UBT International Conference | 2012 UBT International Conference

Nov 2nd, 9:00 AM - Nov 3rd, 5:00 PM

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

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EXPERIMENTAL COMPARISON OF DEFLECTION RESULTS FOR BEAMS OF SELF-COMPACTED CONCRETE (SCC) AND CONVENTIONAL CONCRETE FOR PERIOD t= 40 DAYS

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Abstract. *Concrete is a material which has wide usage in engineering especially in construction engineering and road infrastructure facilities.*
Development trends for high rise constructions, modern skyscrapers indicate that building such constructions with normal concretes and low consistency is impossible, therefore there is a need for concrete with high processes because of great amount of steel in cross section of concrete elements, solution for such construction is self-compacted concrete because of ability to fill pores without compaction and vibration. Considering this fact, researches for deflections, mechanical characteristics of concrete and deformations 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, deformations, modulus of elasticity, etc.*

Forward

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.

Principles used in experimental research

The Reality Principle

The simulation of the actual problem has proved to be the key principle in making the experimental program (software application).
The adaptability of geometry of testing elements and its cementing has been adapted to accurately describe processes in the concrete production technology.

The principle of alikeness

The testing samples are prepared from the same material. The cementing process, sample gathering and its maintenance is carried out under exactly same conditions and circumstances.

Sample testing is carried out under same weather conditions and using same tools.

The principle of results discussion

In order to obtain as much accurate research results as possible, same number of testing samples for both conventional and self-compacted concrete has been used.

The principle of experimental inheritance

This experimental research is a continuity of a series of researches conducted previously which were implemented with different institutions worldwide including here Kosovo as well. The research in question is a continuity of our research attempts on self-compacted concrete.

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)

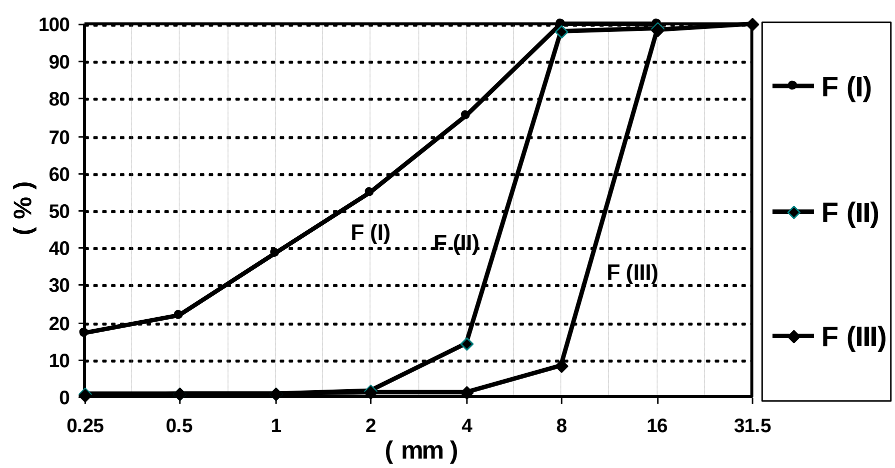
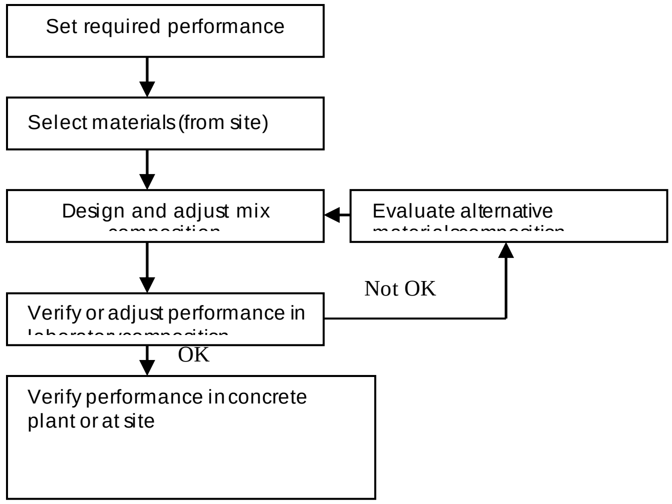


Fig. 1 Sieve curve of aggregate

The execution algorithm of mix design



MIXED DESIGN OF CONVENTIONAL CONCRETE AND SELF-COMPACTED CONCRETE

MIX DESIGN OF CONVENTIONAL CONCRETE	MIX DESIGN OF SELF-COMPACTING CONCRETE
Fraction (0-4)	Fraction (0-4)
Fraction (4-8)	Fraction (4-8)
Fraction (8-16)	Fraction (8-16)
Cement	Stone powder
Water	Cement
	Ujë
	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 Fig.2 below:

