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"Study the strength properties of fiber reinforced concrete by using nano silica and ultra fine fly ash"

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Abstract: *Fiber reinforced concrete (FRC) in various civil engineering applications is indisputable. In This study is aimed at investigating the durability properties of Composite Fiber Reinforced Concrete. A 15% partial replacement of cement by weight was done with ultra-fine fly ash. The addition of nano silica was in fractions of 0%, 1.5%, 3.0% and 4.5% by weight of cement. For each of the above combinations, 1.0% steel and 0.25% polypropylene fibers, respectively, by volume of the binders were added. A constant aggregate binder ratio of 2.0 and varying water binder ratios of 0.275, 0.300, and 0.325 were used in this investigation. By performing these tests in this study try to determined rate of absorption, permeability of concrete, residual compressive strength and percentage of weight loss. And here at the end of this study try to find out optimum percentage of ultra fine fly ash and nano silica to achieve desired durability, porosity and permeability.*

1 Introduction

Concrete which forms major components in the construction Industry as it is cheap, easily available and convenient to cast. Fiber can be effectively used as a reinforcing material which posses certain characteristics. Roulade and his co-authors were first to propose the use of steel fibers as a reinforcement material in concrete. Character of fiber reinforced concrete changes with the varying the material of fiber, densities, distribution and orientation. Fibers are usually distributed uniformly and are present throughout the FRC, whereas wire or bars used foe reinforcement are placed only at some distinct positions. Fibers have been implemented in concrete structures to enhance tensile characteristics by inhibiting crack growth which generally occur due to shrinkage and improving mechanical behavior. Fibers in concrete substantially improve toughness, tensile strength, flexural strength, fatigue resistance, and ductility.

- **Ultra fine fly ash:** An ultrafine fly ash supplied by Boral Material Technologies Inc. Fly ash is a finely divided by product resulting from the combustion of coal in power plant.
- **Nano silica:** Nano-silica increased the volume shrinkage of cement concrete. The potential of producing materials with new and interesting properties, such as enhanced strength and durability properties.

2 Literature Review

Authors at [1] proposed A review on properties of fiber reinforced cement-based materials. In this proposed model the main focus is only on allocation not on the remaining resources and this task is very difficult to handle.
Authors at [2] proposed literature review on partial replacement of cement by fly ash on strength of concrete. In this proposed methodology provides the communication between both side respectively.
Fly ash is richened mendacious industrial wastes and has great potential to replace Portland cement. When the percentage of replacement is increased the water/ binder ratio gets reduced, thereby, increasing the compressive strength.
Fiber reinforcement can be utilized in development of high and ultra-high performance concrete. Nano concrete could reduce the emission of CO2 in atmosphere by using Nano silica concrete instead of cement concrete. The average increases in compressive strength up to 11%, 15%, 19% in 3 days, 7days, and 28 days with application of Nano silica.

