine aggregate gives same strength values as control mix Durability studies reveals that Ph value between 12.5 to 13.5 gives passive cover to the steel.

R.Ilangovana,N.Mahendran [2], aims at the strength and durability properties of concrete containing quarry rock dust as fineaggregate .this study presents the feasibility of usage of quarry rock dust as 100% substitute for natural sand in concrete mixdesign developed for three grades M-20,M-30,M-40 using an design approach IS,ACI,USBR,RN.NO.4,BRITISH for both conventional and quarry dust concrete . Tests were conducted on cubes and beams to study strength .They revealed that the compressive,flexural strength and durability studies of concrete are nearly 10% more than the conventional concrete.

Rajesh kumar suman ,vikas srivastava[3], focused on utilization of stonedust as fineaggregate replacement in concrete to study the suitability for potential use of stonedust as fine aggregate .specimens are casted for different replacements levels at an interval of 10% to determine the workability and compressive strength of concrete .this discloses the optimum replacement of stonedust is 60% based on compressive strength .

MATERIALS USED :

Cement

Ordinary Portland cement available in the local market of standard brand of 53 grade confirming to IS 12269 - 1987 was used for the concrete mix. The cement should be fresh and of uniform consistency and there is no evidence of lumps or any foreign matter in the material. The cement should be stored under dry conditions and for as short duration as possible.

Table 1 properties of cement:

S.No.	Property	Value Obtained Experimentally	Value as per IS: 1489-1991
1.	Normal Consistency	28	30%
2.	Fineness modulus of cement	5%	Max 10%
3.	Setting time Initial setting time Final setting time	26min 512min	Min 30 minutes Max 540 minutes
4.	Specific gravity	3.12	3.15

Fine Aggregate

Locally available river sand was used as fine aggregate in concrete mix. The physical properties of fine aggregate is shown in table.

Table 2 Physical Properties of Fine Aggregate

S.No	Property	Value Obtained
1.	Specific gravity	2.640
2.	Bulk density	1.5g/cm^3
3.	Fineness modulus	2.16
4.	Water absorption	1.8%
5.	Grading Zone	Zone III

Coarse Aggregate

Crushed stone aggregate of 20mm IS sieve retained and 12mm IS sieve passing were used for preparation of concrete

Table 3 Physical properties of Coarse Aggregates

S.No.	Property	Value Obtained
1.	Type	Crushed
2.	Specific gravity	2.75
3.	Fineness modulus	6.03
4.	Water absorption	0.6%

Fly Ash

Fly Ash is a finely divided residue resulting from the combustion of pulverized coal and transported by the flue gases and collected by electrostatic precipitator. Fly ash is the most widely used pozzolanic material all over the world.

Table 4 Physical properties of fly ash

S.No.	Property	Value Obtained
1.	Specific gravity	2.67
2.	Fineness modulus	4%

Quarry Rock Dust:

Quarry rock dust is a waste material obtained from stone quarries while crushing stones, stone crusher dust, which is available abundantly from crusher units at a low cost in many areas, provides a viable alternative for river sand in concrete.

Table 5 physical properties of quarry rock dust

S.N	Property	Value Obtained
1.	Specific gravity	2.70
2.	Fineness modulus	4%
3.	Water absorption	1.68%
4.	Grading zone	Zone –III

EXPERIMENTAL INVESTIGATION:

MIX DESIGN OF CONCRETE

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain strength and durability as economically as possible.

