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Deflection for Beams of Self-Compacted Concrete (SCC) and Conventional Concrete for Period t= 40 Days

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Abstract

Development trends for high rise Building or structures, modern skyscrapers request the different workability of fresh concrete to cast in properly way and to achieve the requested results. The many of factors such are: highest of the cast concrete, sections of concrete elements, request the concrete with more plasticity and higher class of consistency, the smaller size of aggregate, the compacted process, etc. The fulfilling the previous condition, using the Self Compacted Concrete is one of the aims in this paper. Considering this fact, researches for deflections, mechanical characteristics of concrete and strains have been conducted worldwide. In this line, we conducted an experimental research to determine the deflections on beams of self-compacted concrete and compared it with conventional concrete. The experimentally-obtained results will be presented for both types of concrete for: module of elasticity and deflections tests for duration testing time t=40 days.

***Keywords**: Self-Compacting Concrete, Conventional Concrete, deflections, modulus of elasticity, etc.*

1. Introduction

The self-compacted concrete has recently gained widespread acceptance worldwide because of its usage in high-capacity buildings.

This is also because of its capabilities when put into action (when practically implemented).

In 2008, the self-compacted concrete has also been used in our country in repairing the bridges throughout road segment at Hani i Elezit in Kaqanik.

For this reason, a new research study is necessary to analyze its deformities features (deflections, modulation, etc.), during both short-term and long-term cargo operations.

In order to determine the mechanical characteristics, a considerable number of testing samples have been prepared where 18 beams have been categorized in three series as follows:

Series A - with six conventional concrete beams
Series B - with six self-compacted concrete beams and
Series C- with six core-based conventional concrete covered by self-compacted concrete

This study aims to represent the composition and preparation of these two types of concrete and provides the experimental findings about the modulus of the elasticity and reduction samples and tested beams for both types of concrete for test time duration of t=40 days.

2. Sample preparation materials and methods

In concrete production, the three-fractions aggregate has been used. It is a property of Vëllezërit e Bashkuar, based in Prizren, which is made of limestone rocks. In order to produce self-compacted concrete, the SUPERFLUID 21M additive, property of ADING-Skopje, has been applied to the sample, while stone-made powder used in the process comes from the same aggregate. Figure 1 below represents the curves of aggregate for respective fractions:

F {I} Fractions (0-4)
F{II} Fractions (4-8)
F{III} Fractions (8-16)

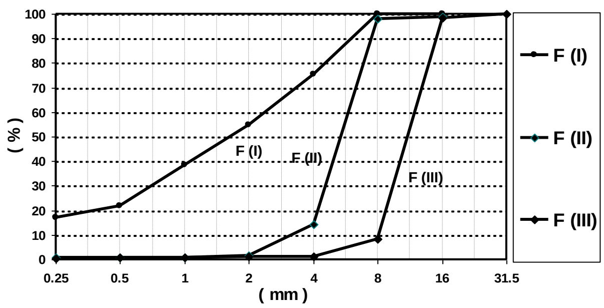

Fig. 1 Sieve curve of aggregate

3. Mixed Design of Conventional Concrete and Self-Compacted Concrete

Mix design of conventional concrete	Mix design of self-compacting concrete
Fraction (0-4) 713 kg/m^3	Fraction (0-4) 750 kg/m^3
Fraction (4-8) 431 kg/m^3	Fraction (4-8) 473kg/m^3
Fraction (8-16) 732 kg/m^3	Fraction (8-16) 473 kg/m^3
Cement 325 kg/m^3	Stone powder 104 kg/m^3
Water 210 kg/m^3	Cement 320 kg/m^3
	Water 200 kg/m^3
	Additive (super fluid) 3.0 kg/m^3

After the preparation of mix design, the integral components of concrete are measured and then mixed altogether. This process is depicted on Figure 2 below.

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Fig.2 Measurement of the integral components of concrete

Prior to obtaining the samples of concrete to carry out testing of the post-solidification phase, other tests such as consistency and temperature measurement, the allocation of the amount of pores are carried out first on fresh concrete (this is especially important for concretes treated with aer additives). Whereas, self-compacted concrete while in fresh conditions has a number of tests which can determine whether it can be used or not. We have only carried out three tests: J-ring, V-funnel and L-box [4]. The following are the results obtained:

- J ring h=7.5cm, d=57cm
- V funnel t_1=8.1s, t_2=9.48s
- U box h=40mm

The obtained temperatures for both concretes were respectively: 23^0 C for conventional concrete versus 25^{0}C for self-compacted concrete with the porosity values of 2.3% for conventional concrete versus 1.8% for self-compacting concrete.

Figure 3 below shows the temperature measurement and porosity calculation using cubical, cylindrical and prismatic samples for both types of concrete.

