INVESTIGATION OF SILICA FUME INULTRA HIGH STRENGTH CONCRETE

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ABSTRACT

Concrete is the most widely used material in building construction. Within the last few decades, research has been conducted on what is known as Ultra High Strength Concrete (UHSC). The term includes a broad range of materials such as defect-free, dense particle, engineered composite, multi-scale particle, and fiber-reinforced cementitious materials with enhanced properties and characteristics. Here silica fume is used to attain the ultra-high strength concrete of M80. Silica fume, also known as micro silica, is an amorphous (non-crystalline) polymorph of silicon dioxide, silica.The aim of the project is to conduct experimental analysis of high strength concrete. By using the silica fume at various proportions. From the optimum percentage of the admixtures a beam is casted. The scope of this project is to attain the high strength concrete of M80 by using the industrial waste such as Silica fume.

1. INTRODUCTION

1.1. GENERAL

Currently, there is a critical need for advanced building materials for the U.S. domestic infrastructure, not only for new high-strength construction, but also to repair and enhance the performance of existing structures. These materials are required to be increasingly more energy-efficient, environmentally friendly, sustainable, affordable, and resilient. They need to meet multi-hazard/-performance design criteria and be easily produced and incorporated into construction methods and practice. Furthermore, these materials must be cost effective through a structure's life cycle. Concrete is the most widely used material in building construction. Within the last few decades, research has been conducted on what is known as Ultra-High Strength Concrete (UHSC). The term includes a broad range of materials such as defect-free, dense particle, engineeredcomposite, multi-scale particle, and fiber-reinforced cementitious materials with enhanced properties and characteristics.

1.2. ULTRA-HIGH STRENGTH CONCRETE

The definition of UHSC is a class of "concrete" materials with an unconfined compressive strength over 20,000 psi (140MPa) that usually has high binder content and specialfine aggregates. For comparison, the unconfined compressive strength of conventional concrete is from 3,000 to 6,000 psi (20 – 40 MPa). Steam curing may be employed to attain strengths approaching 30,000 psi (210 MPa) and higher UHSC may contain fibers to achieve non-brittle behaviour and, if possible, to dispense with passive(non-prestressed)steel reinforcement.If viewed solely on the cost per cubic yard of material, the cost of UHSC materials can be over ten times greater than the cost of conventional strength concrete. Conventional concrete has widespread usage in construction although it is a commodity that does not necessarily perform well in the long-term or when subjected to man-made or natural hazards. AdvancedMaterials, such as UHSC, show exceptional potential to improve infrastructure performance, and need to be transitioned from the research and development phase to common construction use.

1.3. SCOPE AND OBJECTIVE

In this project, we are going to do the ultra-high strength concrete for mix design of M80.To find out the optimum percentage of replacement of cement by mineral admixtures- mass cone volume.To use industrial by-product silica fume.To reduce impact of this waste product on environment.To suggest a cost effective alternate for cement.

1.4. CONTENTS OF ULTRA-HIGH STRENGTH CONCRETE

The following are the contents of Ultra-high strength concrete are

- Cement (OPC 53 grade)
- Silica fume
- Master Glenium8233
- Coarse aggregate (20mm to 4.75mm sieve)
- Fine aggregate (4.75mm to 75µ sieve)

2. EXPERIMENTAL WORK

2.1. INTRODUCTION

In this work, Cement is partially replaced by using the silica fumeand the master Glenium8233 are together to form Ultra-High strength concrete.

2.2. SPECIFIC GRAVITY

Cement	=	3.15
Fine Aggregate	=	2.61
Coarse Aggregate	=	2.73

2.3. RODED DENSITY

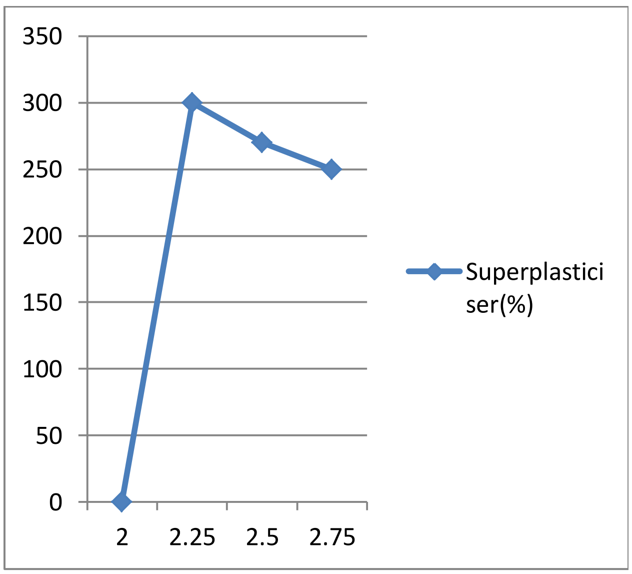
Fine Aggregate =1780kg/m^3

Coarse Aggregate =1682kg/m^3

2.4. SIEVE ANALYSIS

Fine Aggregate = 3.63

2.5. SLUMP VALUE



The optimum percentage is 2.5%

2.6. MIX PROPORTIONS

Cement = 489.6 kg/m^3

Fine aggregate = 730.8 kg/m^3

Coarse aggregate = 1143.76 kg/m^3

Water = 122.4 kg/m^3

So the final ratio becomes

Cement: Fine agg (kg/m^3): Coarse agg (kg/m^3): Water (l/m^3)