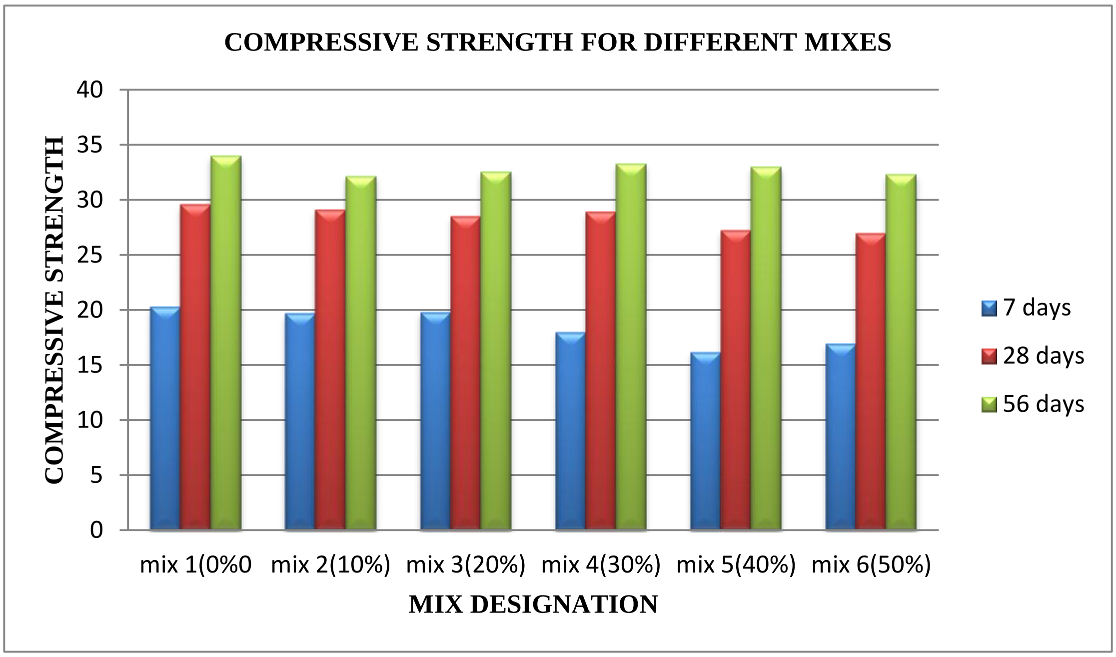
Mix designs for each set having different combinations are carried out by using IS 10262-2009 method. The mix proportions obtained for normal M25 grade concrete is
1 : 2.44: 3.278 with a water cement ratio 0.43.

Table 5 Replacement of Cement with Fly Ash in preparation of high volume flyash concrerte

S.No.	Mix Designation	% Replacement of cement with Fly Ash
1	M1 (Control Mix)	0
2	M2	10
3	M3	20
4	M4	30
5	M5	40
6	M6	50