Fig. 3 Measuring the temperature and porosity on concrete

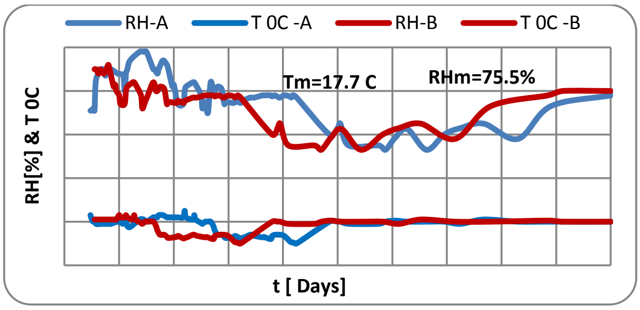

Chart 1 Relative humidity and temperature

4. Modulus of Elasticity – ASTM 469

The procedure and examinations is done according the ASTM 469, in concrete samples, chart 2 are shown the results for conventional concrete and self compacted concrete.

Fig. 4 Testing of Modulus of elasticity

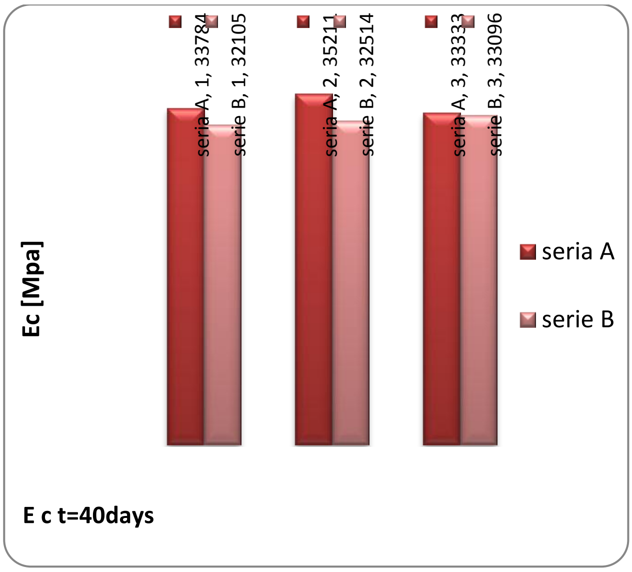

Chart 2 Testing results of Modulus of elasticity [1] [2]

5. Static Scheme and Installation Scheme (of Deflectometers) on Beams

The experiment is done in simple beam loaded with two centered forces. The cross-section dimensions of beams are 15x28 cm, span of the beam is l=3m and are reinforced with two rebar's Φ 12 in the tensile zone and two rebar's Φ 8 in the compressing zone. Static scheme and positions of deflect meters are presented in the

Figure 5.a, and in the figure 5.b is presented the cross sections.

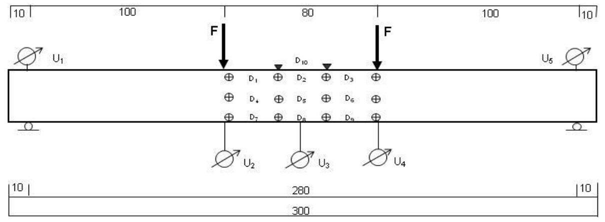

Fig. 5.a Static scheme and positions of deflect meters

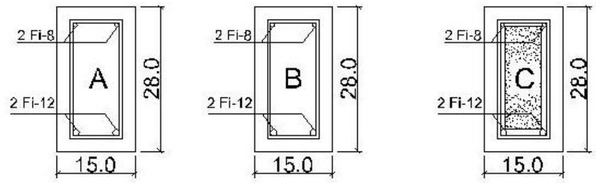

Fig.5.b Cross sections of the beams

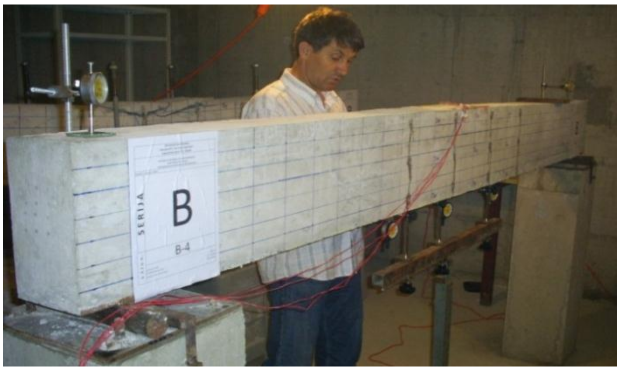

Fig. 6 Testing of beam in failure for t = 40 days [1]

6. Beam testing results

Charts A I-1, A II-1, series A, B-1, B-2, series B, C-1, C-2, series C represent the results of beams immersion during testing for all three series of beams. The comparisons of immersion results between different beams of series A, B and C is graphically shows using diagrams for series A, B and C. In table 1 are presented comparisons of deflections results for beams of three series (A., B, C).

