Strength and Durability Test on Partial Replacement of Cement by Glass Powder in Self-Compacting Concrete

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Abstract
Self-compacting solid that can stream under its own weight and complete the shape work, even within the sight of thick support, without requiring any vibration while saving homogeneity. SCC can likewise be utilized in circumstances where mechanical compaction for new cement is troublesome or difficult to utilize, for example, submerged cementing, projecting in-situ heap establishments, machine bases and sections or dividers with clogged fortification. The piece of SCC is like that of ordinary cement but to accomplish self-stream admixtures, for example, fly debris, glass filler, calcareous powder. The various properties of the materials in the exploratory program were resolved. Glass Powders qualities and the benefits of utilizing them with concrete were examined. An exhaustive investigation on glass powder concrete was likewise directed. Concrete will be supplanted by 5 percent, 10 percent, 15 percent, 20 percent, 25 percent, concrete weight. The solid shapes, chambers and crystals were projected 150x150x150 mm, 150 mm x 300mmhigh, 700x150x150 mm. Utilizing swamp cone test, super plasticizer will be included for improved usefulness and ideal measurements was determined. Distinctive quality and continuance tests will be performed.

I. Self-Compacting Concrete
Self-compacting concrete (SCC) speaks to one of many years of significant advancements in solid innovation. Insufficient cast solid homogeneity because of helpless compaction or isolation can drastically bring down in-situ develop solid yield. SCC was intended to guarantee adequate compaction and advance the situation of cement in blocked fortification and limited territories.

SCC was first implicit late 1980s in Japan, fundamentally for profoundly blocked fortified structures in seismic locales (Bouzoubaa and Lachemi, 2001). As the solidness of solid structures turned into a significant issue in Japan, proficient research facility compaction was important to acquire enduring solid structures. This necessity prompted SCC’s creation and was first recorded in 1989 (Okamura and Ouchi, 1999).

SCC can be characterized as a superior material that streams under its own load without requiring vibrators to accomplish combination by complete formwork filling, regardless of whether access is blocked by restricted holes between fortification bars (Zhu et al., 2001). SCC may likewise be utilized in conditions where mechanical compaction for new concrete, for example, submerged cementing, projecting in-situ heap establishments, machine bases and sections or clogged strengthening dividers, is troublesome or incomprehensible. SCC’s high flow ability permits filling the formwork without vibration (Khayat et al., 2004). Since its origination, it has been normally utilized in Japan's enormous scope development (Okamura, 2003). This solid has as of late increased wide use in numerous nations for different applications and auxiliary setups (Bouzoubaa and Lachemi, 2001).

It can likewise be considered “the most inventive advancement in solid structure for quite a long time.” Originally made to counter an expanding deficiency of gifted work, it is currently embraced in European nations with energy for both site and precast solid work. It has demonstrated financially worthwhile as a result of the accompanying components (Krieg, 2003 and ENFARC, 2002):

- Faster construction
- Reduction in site manpower
- Easier placing
- Uniform and complete consolidation
- Better surface finishes
- Improved durability
Increased bond strength
Freedom indesign
Reduced noise levels, due to absence of vibration
Safe working environment

The method of self-compact capability requires not only high paste or mortar deformability, but also resistance to segregation between coarse aggregate and mortar as concrete flows through the confined area of reinforcing bars (Okamura and Ouchi, 2003). SCC’s homogeneity is its capacity to stay unsegregated during transport and placement. High flow and high SCC segregation resistance are obtained by:

- A larger quantity of fine particles, i.e., a limited coarse aggregate content.
- A low water/powder ratio, (powder is defined as cement plus the filler such as fly ash, silica fume etc.) and
- The use of super plasticizer.

In view of the expansion of a high amount of fine particles, SCC’s inner material structure gives some closeness to superior cement with new stage self-similarity, no underlying beginning phase deformities, and post-solidifying outer security. In any case, because of the lower substance of coarse total, there is some worry that: (1) SCC may have a lower flexibility module, which may impact the disfigurement attributes of pre-focused on solid individuals, and (2) higher drag and shrinkage, influencing pre-stress misfortune and long haul diversion (Mata, 2004).

