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An Experimental Research on Compressive Potency Appraisal of M50 Grade of Concrete with Alternatives of Cement and Fine Aggregate

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Abstract: Over the former twenty years, the evolution of High-Strength Concrete (HSC) has accredited builders to effortlessly reach and exceed the expectations. The major contrast b/w HSC and normal strength concrete associated to the compressive potency that cited to the ultimate resistance of a concrete specimen to enforced strength. The ACI outlined the High- Strength Concrete (HSC), as the concrete with a compressive potency larger than 40Mpa. In this thesis, an experimental research has been carried out on strength parameters of High Strength Concrete (HSC) of M50 grade with replacement of cement by fly ash in the ranges of 10%, 20%, 30% and fine aggregate by Quarry dust of 20%, 40%, 60%, 80% and 100%. M50 Grade of concrete is designed as per IS: 10262-2009 by adopting the water –binder ratio as 0.35. For better workability super plasticizer is used. The result of those investigations demonstrates the potency characteristics of quarry dust and houses of fly ash based totally based concrete mixes. Based on the outcomes acquired, the alternative of 100% quarry dust and 20% of fly ash with super plasticizer which advances traits changed into arrived. The arrived results are bought into comparison with conventional concrete. In this thesis record the information of the investigations alongside the effects are supplied.

***Index Terms* -** High Strength Concrete (HSC), Fly Ash, Quarry Dust, Grade of concrete Strength Parameters and super plasticizer.

I. Introduction

The exalted intrude in the technology of concrete is the advancement of High Strength Concrete (HSC). It conceivably outlined as the concrete with defined characteristic cube potency between 40 and 100 N/mm^2. High Strength concrete (HSC) can be a concrete that meets unique combinations of the overall strength and regularity requirements that can't forever be completed. Commonly mistreated preferred components and traditional mixture and placing and natural movement practices. To offer excessive overall strength concrete it's generally important to apply chemical and mineral admixtures moreover to equal elements that area unit normally used for traditional concrete. Compressive potency is the preliminary variation b/w HSC and normal- strength concrete which refers to the ultimate resistance of a concrete sample to enforced stress. Even supposing, there is no accurate point of division b/w between high-strength concrete and normal-strength concrete, "A concrete with a compressive strength greater than 6000 psi is the HSC stated by ACI". Moreover, there is not a precise point of variation between hsc and ultra-high performance concrete which has greater compressive potency than hsc and other superior properties. High strength concrete (HSC) partakes been evolved over the last twenty years and became generally added via personal region look at fashion and creation like excessive rises and parking garages. By mistreatment by way of- products like ash and Quarry dust with wonderful plasticizers we're able to achieve high strength concrete that own excessive workability excessive strength and excessive modulus of snap high density high dimensional balance low piousness and resistance to chemical assault.

1.1 General Composition of HSC:

In the development of HSC water-binder ratio plays a vital role. The w/c ratio should be less for HSC when compared to Normal Strength concrete. High cement content is required to get low w/c ratio to ensure the ease of concrete. Nevertheless more heat of hydration and extent cracking behaviour in the concrete will occur when huge cement content is used. Hence, to lessen this tendency a volume fraction of cement content is to be alternated by other cementations materials like silica fume, fly ash or GGBS or combinations of these. The incorporation of super plasticizers in compulsory when low w/c ratios and other cementations materials are used. Thus the selected amount of opc, sand, metal, water, Sp's, other pozzolana materials will be the combination of HSC. Manufacture of hsc involves making optimal use of the basic ingredients that constitute normal-strength concrete. Producers of high-strength concrete know what factors affect compressive strength and know how to manipulate those factors to achieve the required strength. In addition to selecting a high-quality Portland cement, modified combinations of materials and the proportions of cement water aggregates and admixtures will be chosen correctly by producers. In hsc, while selecting the metal, producers will take care of potency of metal, size of metals using, bond b/w cement slurry and metal and surface elements of metal will be considered with utmost care. The ultimate potency of high-strength concrete can be limited by any one of the above parameters. In hsc, generally utilization of Pozzolana (such as fly ash and silica fume) is taken. These admixtures will improve the compressive potency of HSC by reacting with cement hydrates. By creating the C-S-H gel which leads to potency of concrete. Without the usage of chemical admixtures, the production of HSC will be so complicated. A common practice is to use a super plasticizer in combination with a water-reducing retarder. The super plasticizer gives the concrete adequate workability at low water-cement ratios leading to concrete with greater strength The water-reducing retarder slows the hydration of the cement and allows workers more time to place the concrete. In engineering projects, the concrete structures have to with stand high compressive loads need HSC. In high rise buildings, hsc is used commonly for erection of structural elements such as columns especially on ground floors where the loads will be greater shear walls and foundations. Hsc is also utilized in bridge applications for instance. Across the globe, hsc is utilized widely in the construction of high rise buildings. In the construction of highway bridges hsc is used. When compared to normal concrete, concrete girders of larger lengths can be casted by using hsc. High Strength Concrete enhances to construct the super structures of long length bridges and ensure the durability of bridge decks. Some of the structural elements in which hsc is utilized are dams, grand stand roofs, marine foundations etc. The main scope of the research is to inspect the variations of potency parameters of High strength concrete (HSC) with the partial alternates of cement by fly ash and full alternates of fine aggregate by quarry dust.