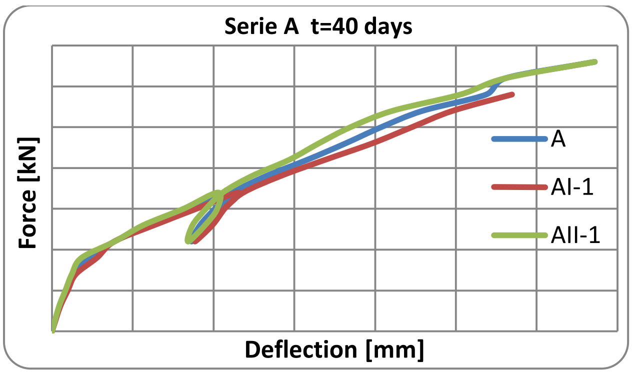

Chart 3 Comparison of deflection diagrams series A t = 40 days [1]

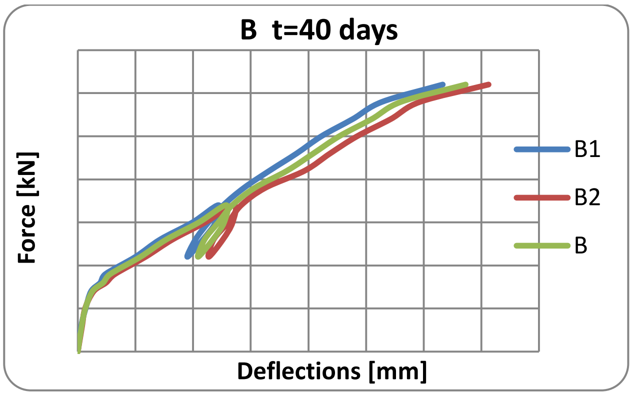

Chart 4 Comparison of deflection diagrams series B t = 40 days [1]

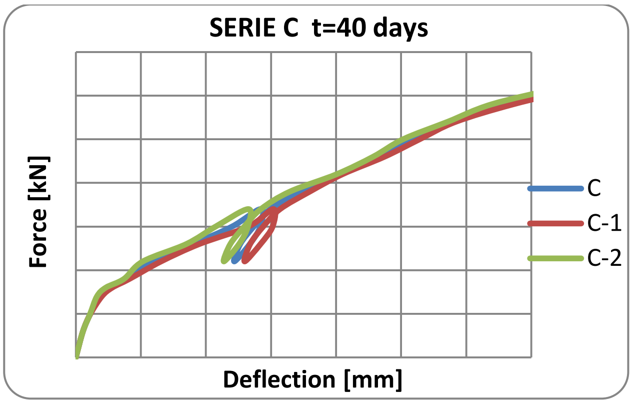

Chart 5 Comparison of deflection diagrams series C t = 40 days [1]

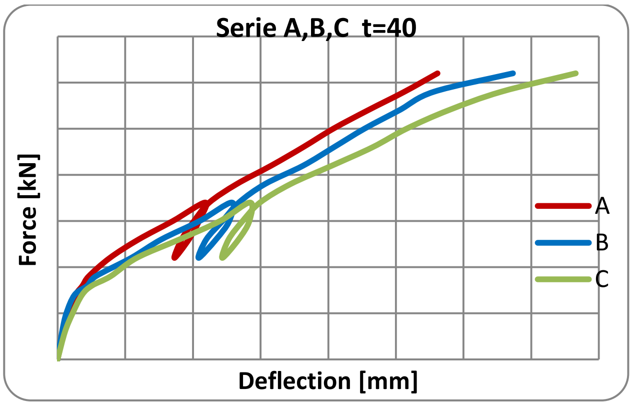

Chart 6 Comparison of deflection diagrams series A, B, C t = 40 days [1]

Table 1 Comparison of deflections results for the beams of series A, B, C for t=40days

Deflections Series A,B,C t=40 days						
Force	**A**	**B**	**C**	**A-B**	**A-C**	**B-C**
8	0.74	0.88	1.02	15.91	27.45	13.73
17	4.37	5.15	5.69	15.16	23.22	9.5
23	7.26	8.17	9.32	11.14	22.06	12.29
Differ on %				**14.07**	**24.24**	**11.84**

Conclusions

Based on the presented results, analyzing and comparison the conclusions are:

- Self-compacting concrete is much pliable and is more suitable for pumping.
- Self-compacted concrete has a smaller elasticity module of 4.5% for the duration of t=40 days.
- With little difference, the observed between the beams of series A and the difference between B is averaged 14% while it is 24% for those of C series.
- The largest values of deflections were found on the beams of C series and the difference between B series is for 14% .

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