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. The following are the results obtained:

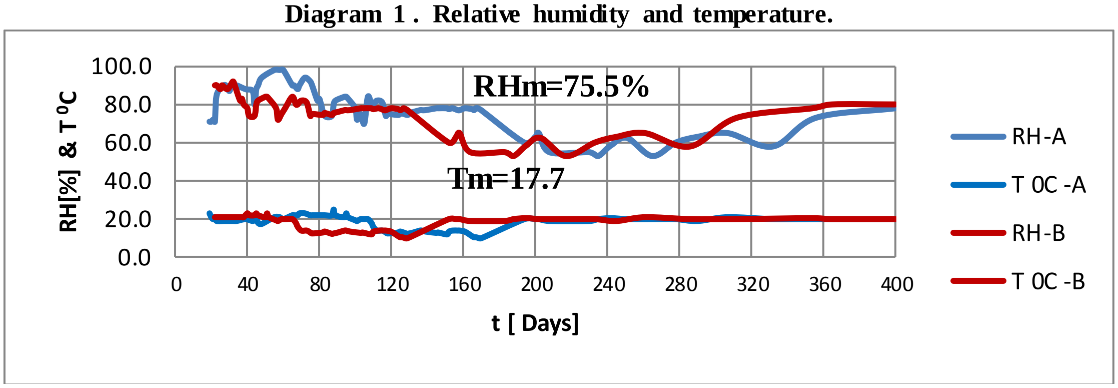
- J ring   h=7.5cm, d=57cm
- V funnel t_1=8.1s, t_2=9.48s
- U box   h=40mm

The obtained temperatures for both concretes were respectively: 23^0 C for conventional concrete versus 25^0C 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

Diagram 1 . Relative humidity and temperature.

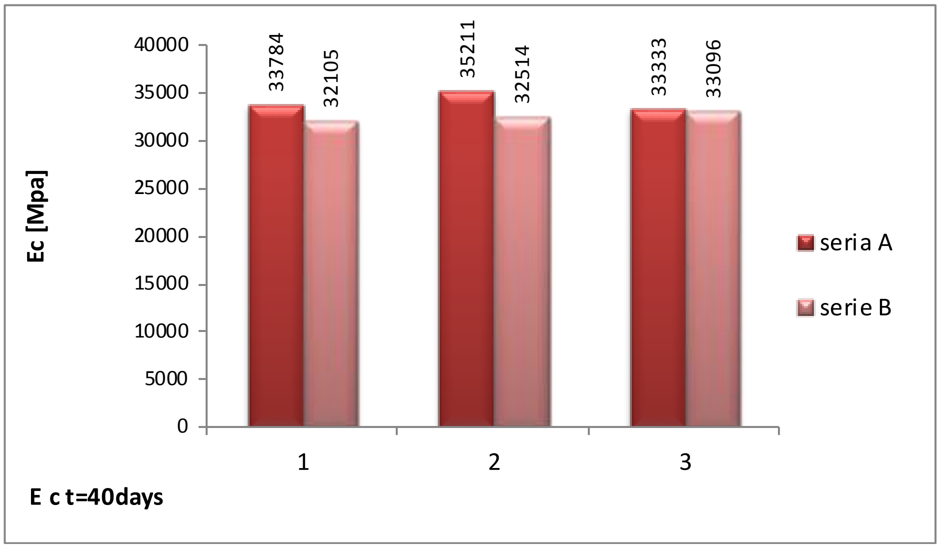


Testing the elasticity module ASTM C 469

Fig 4 below shows the equipment for testing the elasticity module whereas Diagram 2 lists the testing results.