1: 1.49: 2.34: 0.24

2.7. TRIAL MIX RATIOS

Types of Mix	Addition of Silica fume (%)	Cement (%)
Mix 1	25	75
Mix 2	20	80
Mix 3	15	85
Mix 4	10	90
Mix 5	5	95
Mix 6	-	100

3. TEST RESULTS

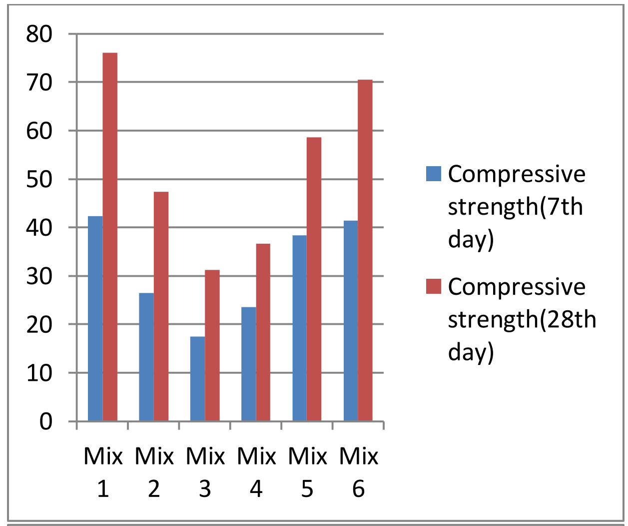
3.1. Theoretical value

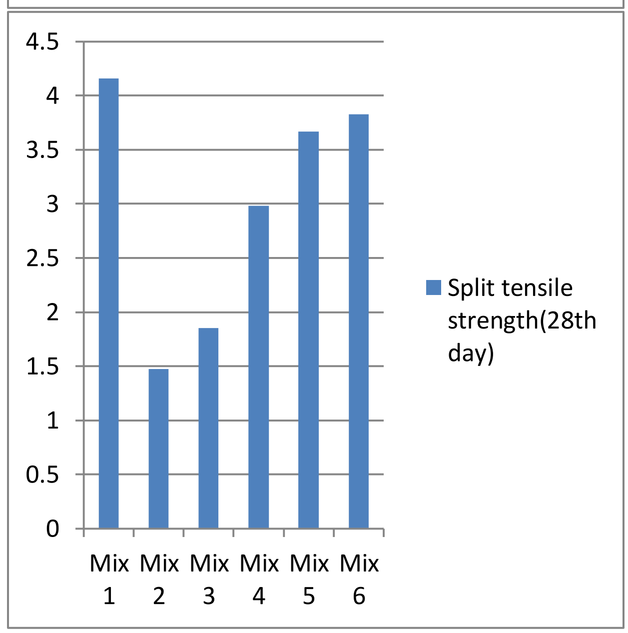
Split Tensile Strength	7.602Mpa
Flexural strength	6.2Mpa

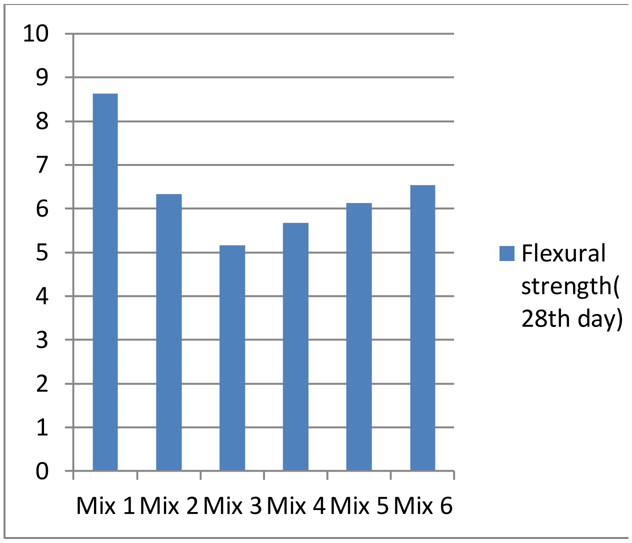
3.2. Experimental value

Specimen (Cube)	Compressive strength(7th day) (Mpa)	Compressive strength (28th day) (Mpa)	Split tensile Strength (28th day) (Mpa)	Flexural strength (28th day) (Mpa)
Mix1	35.5	76.02	4.076	8.63
	42.35	66.03	4.161	8.18
Mix2	24.71	44.0	1.415	6.15
	26.44	47.33	1.472	6.34
Mix3	13.9	22.4	1.812	5.16
	17.51	31.24	1.854	4.95
Mix4	23.6	36.68	2.56	5.67
	18.53	33.27	2.98	5.38
Mix5	34.5	58.65	3.67	6.13
	38.3	56.38	2.98	5.67
Mix6	41.38	70.45	3.83	6.54
	33.2	63.31	3.54	5.87

3.3. GRAPH







4. CONCLUSION

The following are the conclusions obtained after the studyare, out of the six mixes, Mix 1 (Silica fume 25%) had obtained more strength when compared to the other two mixes (Mix 2, Mix 3, Mix 4, Mix 5 and Mix 6). Further works to be done, so from the optimum percentage a beam can be casted and tested. The results are to be analysed.

5. REFERENCES

1.ACI 211.4R-08 Guide for selecting proportions for High Strength Concrete using Portland cement and other cementitious materials.

2. M S SHETTY, “Concrete Technology”, S.Chand and Company.Ltd, Reprint 2005.

3. Jan Olek et al “Investigation into the synergistic effects in ternary cementitious systems containing Portland cement, fly ash and silica fume.” Cement&Concrete Composites 34 (2012) PP-451–459.