Ultra High Performance Concrete on Bridges

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Abstract – *There is a vast development in construction field , one of the emerging construction in India is bridge construction. Bridge construction reached importance in worldwide level. The most preferred method of super structure in concrete bridge is precast girders with cast insitu slab. Our role of this project is to determine better concrete that withstand more strength, ductility, durability, sustainability, economy & environmental impact of concrete structure. The project deals with introduction of ultra-high performance concrete (UHPC). UHPC is developed using locally available material such as cement, silica fume, steel fibers, super plasticizer, water. It is done with different mix proportion in order to determine suitable mix that satisfies our objective.*

Key Words: **UHPC, Steel fibers, Silica fume.**

I. Introduction

Bridges are constructed in any kind of road network by adopting prestess girder Type Bridge which create greater development in bridge engineering. There are distinct type of bridge according to shape of bridge each of them as unique purpose. I girder bridge are one of the type of bridge which are economical in nature, which are simple to design & it has better efficiency similarly every bridge has unique purpose. Portland cement was first developed in 1824 and few years later, there was a massive developed with addition of metallic reinforcement during 1849. In 1980, another form of development emerges which was high performance concrete which improves the comprehensive strength of concrete. Few years later ultra-high performance was termed during 1994. In the year of 1997 UHPC was first implemented in pedestrian bridge in Canada. It achieves better stability, serviceability, economy, aesthetic appearance & structural efficiency. Our role in this project is to introduce UHPC in order to produce better strength with minimum cost and minimum usage of material. In case of high performance concrete bridge 5-cpci 1400 girders are used but in UHPC bridge 3-cpci 900 girders are adopted. The use of UHPC is more economical & attains better strength.

II. Material and properties

The following ingredients are used in UHPC

A. Portland Cement

Portland cement is a binding material which is of 53 grade cement which is used in the study which is recommended by IS: 12269-1987.

Table No.1: Properties of cement

S.No.	PARTICULARS	READINGS
1	Specific gravity	3.05
2	Fineness modulus	2.55

B. Fine Aggregate

M-Sand is used as a fine aggregate which improves the uniformity in concrete mixture and it helps as binding material to hold steel fibres. It is used in study by recommendation of IS: 383-1970.

Table No.2: Properties of Fine aggregate

S.No.	PARTICULARS	READINGS
1	Specific gravity	2.57
2	Fineness modulus	2.55

C. Silica Fume

The admixture used in UPHC is silica fume. It is also called as microsilica or condensed silica. It is obtained from ferrosilicon alloys. Silica fume is used to fill the voids between the cement particles. The amount of silica fume is required is about 10%-30% of total cement mass. The addition of 14% of silica fume is enough to meet the maximum strength at 28days.

D. Steel fibers

The fibers are used to increase the tensile capacity & improve ductility. The zigzag brass coated steel fibers are 50mm long with 1mm diameter. Use of steel fibers controls the cracks during process. Usage of steel fibers reduces the reinforcement in structures.

E. HRWR

The super plasticizer used for this study is high resistant water reducers. This super plasticizer is added inorder to achieve the workability. Large quantities which are upto 5
% of cement mass is required.

F. Water

Water is used to mix the cement, fine aggregate, and admixtures together. Potable water is used for mixing concrete. Salt contain water shall not be permitted.

III. Mix Design

A concrete is designed based on IS 2250-1981: Code of Practice for Preparation and use of Masonry mortars. Assuming the grade, different proportions of steel fiber are used, 10% of silica fume is constant for all the proportions.