II. EXPERIMENTAL PROGRAM

The research program consisting of casting curing & testing of the cube specimens (150mm x150mm x150mm) for conventional concrete and also for HSC. In HSC OPC is replaced partially by fly-ash in the volume fractions 10%, 20% 30% And the fine aggregates are fully replaced by quarry dust in ranges of 20% 40% 60% 80% and 100%. The concrete grade considered is M50. All the casted specimens were cured after casting and tested for strength parameters.

2.1 Concrete Grade and Mix Proportion:

The grade of concrete taken in this project is M50. The concrete design was done according to the codal provisions of IS: 10262-2009 and also from IS 456-2000 and from the results of many trails of the obtained proportion the final mix design was taken as 1:1.21:2.26 with the water / binder ratio 0.35. As per code guidelines a super plasticizer is also used in this project which helps in low water- binder ratio.

2.2 Materials Used:

Cement: Ordinary Portland cement conforming to IS 12269 – 1983 was used for the concrete mix and Specific gravity was found to be 3.15.
Fine Aggregate: The fine aggregate (sand) used in the work was obtained from a nearby river course. The fine aggregate that falls in zone –II was used the specific gravity was found to be 2.65.
Coarse aggregate: Crushed coarse aggregate of blended size < 10mm and < 20mm are used in this mix having specific gravity of 2.65 with 60% and 40% of aggregates.
Water: Portable water supplied by the college is used in this work.
Fly Ash: Fly Ash used in this project was taken from the VTPS (Vijayawada Thermal Power Plant) Vijayawada.
Quarry Dust: Quarry dust obtained from Chimakurthy granites is used in this project.

2.3 Casting and Curing:

Casting was done several stages In first Stage the casting of conventional concrete for M50 grade without any replacements (0% replacements) of cement and fine aggregates is done. In the latter stages the casting was done by replacing cement with fly-ash and fine aggregate with quarry dust were casted. After casting curing of specimens was done for 28 days The casted specimens are tested for 7,14 and 28 days compressive potency values.

2.4 Testing Procedure:

After curing, the casted specimens are tested for compression strength values at 7days, 14 days and 28 days on UTM.

2.4.1 Compression Strength Test:

The compressive strength of hardened concrete is considered one of the most important properties and is often used as an index of the overall quality of concrete. This test is done for finding the compressive strength of concrete that is casted in cube mould of size(150mm x150mm x150mm).

III. RESULT AND DISCUSSION

For M50 grade of concrete, and cubes were casted with 0%, 10 %, 20%, 30% of fly ash and 0%,20%,40%,60%,80% and 100% alternate of fine aggregate with quarry dust. All the casted specimens were cured and tested to evaluate the compressive potency values at 7, 14 & 28 days. The obtained results are tabulated and graphs are drawn accordingly.