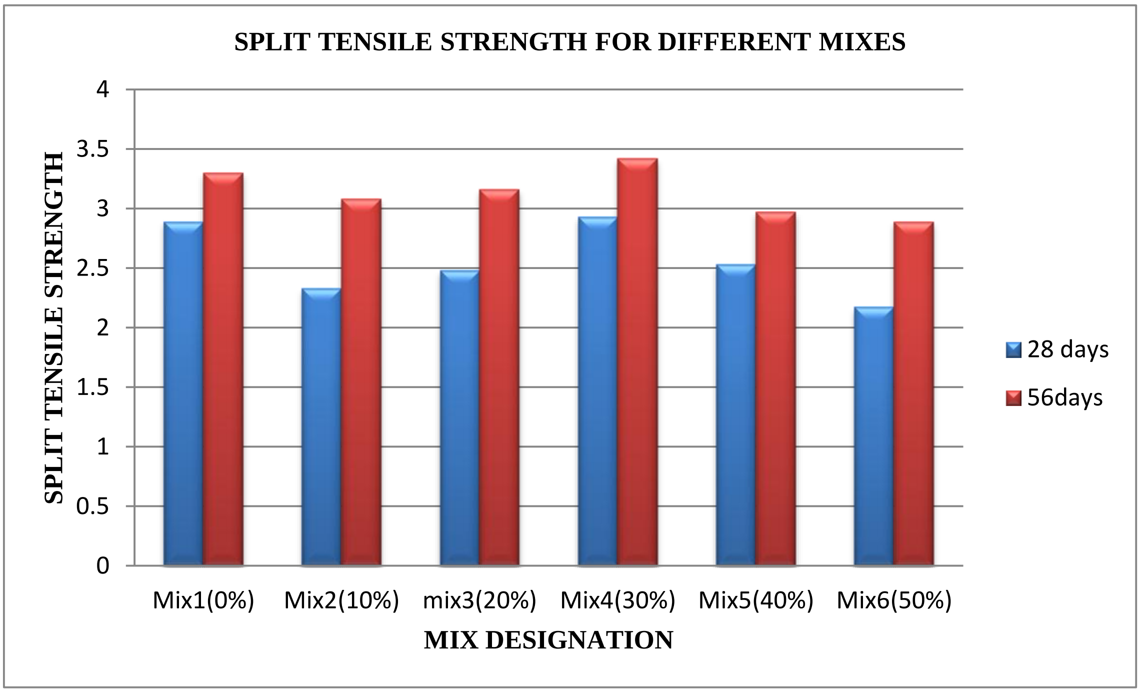
Compressive Strength

After curing, cubical specimens are tested to determine the compressive strength of concrete. The compressive strength of cubical specimens after 7, 28, 56, 90 days of curing are determined.



Split Tensile Strength

After 28 days of curing, cylinder specimens are tested to determine the compressive strength of concrete. The compressive strength of cylinder specimens after 28 days of curing are determined



Flexural Strength

After 28 days of curing, prism specimens are tested to determine the compressive strength of concrete. The compressive strength of prism specimens after 28 days of curing are determined

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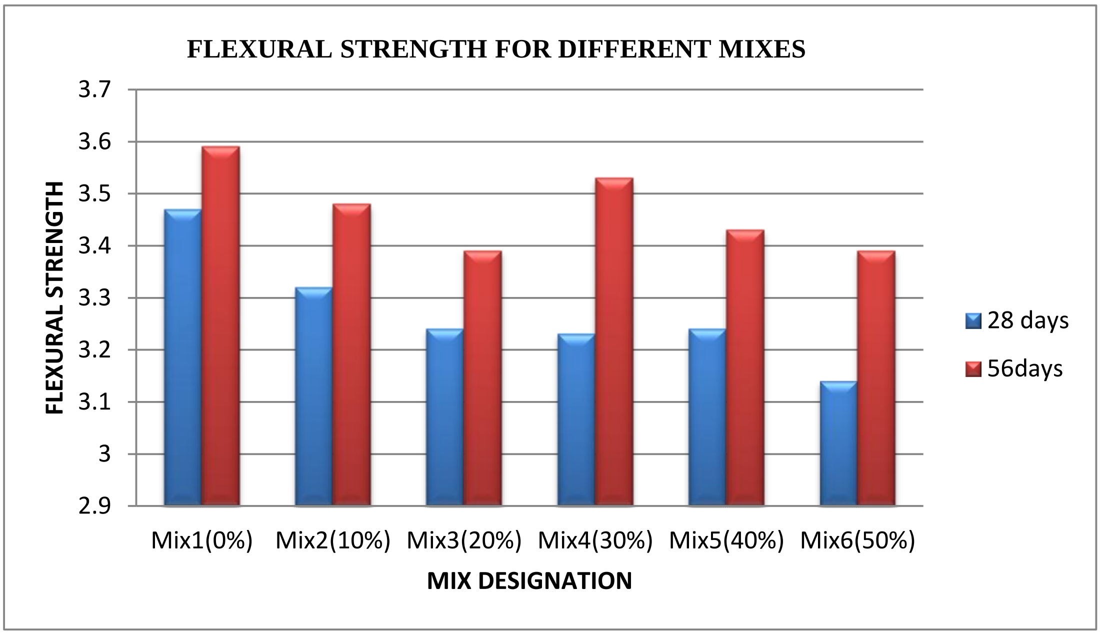

PHASE –II

The results obtained before concreting and after testing of the cube, cylinder and prism specimens are casted by partially replacing fine aggregate by quarry rock dust.