3 Methodology

- **Flow chart**

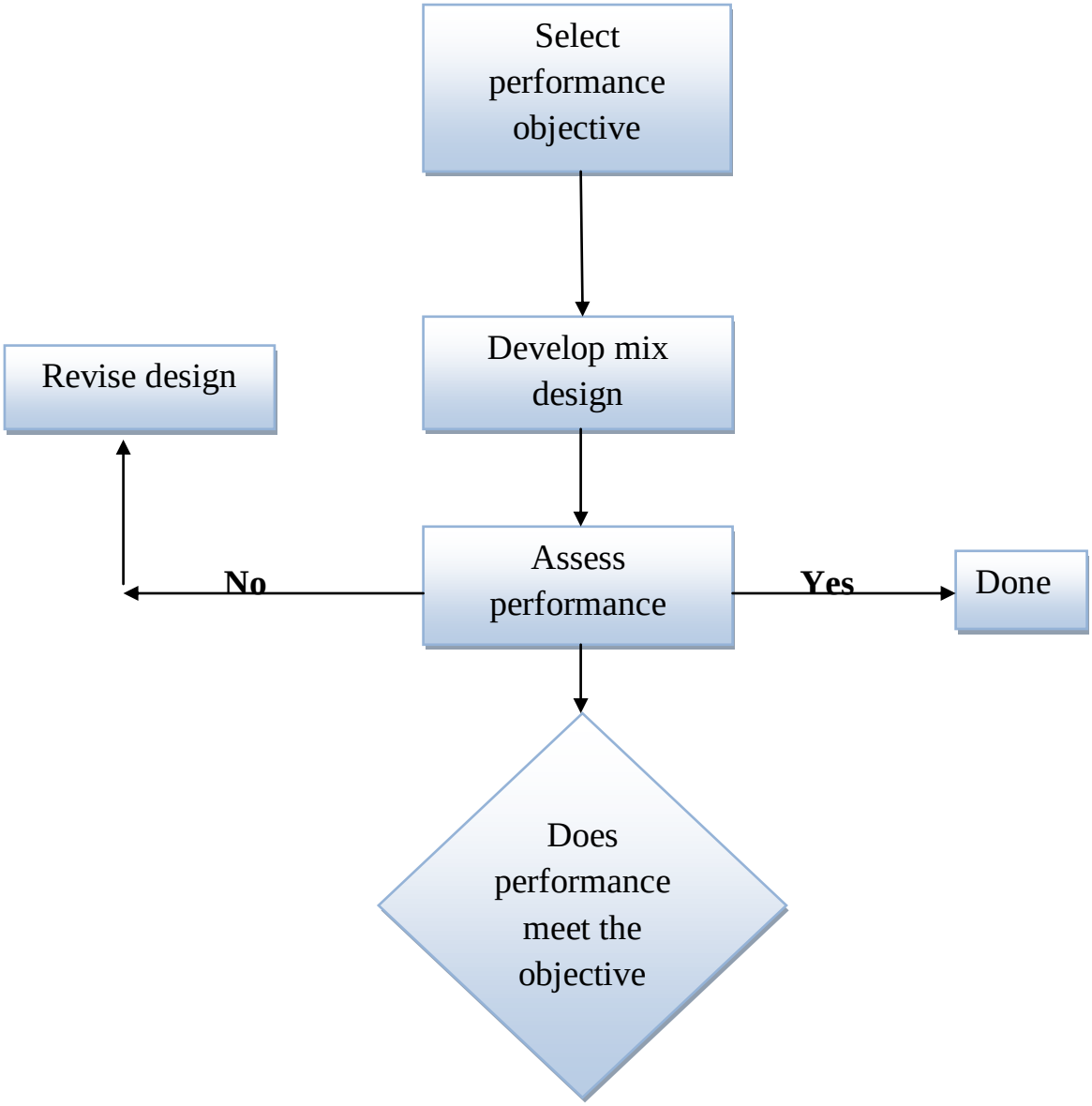

Figure 1: Flow diagram for performance based design concept

➢ **Important criteria**

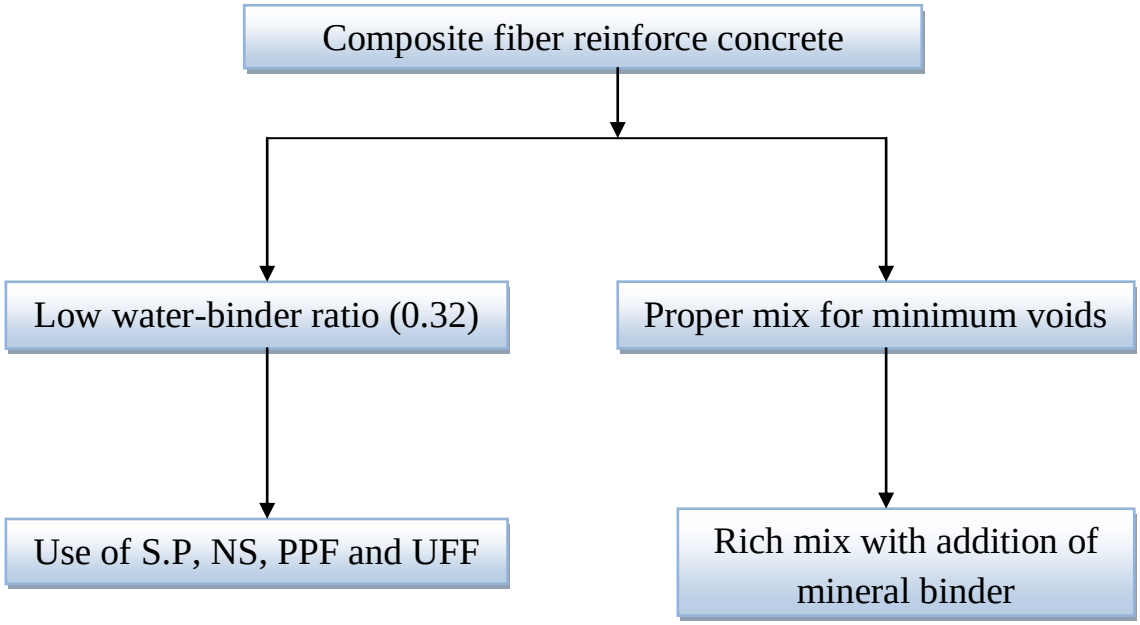

Figure2: Flow chart of important criteria

➢ **Material used per mix (for 9 nos of cubes)**

Sr.No	Mix	Cement	Sand	CA	Fly ash	Water	S.P	NS	PPF	UFF
1	NS 0	9.45	21.54	33.54	2.37	3.024	0	0	0	0
2	NS 1.5	9.45	21.54	33.54	2.37	3.024	0	0.141	0	0
3	NS 3.0	9.45	21.54	33.54	2.37	3.024	0	0.283	0	0
4	NS 4.5	9.45	21.54	33.54	2.37	3.024	0	0.425	0	0
5	NS 0F	9.45	21.54	33.54	2.37	3.024	0.0945	0	0.023	0
6	NS 1.5F	9.45	21.54	33.54	2.37	3.024	0.0945	0	0.141	0
7	NS 3.0F	9.45	21.54	33.54	2.37	3.024	0.0945	0	0.283	0
8	NS 4.5 F	9.45	21.54	33.54	2.37	3.024	0.0945	0	0.425	0
9	UF NS 0	9.45	21.54	33.54	2.37	3.024	0	0	0	1.417
10	UF NS 1.5	9.45	21.54	33.54	2.37	3.024	0	0.141	0	1.417