Self-compacting cement can be delivered with customary concretes and added substances. It mostly comprises of concrete, coarse and fine totals and filler, for example, fly debris or super-pozz, water, super plasticizer and stabilizer. SCC’s organization is indistinguishable from that of standard cement, but to accomplish self-stream admixtures, for example, fly debris, glass filler, calcareous powder, silica seethe, Super-pozz, and so on. Since Super-pozz is another developing admixture and a profoundly receptive alumino – silicate pozzolanic content, its fineness and circular molecule structure improve SCC’s usefulness. It very well may be utilized as a reasonable in SCC admixture.

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**Powdered Glass**

![Powdered glass](image)

Clear glass powder produced using leaded gem glass and ground into fine powder can be utilized in all media to help hues or produce textural consequences for painting surfaces. Hued and straightforward glass powder can be utilized in all media including oil, acrylic scatterings, lime and pastes of different types. This glass powder was produced using clear glass squander. It was grounded and afterward went through the 0.6 mm (N ° 30) sifter, where over 95% went through the 0.25 mm (N ° 60) strainer. Physical and mechanical estimations gave a fundamental thickness estimation of 2,500 kg/m3 and 2,850 cm2/g for the particular surface zone; the soaked grinding edge estimation of the dry inside point extended between 24 ° and 26 ° and 18 ° to 20 °. The substance organization examination gave the measure of CaO and Na2O an estimation of 65% by weight of SiO2 and 15%. An extra test indicated a zero and incentive for the assimilation rate and an incredible fine activity that made a 60-cm segment for a 3-3-cm section.
II. Literature Review

J.m. J.m. Khatib, Like fly debris on the properties of self-compacting concrete is researched. Portland concrete was incompletely supplanted by 0-80% FA. The water to cover proportion was held at 0.36 for all blends. Properties included functionality, compressive quality, ultrasonic heartbeat speed, assimilation and shrinkage. Discoveries propose that high volume of FA can be utilized in SCC to accomplish high quality and low shrinkage.

Zoranjure, Goradana An., analyzed the conceivable utilization of coarse reused total acquired from squashed cement to create self-compacting concrete. Then again, the issue of garbage removal destinations delivered by destruction of old structures is settled. In the investigation, three sorts of solid blends were made, where the substitution of coarse total by reused total was 0 percent, 50% and 100%. In the blending stage, similar nature of all solid blends was accomplished.

Testing Methods for SCC

The rule for assessing new self-compacting concrete has not yet been normalized. As of recently, no single methodology or mix of strategies has gotten widespread acknowledgment and most have their followers. Lately, the consistent mission for more appropriate field test strategies has prompted the rise of barely any scientific techniques. The filling capacity, passing capacity and protection from isolation are SCC’s recognized properties that are not regular to customary cement and hence SCC tests are performed by extraordinary tests. Utilizing the wide viable experience of all individuals from the European alliance with SCC, EFNARC drew up prerequisites and rules for checking the SCC and furthermore characterized limit esteems for accepting SCC. It likewise offers a structure for creating and utilizing excellent SCC.

III. Workability Test Results

| Mix   | Slump flow | L-Box | J-Box |
|-------|------------|-------|-------|
| SCC   | 695        | 0.82  | 9.8   |
| CG 1% | 680        | 0.84  | 10.1  |
| CG 2% | 710        | 0.89  | 10.2  |
| CG 3% | 740        | 0.92  | 10.7  |
| CG 4% | 715        | 0.88  | 10.5  |
| CG 5% | 690        | 0.85  | 10.4  |

Hardened Concrete Properties and Test Results

| Mix   | % of Glass | Spe I | Spe II | Spe III | Avg. |
|-------|------------|-------|--------|---------|------|
| SCC   | 0          | 22.22 | 21.77  | 22.44   | 22.14|
| SCC1  | 1          | 29.3  | 29.68  | 29.06   | 29.35|
| SCC2  | 2          | 29.5  | 29.78  | 29.86   | 29.71|
| SCC3  | 3          | 37.33 | 37.24  | 37.57   | 37.38|
| SCC4  | 4          | 32.89 | 33.16  | 33.33   | 33.13|
| SCC5  | 5          | 31.11 | 31.29  | 30.84   | 31.08|
Compressive strength of cube at 14 days

| Mix | % of Glass | Spe I  | Spe II | Spe III | Avg  |
|-----|------------|--------|--------|---------|------|
| SCC | 0          | 29.55  | 29.7   | 30/04   | 29.7 |
| SCC1| 1          | 31.1   | 31.28  | 30/60   | 30.9 |
| SCC2| 2          | 31.56  | 31.91  | 32      | 31.8 |
| SCC3| 3          | 39.56  | 40.0   | 40.18   | 39.9 |
| SCC4| 4          | 37.33  | 37.2   | 37.42   | 37.3 |
| SCC5| 5          | 35.56  | 35.61  | 35.20   | 35.3 |