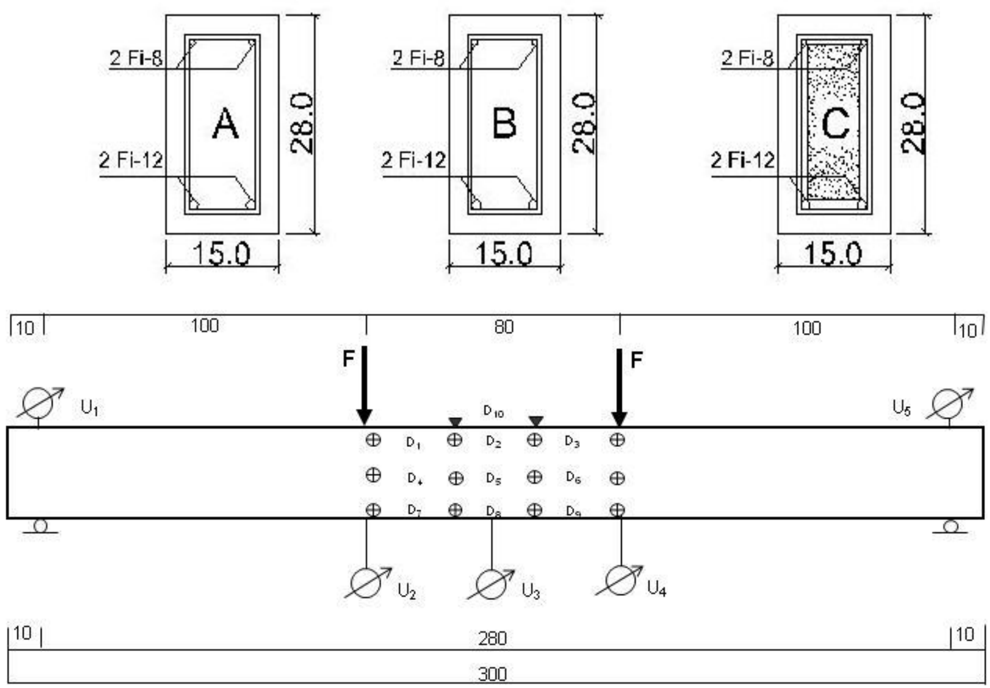
Fig. 4 Testing of Modulus of elasticity

Diagram 2 Testing results of Modulus of elasticity



STATIC SCHEME AND INSTALLATION SCHEME (OF DEFLECTOMETERS) ON BEAMS

The static scheme is basically a simple beam charged with two concentrated forces. The cross-section dimensions of beams were 15x28 cm, their length of 3m, reinforced with two fi-12 rebar's on the lower zone (static reinforcement) and other two fi-8 rebar's on the upper zone (constructive reinforcement) as descript on the figure below. Fig. 5 shows the cross-section of beams for all three series and the schematic presentation of the installation of deflection-meters.