11	UF NS 3.0	9.45	21.54	33.54	2.37	3.024	0	0.283	0	1.417
12	UF NS 4.5	9.45	21.54	33.54	2.37	3.024	0	0.425	0	1.417
13	UF NS 0 F	9.45	21.54	33.54	2.37	3.024	0.0945	0	0	1.417
14	UF NS 1.5 F	9.45	21.54	33.54	2.37	3.024	0.0945	0.141	0.023	1.417
15	UF NS 3.0 F	9.45	21.54	33.54	2.37	3.024	0.0945	0.283	0.023	1.417
16	UF NS 4.5 F	9.45	21.54	33.54	2.37	3.024	0.0945	0.425	0.023	1.417

Table 1: Material used per mix

➢ **Results**

SR .NO	Name of Mix	Strength after 7 days	Strength after 28 days
1	NS 0	19.36	32.45
2	NS 1.5	21.3	34.6
3	NS 3.0	24.5	37.5
4	NS 4.5	26.2	39.8
5	NS 0F	19.2	31.85
6	NS 1.5F	20.1	32.7
7	NS 3.0F	20.8	33.1
8	NS 4.5 F	21.45	34.6
9	UF NS 0	18.89	31.1
10	UF NS 1.5	20.15	33.25
11	UF NS 3.0	22.3	34.6
12	UF NS 4.5	23.15	34.9
13	UF NS 0 F	21.2	32.8
14	UF NS 1.5 F	22.4	35.4
15	UF NS 3.0 F	24.3	37.1
16	UF NS 4.5 F	25.15	38.1

