Performance of High Strength Self Compacting Concrete at Elevated Temperatures

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Abstract— The High Strength Self Compacting Concrete comprises of higher level of fines when contrasted with the customary cement. So it has higher danger of spalling when presented to lifted temperatures due its conservative miniaturized scale structure. In this examination the impact of hoisted temperature running from room temperature to 600oC for various lengths on the compressive quality and weight reduction of high quality self-compacting cement of review M70 with Fly fiery remains and Micro Silica as mineral admixtures. The blend extents are gotten based on NAN-SU blend structure. This plan depends on pressing element (PF) of total and W/C proportion and FA/CA utilized are 0.25 and 52/48 for various Packing Factors. The water concrete proportion is considered from writing survey. Pressing variable of total is characterized as the proportion of mass of total of firmly stuffed state in SCC to that of approximately pressed state. Extents of Coarse total, Fine total, Fly Ash, Super plasticizer and water cover proportions are unique and extents of Cement, Micro Silica and VMA are consistent for various Packing Factors. The rates of Micro Silica and VMA included are 7% and 0.3% for all blends. It is seen that the rate of abatement in compressive quality of High Strength Self Compacting Concrete (HSSCC) is increasingly when contrasted with High Strength Vibrated Concrete (HSVC) of same review at higher temperatures, and also rate in loss of weight in HSSCC is progressively when contrasted with HSVC of same review at high temperatures. (i.e.at 600 0C). It is distinguished that, when the temperature is under 2000C the lingering compressive quality and misfortune in weight of HSSCC is less contrasted with HSVC. At the point when the temperature is above 4000C the lingering compressive quality and misfortune in weight of HSVC is less contrasted with HSSCC.

Keywords: VMA, HSSCC, PF

I. INTRODUCTION

Concrete is a standout amongst the most flexible and broadly utilized development materials. With the interest expanding for strengthened solid structures in the advanced society to address the issues of new improvements, expanding populace and new aggressive auxiliary plan thoughts, the support in solid structures is ending up more thick and bunched. The overwhelming and thick support can raise issues of pouring and compacting the solid. The solid must have the capacity to pass the thick rebar course of action without blocking or isolating. The plan of such cement is extremely testing since poor position and the absence of good vibratory compaction can prompt the incorporation of voids and loss of long haul sturdiness of solid structures. This has been a worry for designers for a long time.

Amid the most recent decade, solid innovation has made a gigantic development through the presentation of self-compacting concrete (SCC). Self-compacting or self-combining concrete is a generally new age of superior solid that can accomplish amazing deformability and homogeneity in its crisp state, filling all the space around the support, going through thick strengthening steel bars while compacting under its own weight with no outer vibration.

A. Definition of Self-Compacting Concrete:

The British Standard (BS EN 206-9, 2010) characterizes "SCC is the solid that can stream and minimized under its own weight; fill the formwork with its fortification, conduits, box outsect, while looking after homogeneity". In the development of structures having slight segments, pour-statures of more than satisfactory freefall for ordinary concrete, joined with thick support and embeds, it is basic that the solid utilized has high deformability with moderate thickness to guarantee uniform scattering of solid constituents amid transportation, throwing and from there on until settling. It ought to be able to go through the clog, and involve finish space in the shape. The solid ought to be fit for holding crisp solid properties for longer length to oblige the time necessities of other cementing activities from transportation to last wrapping up. Truth be told the most critical property is the capacity of cement to oppose isolation, i.e. the solidness of new concrete. It relies upon the cohesiveness and consistency of the blend. The blend ought to be equipped for withstanding the normal/conceivable varieties in the measure of blending water, dampness substance of fixings or in the extents of coarse and fine total, to stay firm and free streaming.

Different scientists (Ozawa et al., 1989; Bartos and Marrs, 1999; Khayat, 1999) have characterized SCC in nearly indistinguishable terms from an exceptionally stream capable solid that should meet the accompanying necessities:
Stream capacity (Filling capacity), Passing capacity (Blocking test) and Segregate obstruction (steadiness of blends) can be considered as the separating properties of crisp SCC. These necessities are not regular to ordinary cement and, consequently, are taken care of through uncommon tests. These tests ought to be done deliberately to guarantee that the capacity of SCC to be put stays satisfactory.