3.1 Compressive Strength:

We recognize, compressive potency is equal to remaining load divided with the aid of move sectional region of concrete specimen. We took the concrete specimen's dimension before beginning the trying out and calculated move sectional vicinity. Now we got the final load. So we can now calculate the concrete compressive electricity. Compressive potency = Ultimate load (N) / go sectional area (mm^2).= P/A. The unit of compressive potency could be N/mm^2. Normally 3 samples of concrete specimens are examined and common result is taken into consideration. If any of the specimen compressive electricity end result varies through extra than 15% of average result, that result is rejected. After 7 days, 14 days and 28 days of curing, 3 no 150 mm cubes of a concrete aggregate had been tested the use of the compression device. These cubes had been loaded on their facets throughout compression trying out such that the load was exerted perpendicularly to the route of casting. The average cost of the three cubes was taken because the compressive strength.

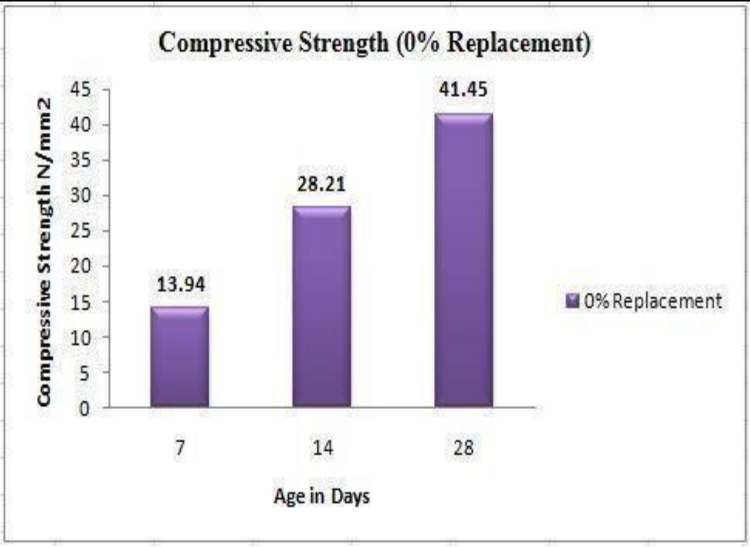

Fig.1: Graph b/w Compressive strength Vs Age for 0% Replacement of Fly-Ash and Quarry Dust

The above graph is plotted b/w compressive potency and age for concrete cube specimens casted with 0% alternates of fly ash and quarry dust. It was identified that the required strength was not achieved. Latter, the cube specimens are casted with 10%, 20% ,30 % replacement of cement with fly ash and 20%, 40%, 60%, 80% and 100% alternates of fine aggregate with Quarry dust. Corresponding graphs are given below.

3.2 Compressive Strength for 10% Fly ash and Different percentages of Quarry Dust:

The cube specimens are casted with 10% replacement of cement with fly ash and 20%, 40%, 60%, 80% and 100% alternates of fine aggregate with Quarry dust. Corresponding graphs are given below.