Table 2: Result for Material used per mix

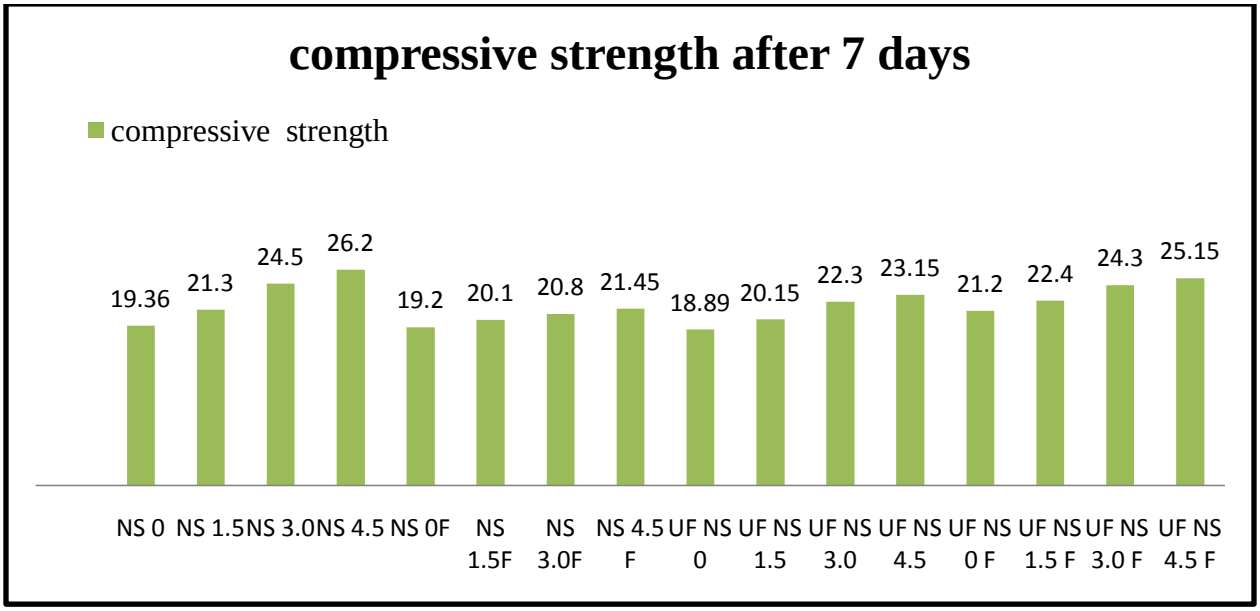

Figure 3: Compressive strength after 7 days

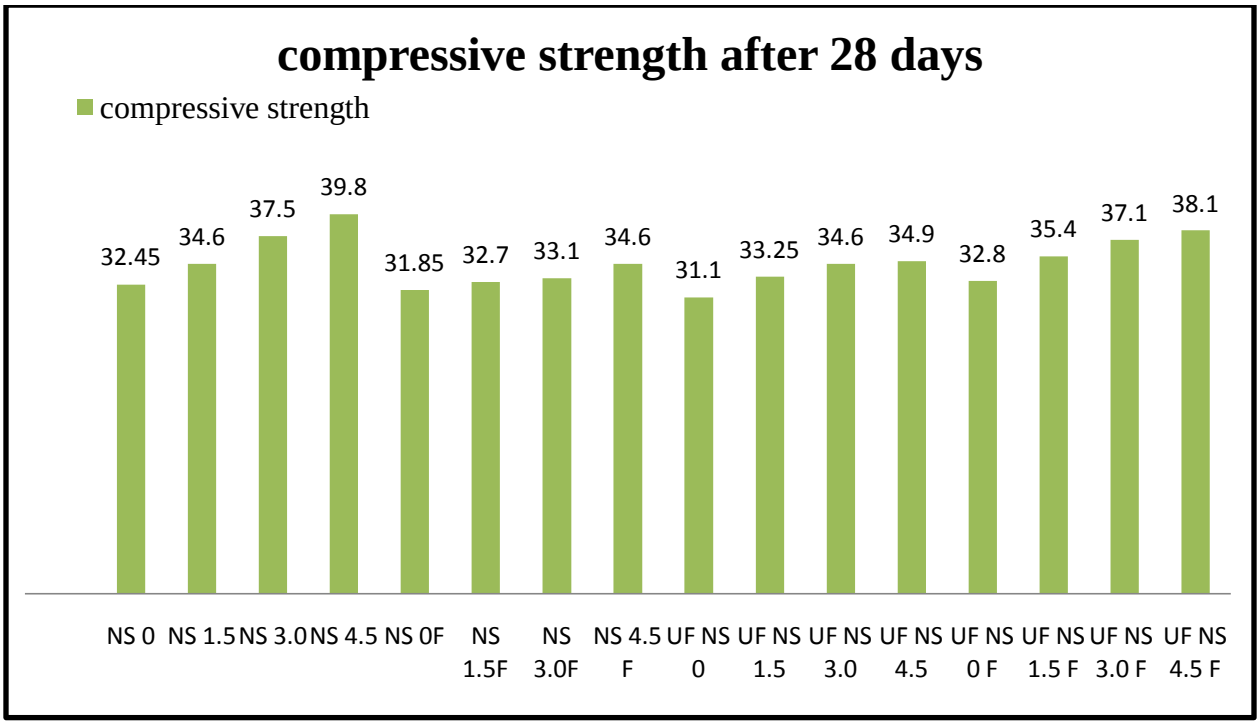

Figure 4:-compressive strength after 28 days

4 Conclusion

- In the past years whatever structures were constructed did not meet serviceability requirements, specially structures which are constructed near to sea area and structures which are in severe and very severe environmental conditions.
- By replacing cement with UFFA and adding nano silica in to concrete it gives immense resistance against environmental conditions.
- Here in this thesis, varying percentage of UFFA with nano silica used also reinforced materials are used for the compressive strength.
- Results shows there s quantity of UFFA and nano silica increased water absorption decreased by available hydraulic quantum in concrete by 18%.
- Results compressive strengths are also meet the design mix requirements of IS codes.
- Acid attack test results shows percentage of weight loss after 28 days and it decreased as percentage of nano silica and UFFA increased, the decrement is about to 35% as compared to normal concrete.
- This investigation shows that use of nano silica to improve durability properties of concrete has huge potential in the construction industries.
- As above results 15% replacement of cement with UFFA and adding 3% nanosilica in to concrete is the optimum percentage of dosage to improve durability of concrete when the concrete is being used in coastal areas and in severe or very severe type of environmental conditions.

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