Compressive Strength

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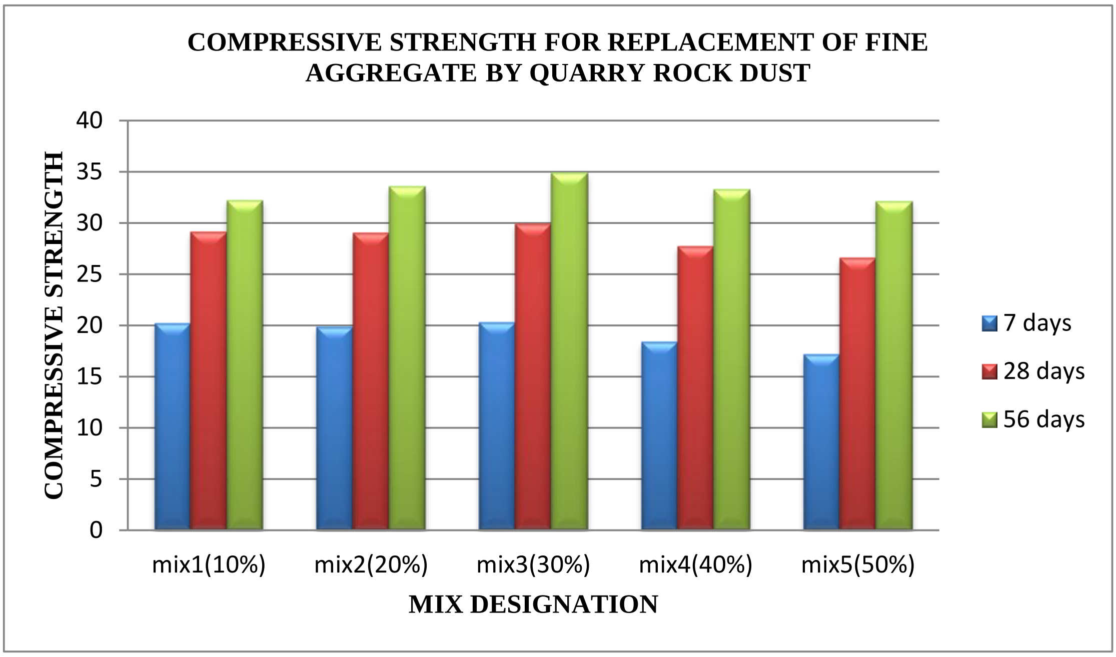

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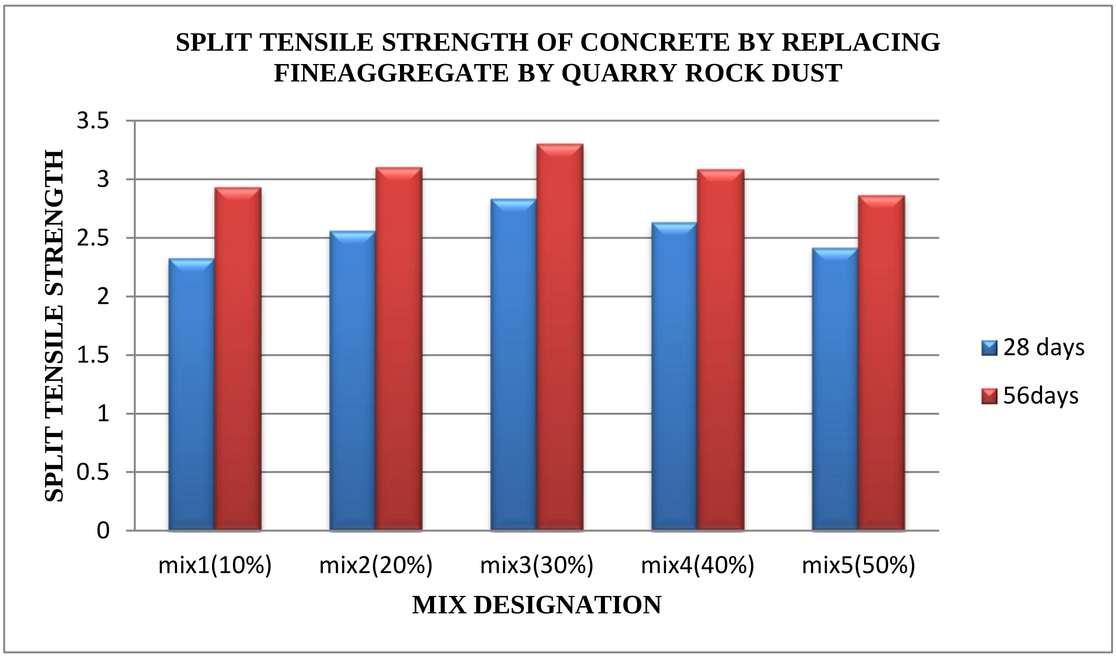