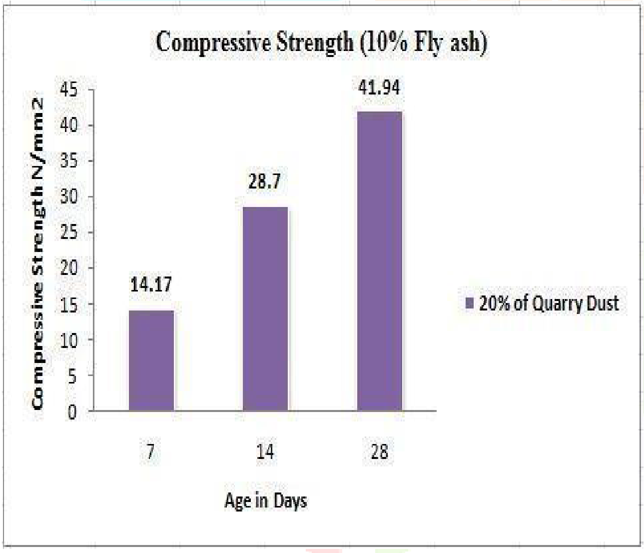

Fig.2: Graph for 20% Quarry Dust

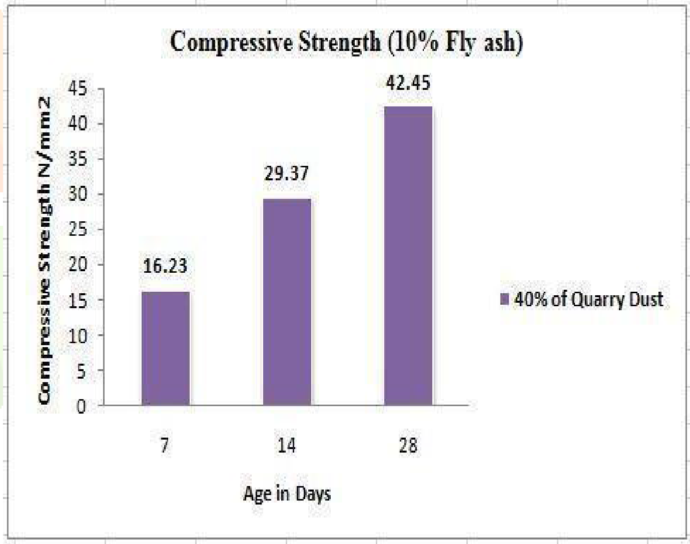

Fig.3: Graph for 40% Quarry Dust

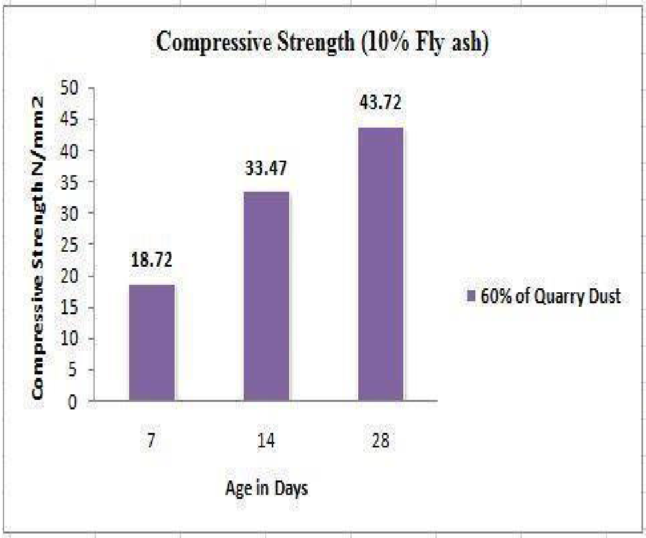

Fig.4: Graph for 60% Quarry Dust

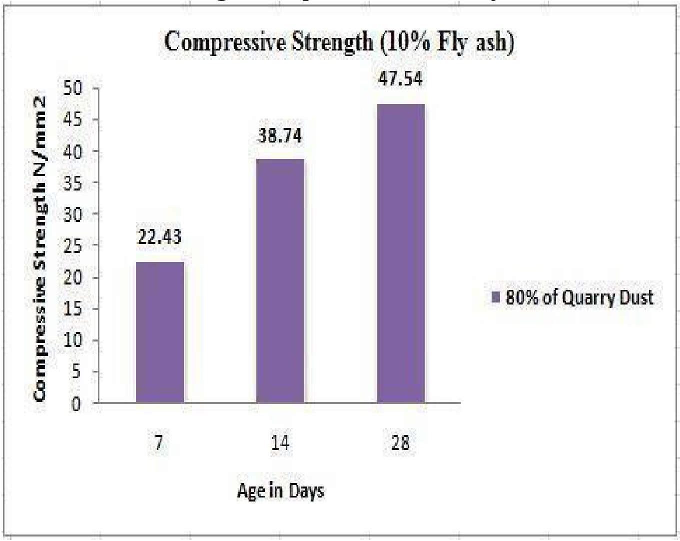

Fig.5: Graph for 80% Quarry Dust

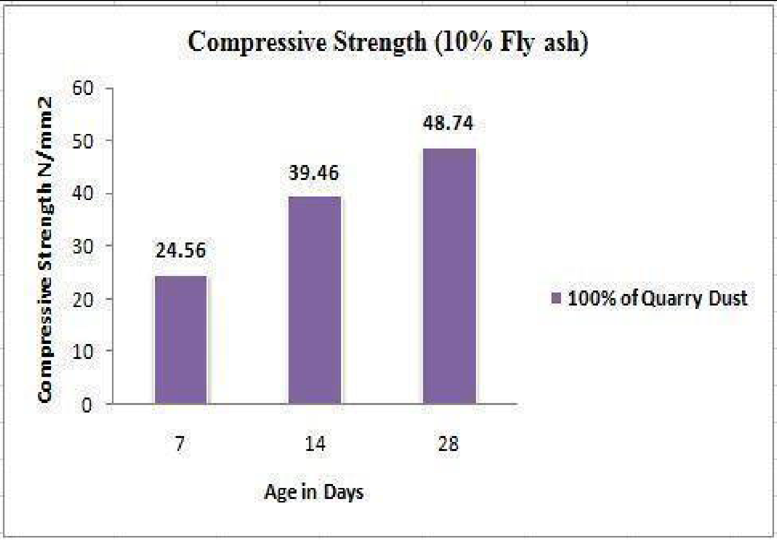

Fig.6: Graph for 100% Quarry Dust

The above graphs are plotted b/w compressive potency and age for concrete cube specimens casted with 10% alternates of fly ash and 20%, 40%, 60%, 80% and 100% quarry dust. The maximum strength was achieved with combination of 10% Fly ash and 100% quarry dust. It was also identified that the required strength was not achieved.

3.3 Compressive Strength for 20% Fly ash and Different percentages of Quarry Dust:

The cube specimens are casted with 20% replacement of cement with fly ash and 20%, 40%, 60%, 80% and 100% alternates of fine aggregate with Quarry dust. Corresponding graphs are given below.

