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**EXTENDED ABSTRACT**

# The Effect of Change in Composition Ratios on the Robustness of Self-Consolidating Concrete

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## 1. Introduction

The mix design of SCC may be achieved the better requirements of workability by using a targeted variation in mix proportion (Shi and Caijun, 2015). However, these changes lead to problems such as change in the robustness of SCC (Kwan and Ng, 2008). In other words, in order to the complete optimization of SCC mix proportion, the robustness of SCC must be considered in addition to the workability restrictions. Hence, the main objective of this study is the evaluation of the SCCs robustness self-consolidating concretes.

## 2. Methodology

### *2.1. Experimental study*

The evaluation and comparison of robustness of eight selected SCCs is the aim of this research. A control mix considered to be a "good" SCC was the initial target and, seven series of mixes with variations of each of the principal properties, i.e. filling ability, passing ability and segregation resistance, based on the following principles, were developed. In order to increase the filling ability of control mix ((SP) and F (W+SP)), while the ratio of cement to powder was decreased and the SP dosage was increased, the aggregate ratio has been remained constant. In order to decrease the passing ability (P), while the composition of mortar was kept invariable, the volume of coarse aggregate was increased and slight decrease in SP dosage was subjected. To design of modified segregation concrete base on the control mix proportion, the volume of paste was decreased and the amount of water and SP dosage was increased moderately (S(C+L), S (L)).

In order to evaluate the robustness of each mixture, in addition to the reference mixture, four batches were made that the water content of each batch is changed ±3 and ±6% relative to the base water content. Then workability of each batch were measured based on different fresh SCC tests.

## 3. Results and discussion

### *3.1. Effect of slight change in water in fresh tests*

In results of slight change of water content in slump flow test indicate that increase in water content lead to increase in slump flow test. This increase is variable in different SCCs and the SCC with lower paste volume has been had the maximum changes. The results of J ring test show that 6% increase in water content (based on the exact water of mixture) of concrete with lower paste volume and also concrete with higher coarse

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aggregate cause to increase in J ring test higher than 10 mm therefore these SCCs couldn't tolerate 6% increase in water content.

The maximum influence of water change has created in segregation resistance of SCCs. 6% increase in water content cause to pass of sieve stability test of six SCCs from 20%. Therefore these concretes couldn't tolerate 6% increase in water content (Fig 1).

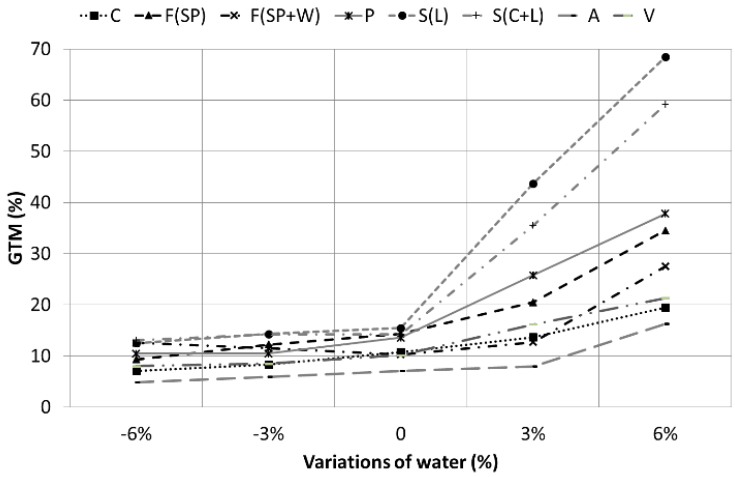


**Fig. 1.** Variation of Sieve stability test due to slight change of water content

### *3.2. Robustness Ranking*

Since, several tests are required to show the fresh properties of SCCs and variations in any of these tests is not systematic, the comparison of individual tests is not useful for comparing the robustness of SCCs. To achieve this purpose, it is required to methods that are considered simultaneously changes in all tests. Hence, in order to compare the robustness of SCCs, the coefficient of variation method are used (Table 1).

**Table 1.** Robustness ranking of SCCs based on the coefficient of variation method

| Concrete | Sub- ranking of fresh concrete tests | | | | | | | SUM | Robustness Ranking |
|---|---|---|---|---|---|---|---|---|---|
| | SF | $T_{50}$ | $V_0$ | $V_5$ | J $ring_{\Delta}$ | J $ring_s$ | GTM | | |
| C | 4 | 7 | 1 | 1 | 3 | 5 | 1 | 22 | 1 |
| V | 2 | 8 | 6 | 2 | 2 | 3 | 2 | 25 | 2 |
| P | 6 | 3 | 4 | 6 | 1 | 1 | 5 | 26 | 3 |
| A | 1 | 5 | 7 | 5 | 5 | 2 | 4 | 29 | 4 |
| F(SP+W) | 3 | 1 | 8 | 4 | 6 | 4 | 3 | 29 | 5 |
| F(SP) | 5 | 2 | 3 | 3 | 7 | 6 | 6 | 32 | 6 |
| S(C+L) | 7 | 6 | 2 | 7 | 4 | 7 | 7 | 40 | 6 |
| S(L) | 8 | 4 | 5 | 8 | 8 | 8 | 8 | 49 | 7 |

## 4. Conclusions

Since, several tests are required to show the fresh properties of SCCs and variations in any of these tests is not systematic, the comparison of changes of individual tests is not useful for comparing the robustness of SCCs. To achieve this purpose, it is required to employ analysis methods that consider changes in all tests simultaneously. Therefore, in this research based on the proposed method by Naji et.al, the coefficient of variation was used. The results of this method indicate that decrease in paste volume of SCC cause to the most decrease in robustness.

## 5. References

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