B. Application of Self Compacting Concrete Burj Dubai

The Burj Dubai structure speaks to the best in class in too elevated structures. Amid its development the latest achievements in the sum total of what fields have been joined together, including solid generation innovation. A few diverse cement blends tower, platform and office add barring establishments. The planned cements were acquired utilizing Portland bond joined with silica seethe, fly fiery debris or ground slag. Thus, extraordinary materials having high thickness and high last quality were acquired (concrete C50

was incorporated in with floor structures and C60 and C80 into vertical load-bearing individuals).

The structure has adequate unbending nature, strength and high load-bearing limit. In course of development of the building the solid was siphoned to ever more elevated statures so it was important to give exceptional streaming capacity of cement through funnels. A world record was accomplished: on November 8, 2007 most elevated vertical cement siphoning for structures, 601m, was performed. Everything in this phenomenal venture was painstakingly arranged. Therefore concrete was poured as a rule during the evening to empower work at lower temperatures and higher mugginess. Concrete was also cooled by including a piece of water as ice. Add up to stature, 818 m, was come to on January 17, 2009.

C. Arlanda Airport Tower

This pinnacle was structured by WingårdhArkitektkontor AB. The aggregate tallness of the pinnacle is 83 m. The structure of the column comprises of two shafts having diverse measurements which are underscored by two-shading plan. There are a few unpredictably put round floor structures at the best. Veneer dividers are parts of a cone. The pinnacle was amid the development organize, the internal formwork was being move by a crane while the external framework and formwork were self-climbing. SCC was utilized so as to accomplish the cementing pace of a standard floor stature h=3.27m in a multi-day climbing cycle of formwork and to guarantee astounding cement putting without vibration. The diminished clamor level amid cement putting empowered cementing amid the night move.

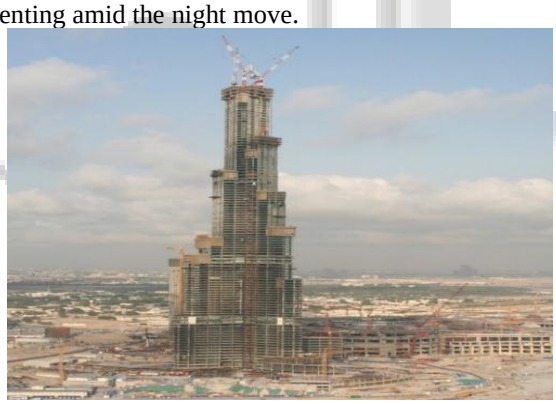


Fig. 1.1: BurjDubai

Fig. 1.2: Arlanda Airport Tower

II. MATERIALS FOR MIX DESIGN

A. Cement

In the present investigations Ordinary Portland cement of 53 Grade is used. Care should be taken that it is made from a single source and of same grade and it is stored in an air-tight container to prevent it from the atmospheric moisture and humidity. The cement thus produced was tested for physical properties in accordance with IS: 4031.

1) Physical Properties of OPC

S.no.	Property	Result
1	Normal consistency	29%
2	Specific gravity	2.95
3	Initial setting time	95 minutes
4	Final setting time	220 minutes
5	Soundness of cement	3.5mm
6	Fineness of cement	4.47%
7	Compressive strength 7days 14days 28days	 21.194 N/mm^2 38.4 N/mm^2 53.58 N/mm^2

2) Typical Compositions

% by mass	PC	GGBFS	F-FA	C-FA	SF
SiO_2	21	35	50	35	90
Al_2O_3	5	8	25	20	2
Fe_2O_3	2	3	10	5	2
CaO	65	40	1	20	-

