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SELF-COMPACTING CONCRETE USED FOR BUILDING A MONUMENT WITH BASIC TECHNOLOGY AND CONTROL

C. BADEA[1] O. SUSA[1] R. CHENDES[1] L. IURES[1]

Abstract: *Self-compacting concrete is the best choice for building a durable monument with intricate forms and design. The mixture was designed and tested for the applicability to be produced on site with rudimentary technology and unskilled manpower. The mechanical properties were in the range of C25/30- C30/37 – with a great workability, surface smoothness and accurate architectural details.*

Key words: *workability, self-compacting, mechanical properties*

1. Introduction

Self-compacting concrete(SCC) is one of the most interesting developments in the field of building materials and with a wide variety of application, flows under its own weight and does not require any external vibration for compaction, has revolutionized concrete placement. SCC was first introduced in the late 1990's by Japanese researchers [1-4]. It is easy to use and time efficient. Due to its fluid nature, it can take virtually any shape or desired details from the cast mould. By using a precise granulation curb and the right combination of cement and add mixture, the bleeding and segregation of the concrete can be prevented [5-6].

SCC, generally needs to use super plasticizers in order to obtain high mobility. Adding a large volume of powdered material or viscosity modifying admixture can eliminate segregation. The powdered materials that can be added are fly ash, silica fume, lime stone powder, glass filler and quartzite filler.

The current paper presents the use of this material for the building of a monument with different religious symbols imbedded in the mould, located in the outskirts of Timisoara.

2. Objectives

This work started from the need of obtaining the exact designed symbols impregnated in the concrete- from the cast mould.

The reason for it was selected a SCC is that it should have a relatively low yield value to ensure high flow ability, a moderate viscosity to resist segregation and bleeding, and must maintain its homogeneity during transportation, placing and curing to ensure adequate structural performance and long term durability.

3. Experimental Program

3.1. Materials

For this experimental work there was used the following materials: cement, aggregates, limestone filler, water, and the add mixture-Viscocrete 2011 (provided by Sika). [1], [4]

[1] Politehnica University of Timisoara, Faculty of Civil Engineering, Romania

Use recipe for the SCC Table 1

Self-compacting concrete						**V1**
Cement Tip/Producer	CEM/BM (V-LL) 42,5 N (LAFARGE)					
Add mixture Type / Source	Viscocrete 2011 (SIKA)					
SSC 25/30						
Recipe	**ρ concrete**			2350	kg/m²	
Materials	**Quantity**		**UM**	**Prepared concrete**	**0.040**	**mc**
Cement		420.00	kg		16.800	kg
Water		171.0	kg		6.840	kg
W/C		0.45	kg		0.018	kg
VF 2011	2.50%	9.50	kg		0.380	kg
Lime stone filler		80.00	kg		3.200	kg
Total Aggregate		1712.1 6	kg		68.486	kg
0-4	50%	856.08	kg		34.243	kg
4-8	13%	222.58	kg		8.903	kg
8-16	37%	633.49	kg		25.340	kg
16-32		0.00	kg		0.000	kg

The percentage of each material used for obtaining the self-compacting concrete is noted in Tab.1, for the volume of each frame individually.

The use of small diameter aggregate was helpful in obtaining the smooth surface and compact elements that were desired.

The cast mould was thin and by placing the reinforce steel; the space left between was reduced even more. [2]

The workability of the mix was aided by the use of the add mixture Viscocrete 2011, which facilitated the uniform distribution of the concrete in the mould.

The technology used was a simple free fall mixture. This allowed us to constantly evaluate the homogenous characteristics of the mix.

The materials were stored in a clean and controlled environment, ensuring a greater quality of the poured concrete and bases of guaranty for the future performance and durability of the monument. [4]

Fig.1 presents the materials used for the mixture while Fig.2 presents the mixing equipment.

Fig. 1. *Used materials and molding environment*

Fig. 2**.** *Mixing equipment*

For a greater efficiency there were used two free fall mixture and the workers were split in two teams, ensuring a constant flow of concrete in the mould.

3. Results and Discussions

3.1. Moulding the Frames

Before moulding the frames the cast was made out of wood panels, that were sealed thigh mechanical and with polyurethane foam-, like it can be seen in Fig.3.

Fig. 3. *The wooden cast mould*

After that, in the cast mould were placed the engraved pieces with the desired symbols and fixed into position- as can be seen in Fig.4.

Fig. 4. *Fixing of the engraved symbols to the cast mould*

The desired effect through the placement of the symbols directly in the cast concrete and not adding them later on, was to ensure a greater durability of the monument and its intricate features.

In Fig.5, it can be observed the rebar's who placed and fixed in term, into position with a great care so that any possibility of displacing itself during the pouring, would be removed.

Fig. 5. *Placement of the rebars*

To ensure the unity of the structure, the rebars were welded together an overlapping ends, as can be seen in Fig.6.

Fig. 6. *Welding the rebars*

The cast mould and its components can be seen in Fig.6.

There is the mould for the third part of the monument and in the background can be seen the prior two casts. [3]

The mould was filled in a continuous flow of concrete, resulted from the use of the two free fall mixers.

Fig. 7. *Casting and moulding the elements*

In Fig.8 – can be seen the cast for the independent part of the monument, with its design symbols placed directly in its interior and the rebar's fixed in position.

Fig. 8. *Moulding the central part of the monument*

The resulting concrete was very satisfactory in its characteristics, being fluid enough to flow through the space in the rebars and to homogenous enough not to separate its aggregates or bleed.

The resulted concrete frame was satisfactory, in that it was a uniform colour, had no visible bleeding or segregation and no visible pours Fig.9.

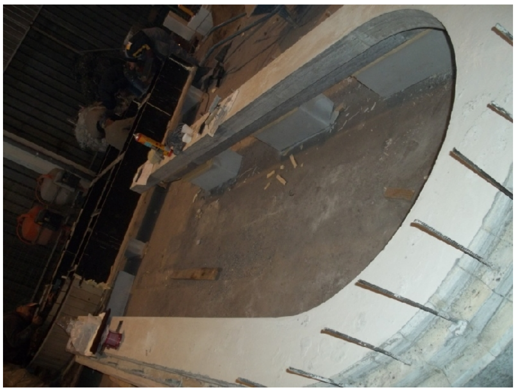

Fig. 9. *The resulted self compacting concrete frame*

The monument was defined by joining the several frames. The monument can be seen in Ghiroda, Brates Street, in the outskirts of Timisoara- Fig.10 and Fig. 11.

Fig. 10.
A side view of the monument

The compressive strength, determined, was at least 33.57 N/mm^2 and maximum 42.15 N/mm^2. This indicates a minimum concrete class of C25/30, which is sufficient for the desired exposure and designed vulnerability.[5]

Fig. 11.

The frontage of the monument

4. Conclusions

1) At the water/powder ratio of 0.45 up to 60, slump flow test, V-funnel test and L-box test results were found to be satisfactory, i.e. passing ability, filling ability and segregation resistance are well within the limits.
2) In terms of mechanical properties, the obtained SCC is a C25/30 concrete, which satisfy the imposed conditions.
3) SCC gives good finishing as compared to ordinary concrete without any external mean of compaction.
4) Due to the conditions of reinforced concrete buildings durability and high-quality .in this case SCC it has the perfect choice.
5) As a material, SCC, seeks new standards in production and control. These standards connect fresh concrete properties and possible application fields.

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