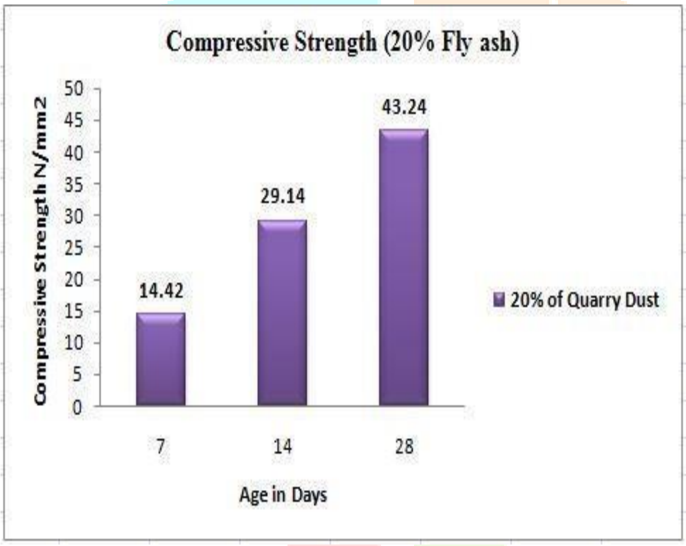

Fig.7: Graph for 20% Quarry Dust

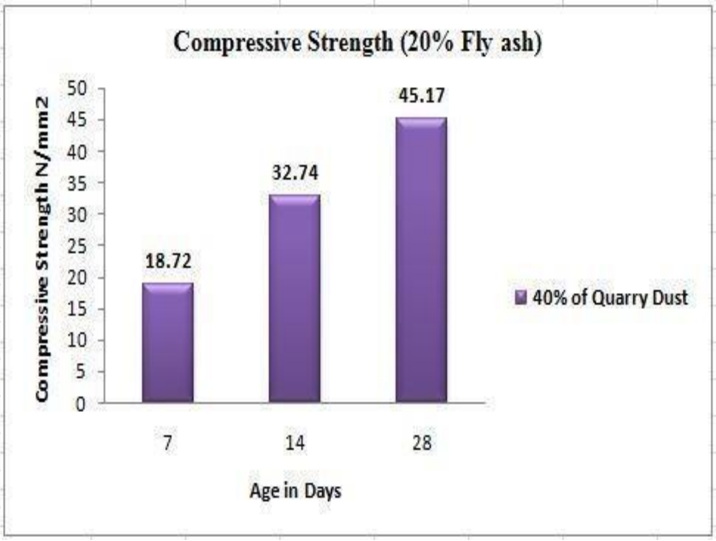

Fig.8: Graph for 40% Quarry Dust

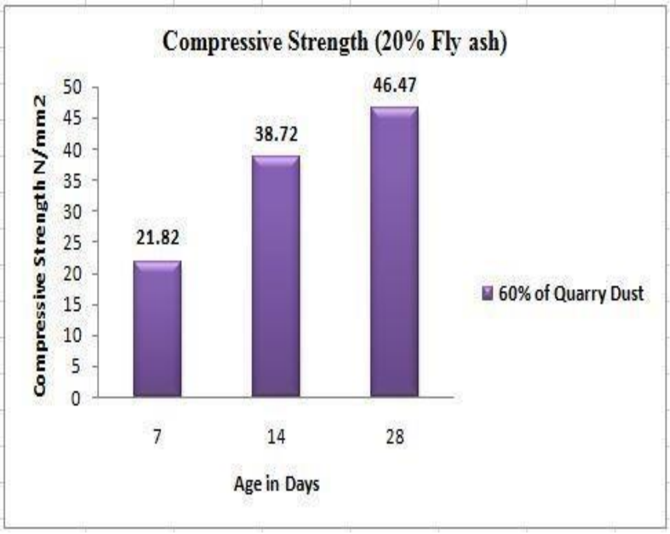

Fig.9: Graph for 60% Quarry Dust

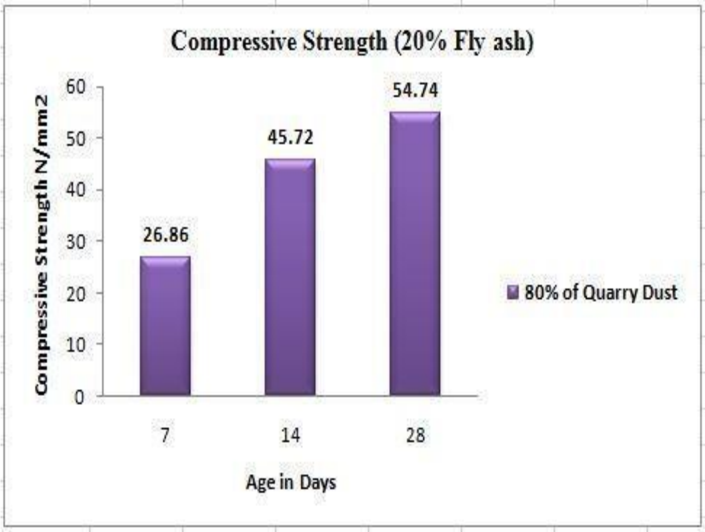

Fig.10: Graph for 80% Quarry Dust

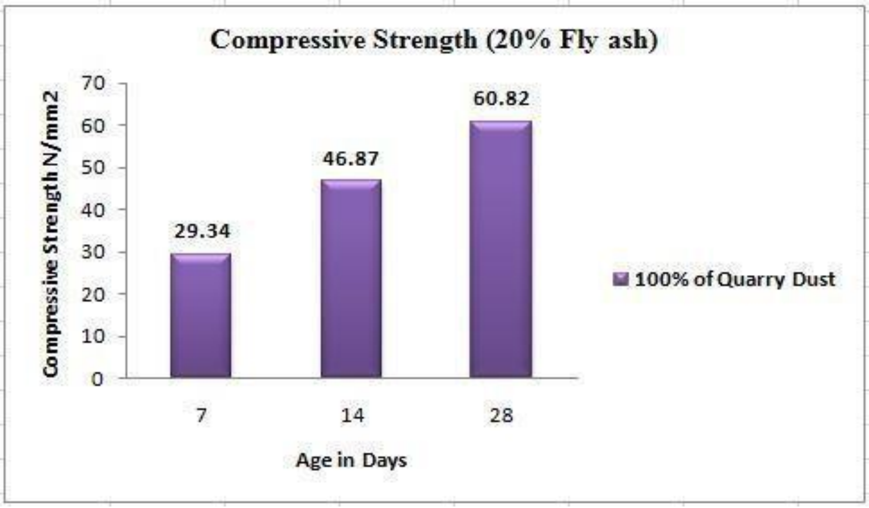

Fig.11: Graph for 100% Quarry Dust

The above graphs are plotted b/w compressive potency and age for concrete cube specimens casted with 20% alternates of fly ash and 20%, 40%, 60%, 80% and 100% quarry dust. The maximum strength was achieved with combination of 20% Fly ash and 100% quarry dust. It was also identified that the required strength was achieved for the mixes with combination of 20% fly ash and 80% quarry dust and 20% fly ash and 100% quarry dust.