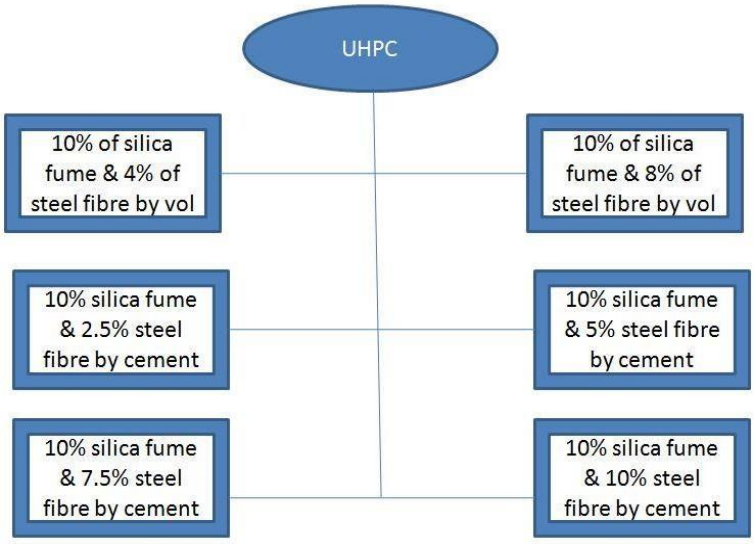

Fig : 1: Mix proportions

Table No.3: Materials used in m^3

Description	Trial 1	Trial 2	Trial 3	Trial 4
Cement	1.836kg	1.836kg	1.836kg	1.836kg
Fine aggregate	6.096kg	6.096kg	6.096kg	6.096kg
Silica fume	0.183kg	0.183kg	0.183kg	0.183kg
Steel fibers	0.045kg	0.0918kg	0.1377kg	1.836kg
Super plasticizer	3%	3%	3%	3%

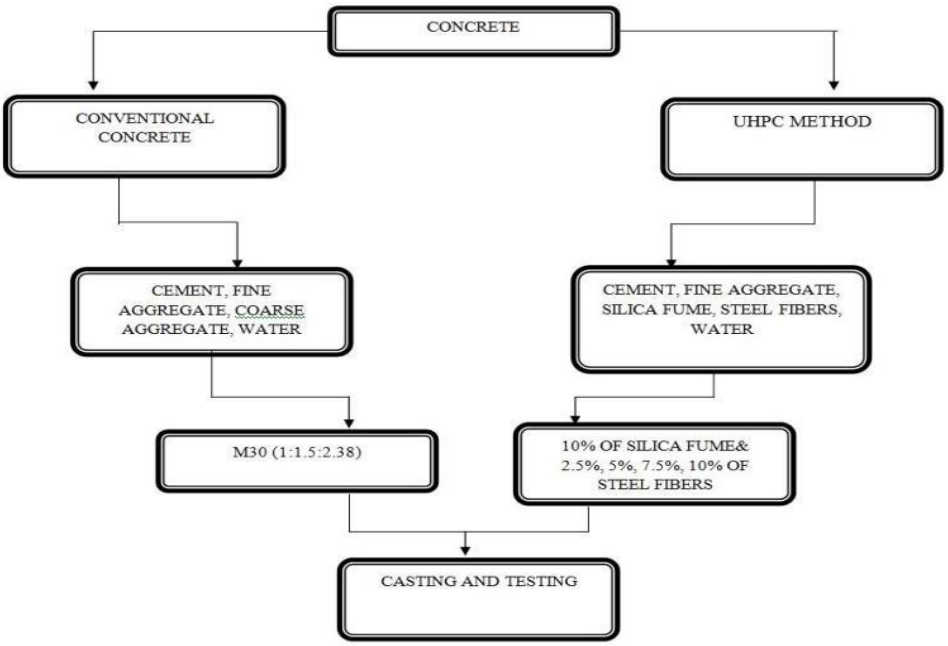

Fig.-2: comparison of conventional & UHPC

IV. Result and Discussion

Compressive strength

It is one of the hardened property of concrete. The test is mainly done to determine the capacity of concrete to withstand the loads. It is to determine under which condition concrete breaks. It is done at 3^{rd},7^{th},28^{th} days. It is done with the help of compression testing machine

Table 4: Compressive strength of concrete in MPa

Percentage of steel fiber	3^{rd} day	7^{th} day	28^{th} day
2.5 %	17.8	22.1	32.2
5%	21.5	29.8	41.7
7.5%	29.6	36.7	52.7
10%	18.7	21.6	30.2

Tensile strength

Tensile strength is one of the property of concrete. It is done to determine the strength of concrete. As concrete is weak in tension, it is necessary to ensure the strength of concrete

Table 5: Tensile strength of concrete in N/mm^2

Percentage of steel fiber	7th day	28th day
2.5 %	1.96	3.11
5%	2.25	3.78
7.5%	2.45	4.21
10%	1.50	2.60

V. Conclusion

The main objective of our project is to determine better concrete that withstand strength, ductility, durability and sustainability. Our role is to suggest better concrete in bridge construction. The implementation of UHPC in bridge construction increases the compressive strength and tensile strength. Compare to conventional concrete in UHPC has more compressive and tensile strength. The compressive and tensile strength in UHPC attained two times more compared to conventional concrete. UHPC is economical compare to conventional concrete. The proportion used by us 2.5%, 5%, 7.5%, 10%. Through our finding comparing to other proportions 7.5% attained maximum compression and tensile strength. The usage of steel fibers reduces the reinforcement. In normal concrete the number of pier installed is more compared to UHPC. The only drawback it requires machine mixing in order to attain uniformity in the mix of fiber.

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