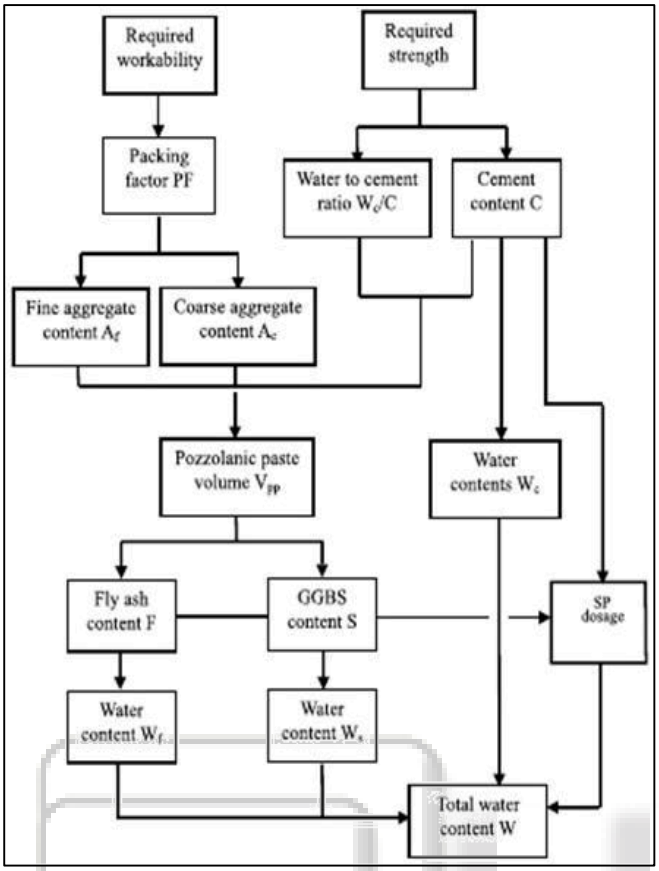
3) Physical and Chemical Properties of Micro silica

S. No.	Property	Result
1.	Form or state	Ultra fine amorphous powder
2.	Color	Grey
3.	Odour	Odourless
4.	Specific gravity	2.2 – 2.3
5.	Bulk Density (kg/m^3)	660
6.	Specific Surface (m^2/g)	20.2
7.	Particle size, mean (µm)	≈0.5
8.	Moisture content	1%
9.	Silicon Dioxide	92.00%

4) Typical Physical Properties of Fly Ash

1	Colour	Whitish Grey
2	Bulk Density(gm/cum)	0.994
3	Specific Gravity	2.288
4	Moisture (%)	3.14
5	Avg Particle Size(µm)	6.92

III. SCC MIX DESIGN



A. Experimental Investigation:

Comparison of Percentage loss in compressive strength of HSSCC(PF=1.14) and HSVC(w/c=0.3)

.S.NO	TEMPE- RATURE	Loss in residual compressive strength	
		HSSCC	HSVC
1	100^0C	0.45	0.56
2	200^0C	9.84	10.51
3	400^0C	22.79	14.26
4	600^0C	39.99	34.03

Comparison of percentage loss of HSSCC (at PF =1.14) and HSVC (at w/c-0.3)

S.NO	TEMPE-RATURE	Percentage of loss weight	
		HSSCC	HSVC
1	100^0C	0.69	0.80
2	200^0C	2.83	3.10
3	400^0C	6.05	4.72
4	600^0C	7.21	5.85

IV. CONCLUSIONS

From the results presented in this paper using M70 self-compacting concrete with different Packing Factors for constant water cement ratio, the main conclusions are

- Required minimum slump is achieved for a Packing Factor of 1.14 with minimum strength for M70 grade high strength self- compacting concrete.
- Maximum strengths are achieved for a Packing Factor of 1.10 with optimum slump for M70 grade high strength self -compacting concrete.
- These values are obtained for a Water Cement ratio of 0.25 with addition of 7% micro silica.
- It is observed that when Packing Factor is less than 1.10 the mix requires more binders there by affecting the workability. Whereas when Packing Factor is more than 1.14 the required strengths and workability are not achieved.
- There is an increase in compressive strength with decrease in packing factor.
- All the workability factors for SCC are improved with decrease in packing factor from 1.14 to 1.10.

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