3.4 Compressive Strength for 30% Fly ash and Different percentages of Quarry Dust:

The cube specimens are casted with 30% replacement of cement with fly ash and 20%, 40%, 60%, 80% and 100% alternates of fine aggregate with Quarry dust. Corresponding graphs are given below.

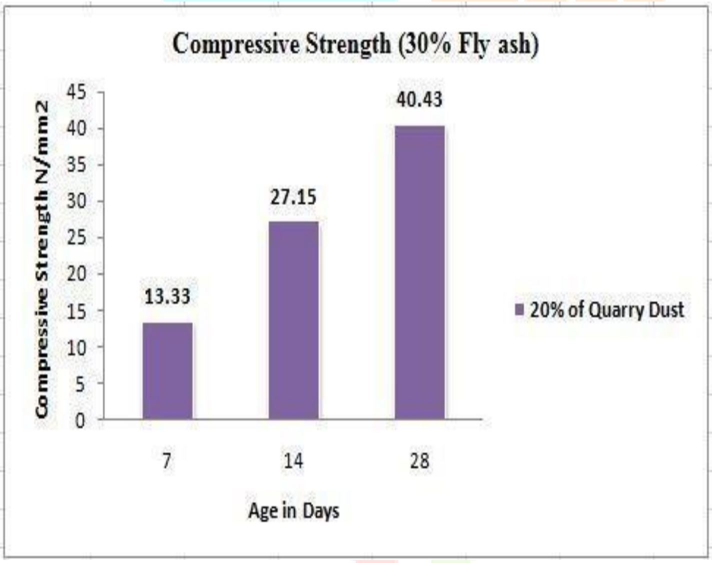

Fig.12: Graph for 20% Quarry Dust

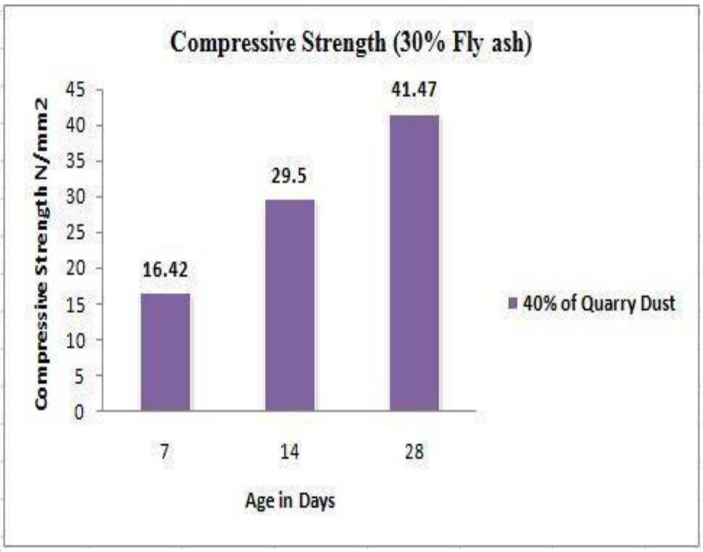

Fig.13: Graph for 40% Quarry Dust

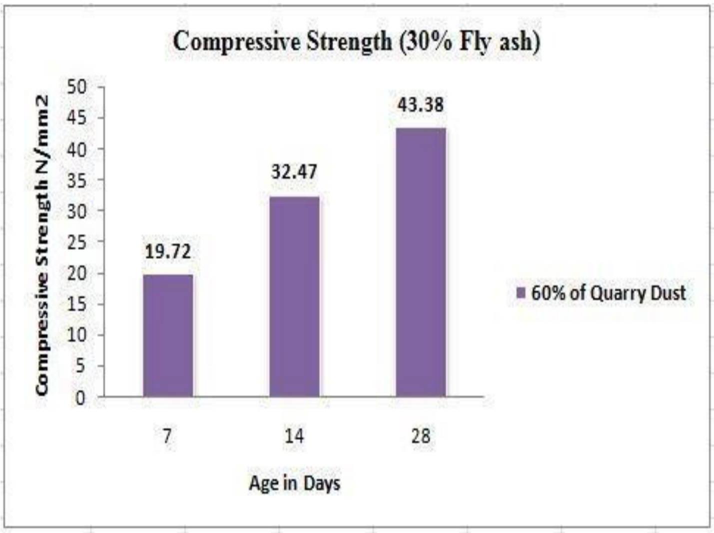

Fig.14: Graph for 60% Quarry Dust

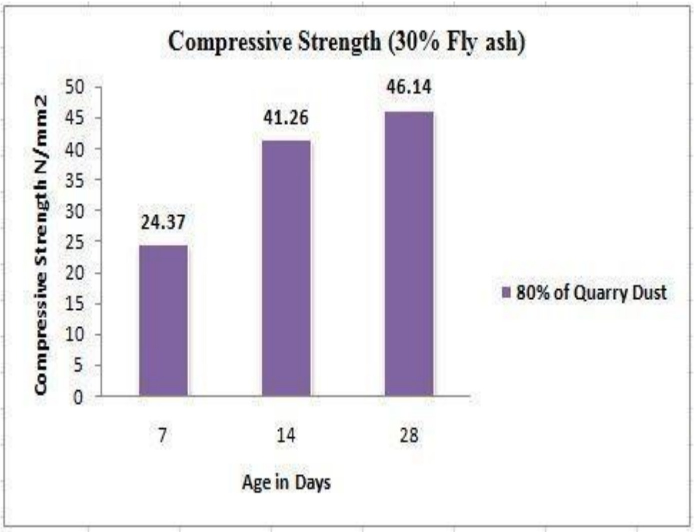

Fig.15: Graph for 80% Quarry Dust

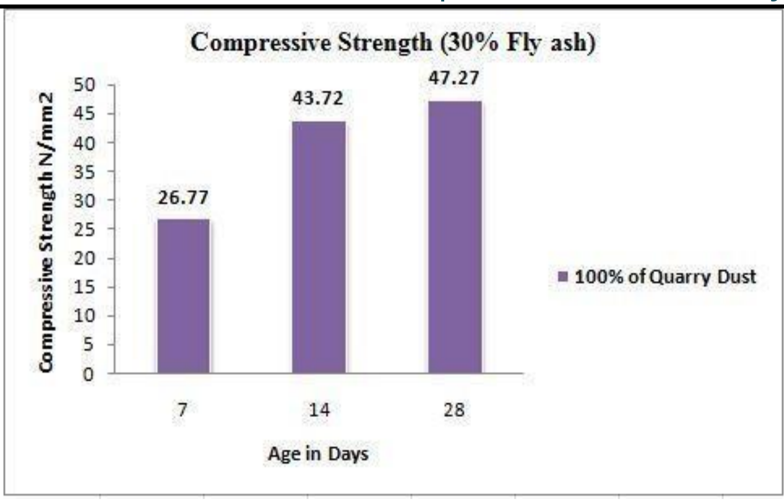

Fig.15: Graph for 100% Quarry Dust

The above graphs are plotted b/w compressive potency and age for concrete cube specimens casted with 30% alternates of fly ash and 20%, 40%, 60%, 80% and 100% quarry dust. The maximum strength was achieved with combination of 30% Fly ash and 100% quarry dust. It was also identified that the required strength was not achieved.

IV. Conclusion

- In this research, the Concrete Mix of M50 has been designed as 1:2.21:2.26 with water-binder ratio 0.35. The concrete with optimum percentage of 20% alternate of cement by fly ash and 100% fully alternate of fine aggregate by quarry dust in concrete mix quantities also arrived.
- For M50 grade of concrete, the value of slump is increased when the alternatives of cement and fine aggregate by fly ash , quarry dust is considered as 20% & 80%.
- While comparing to the nominal concrete, i.e, with 0% alternatives with the HSC, the compressive potency values are increased for each % of fly Ash and quarry Dust by using low water – binder ratio.
- Therefore, the compressive potency of HSC can be increased by using the alternatives of cement and fine Aggregate with fly ash and quarry dust.
- Generally it is recommended to use around 20% of fly ash as replacement of cement in order to obtain effective resultant end products.

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