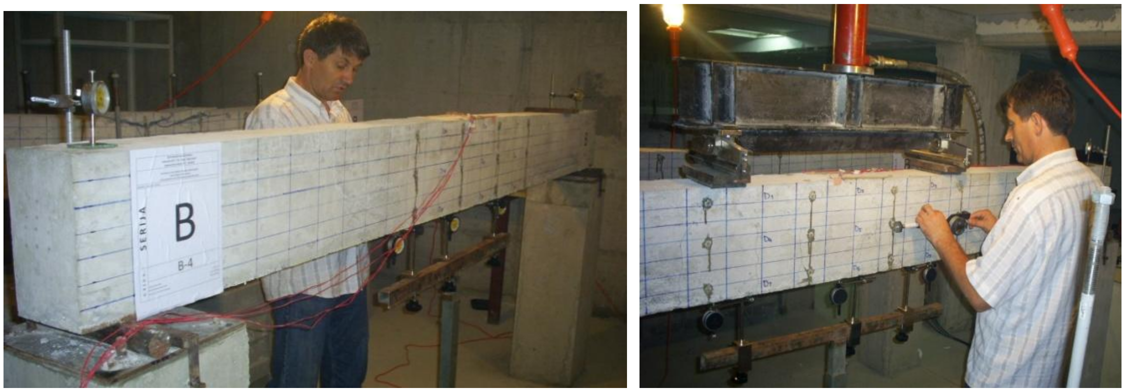
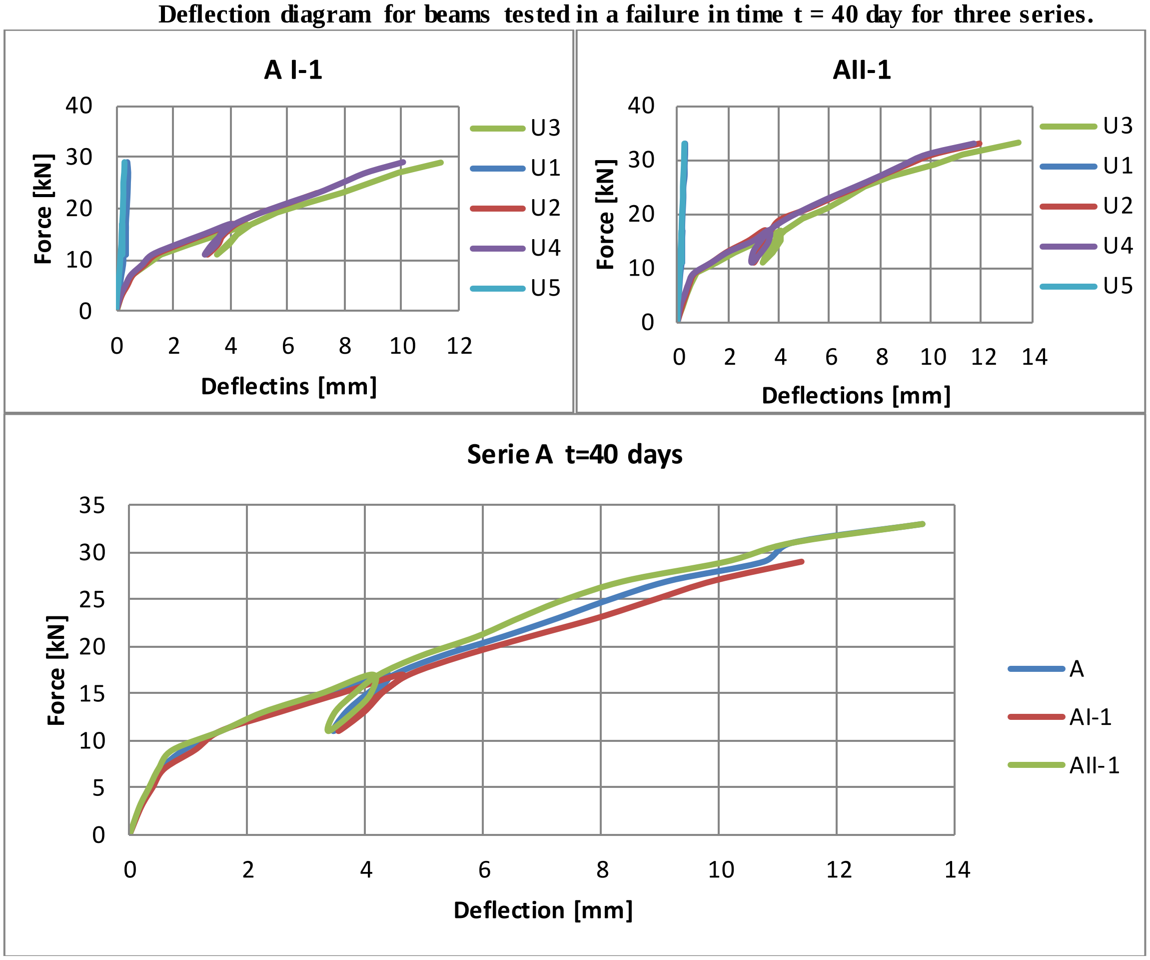


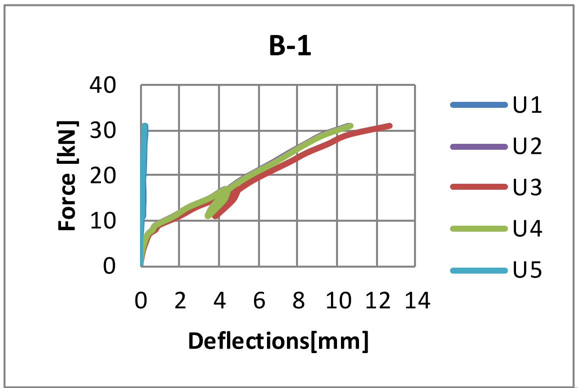
Fig. 5 Testing of beam in failure for t = 40 days