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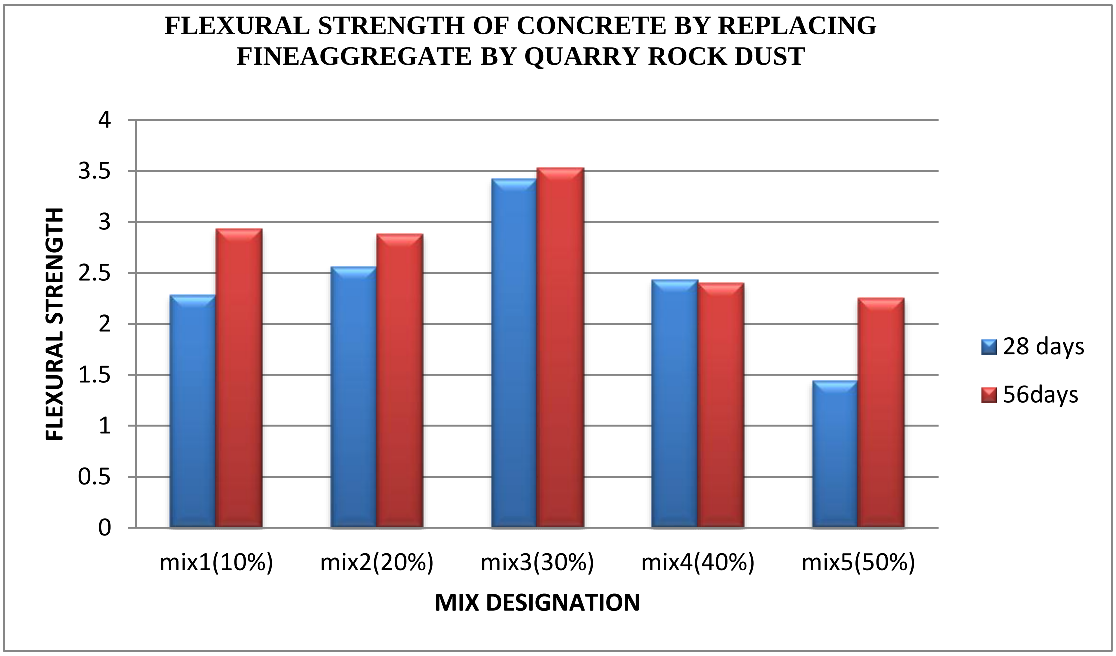

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Photographs :

Fig 1 slump cone test of concrete

Fig 2 specimens after casting

fig 3 measuring of crack distance

Fig 4 cylindrical specimen after failure

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CONCLUSIONS

[1] By observing the mechanical properties of flyash concrete, 30% replacement of flyash is adopted as optimum percentage.

[2] Addition of flyash to the concrete increases workability.

[3] Maximum compressive strength of 33.26 N/mm^2 is achieved at 30% replacement of cement by flyash.

[4] Maximum split tensile strength of 3.42 N/mm^2 is obtained at replacement level of 30%.

[5] Maximum Flexural strength of 3.53N/mm^2 is observed 30% replacement of cement by flyash.

[6] After obtaining the optimum value of flyash quarry rock dust is used as replacement of fine aggregate .

[7] By replacing fine aggregate by quarry rock dust increase in strength is observed upto 30% and s decrement of strength is observed by increment in %of quarry rock dust in concrete.

[8] Maximum compressive strength is observed at 30% replacement of fineaggregate by quarry rock dust and the value is34.87N/mm^2.

[9] Split tensile strength maximum value is obtained at 30% replacement level of fine aggregate by quarry rock dust.

[10] Maximum flexural strength of 3.53N/mm^2 is observed at 30% replacement of fine aggregate by quarry rock dust.

[11] In high volume flyash concrete compressive strength of 101.97% is achieved at 30%replacement of cement by flyash.

[12] In fineaggregate replacement maximum compressive strength of 110.34% is achieved at 30% of quarry rock dust.

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