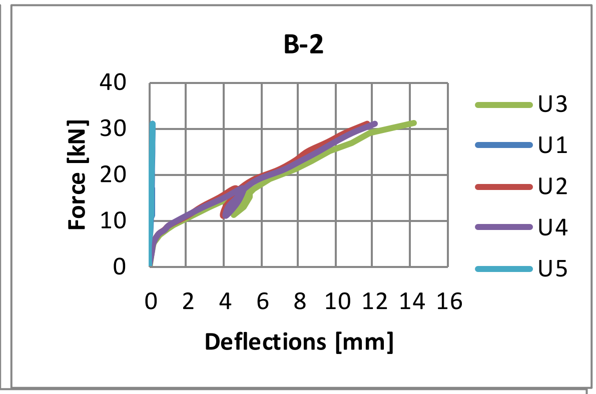
BEAM TESTING RESULTS

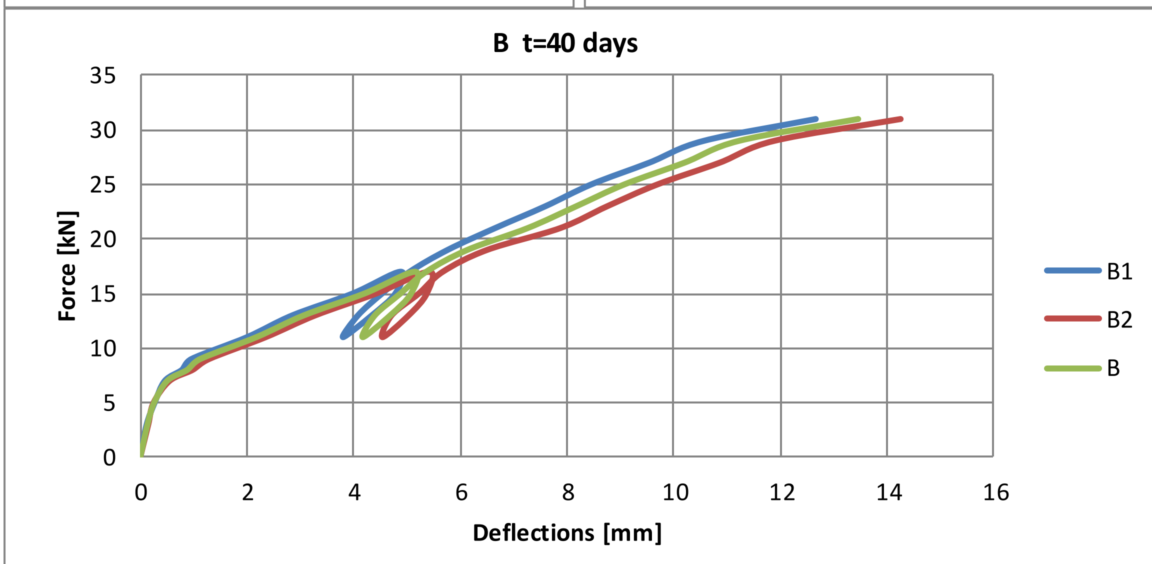
Diagrams A I-1, A II-1, series A, B-1, B-2, series B, C-1, C-2, series C represent the results of beams immersion during testing for all three series of beams. The comparisons of immersion results between different beams of series A, B and C is graphically presented using diagrams for series A, B and C.

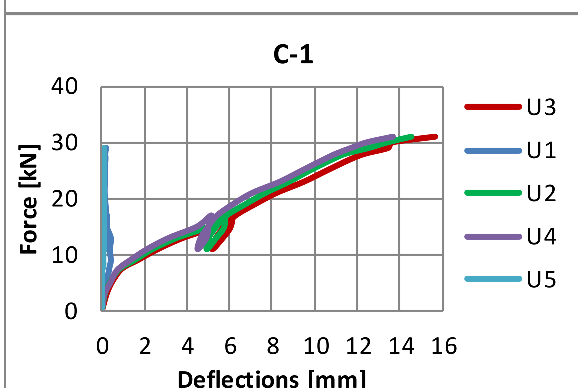
Deflection diagram for beams tested in a failure in time t = 40 day for three series.

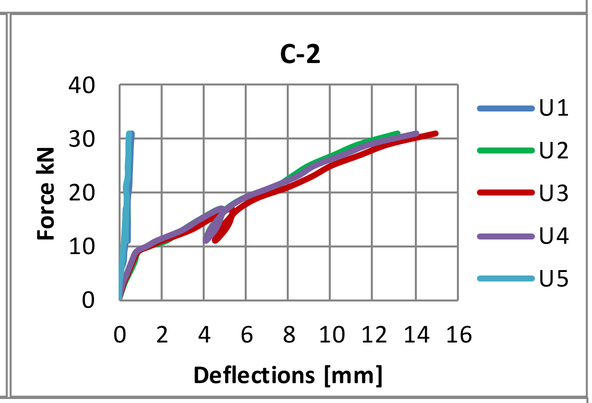


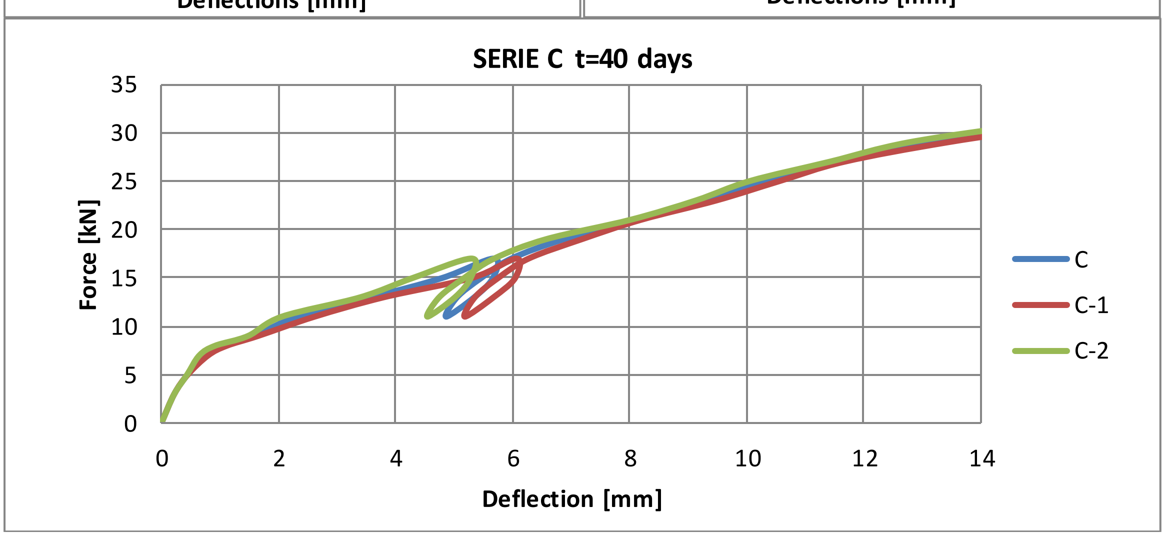

B-1
Force [kN]
Deflections[mm]
U1
U2
U3
U4
U5


B-2
Force [kN]
Deflections [mm]
U3
U1
U2
U4
U5

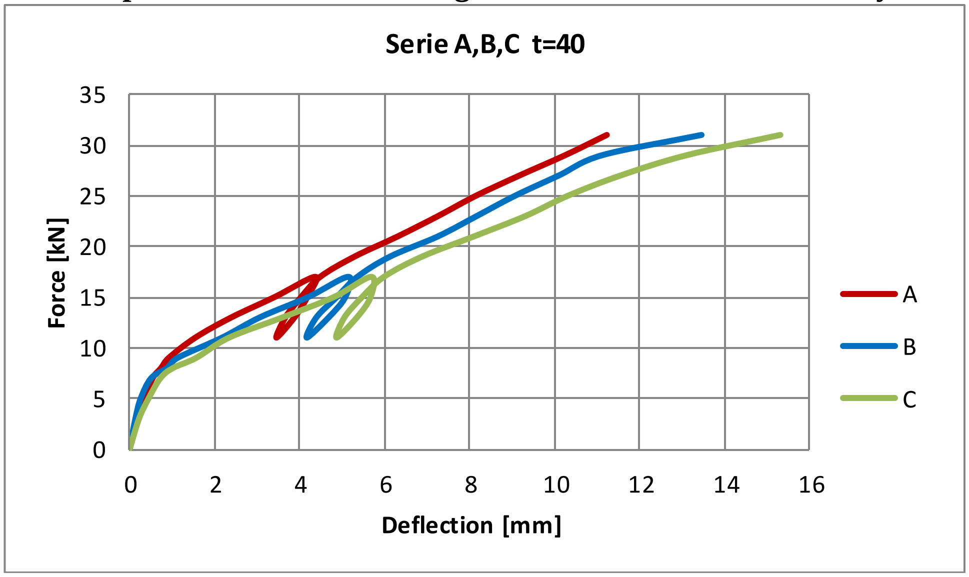

B t=40 days
Force [kN]
Deflections [mm]
B1
B2
B


C-1
Force [kN]
Deflections [mm]
U3
U1
U2
U4
U5


C-2
Force kN
Deflections [mm]
U1
U2
U3
U4
U5


SERIE C t=40 days
Force [kN]
Deflection [mm]
C
C-1
C-2

Comparison of deflection diagrams series A, B, C t = 40 days



CONCLUSIONS

Based on the obtained results, the following conclusions can be drawn:

- **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 B averaged 10% and this value is the approximate difference of results of the elasticity module.**

- **The largest values of deflections were found on the beams of C series and the difference between A series is for 25% while it is 15% for those of B series.**

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