Compressive strength of cube at days

| Mix | % of Glass | Spe I  | Spe II | Spe III | Avg  |
|-----|------------|--------|--------|---------|------|
| SCC | 0          | 39.5   | 36     | 34.9    | 35.47|
| SCC1| 1          | 33.77  | 33.42  | 33.51   | 33.57|
| SCC2| 2          | 33.86  | 34.04  | 34.13   | 34.01|
| SCC3| 3          | 42.67  | 42.4   | 42.04   | 42.37|
| SCC4| 4          | 40.44  | 40.71  | 41.16   | 40.77|
| SCC5| 5          | 39.56  | 39.2   | 39.29   | 39.35|

IV. Discussion

The compressive quality trial of self-compacting concrete is led in various rates with the expansion of glass filaments. Tests were directed at 7 days, 14 days, and 28 days. It is discovered that the compressive quality expanded up to 16.28% with 3% of glass filaments.

Split tensile strength of cylinder at 7 days

| Mix | % of Glass | Spe I  | Spe II | Spe III | Avg  |
|-----|------------|--------|--------|---------|------|
| SCC | 0          | 0.63   | 0.70   | 0.75    | 0.69 |
| SCC1| 1          | 0.54   | 0.55   | 0.58    | 0.56 |
| SCC2| 2          | 0.59   | 0.59   | 0.61    | 0.60 |
| SCC3| 3          | 0.78   | 0.81   | 0.87    | 0.82 |
| SCC4| 4          | 0.74   | 0.72   | 0.78    | 0.74 |
| SCC5| 5          | 0.69   | 0.65   | 0.64    | 0.64 |

Split tensile strength of cylinder at 14 days

| Mix | % of Glass | Spe I  | Spe II | Spe III | Avg  |
|-----|------------|--------|--------|---------|------|
| SCC | 0          | 0.91   | 0.99   | 0.97    | 0.96 |
| SCC1| 1          | 0.87   | 0.84   | 0.91    | 0.87 |
| SCC2| 2          | 0.93   | 0.96   | 0.99    | 0.96 |
| SCC3| 3          | 1.27   | 1.21   | 1.20    | 1.23 |
| SCC4| 4          | 1.20   | 1.24   | 1.22    | 1.22 |
| SCC5| 5          | 1.13   | 1.08   | 1.11    | 1.11 |

Split tensile strength of cylinder at 28 days

| Mix | % of Glass | Spe I  | Spe II | Spe III | Avg  |
|-----|------------|--------|--------|---------|------|
| SCC | 0          | 1.48   | 1.51   | 1.54    | 1.51 |
| SCC1| 1          | 1.41   | 1.34   | 1.39    | 1.38 |
| SCC2| 2          | 1.49   | 1.50   | 1.53    | 1.51 |
| SCC3| 3          | 1.70   | 1.78   | 1.75    | 1.74 |
| SCC4| 4          | 1.63   | 1.61   | 1.66    | 1.63 |
| SCC5| 5          | 1.54   | 1.57   | 1.59    | 1.56 |

V. Discussion

In this examination, oneself compacting solid split rigidity test is performed by embeddings glass filaments in various rates. Tests were directed at 7 days, 14 days, and 28 days. The split elasticity expanded to 13.21 percent at 28 days with 3 percent of glass filaments.
| Mix  | % of Glass | Spe I | Spe II | Spe III | Avg.  |
|------|------------|-------|--------|---------|------|
| SCC  | 0          | 5.77  | 5.33   | 5.11    | 5.40 |
| SCC1 | 1          | 5.56  | 5.56   | 5.33    | 5.48 |
| SCC2 | 2          | 6.67  | 6.22   | 6.01    | 6.30 |
| SCC3 | 3          | 7.78  | 7.56   | 7.61    | 7.63 |
| SCC4 | 4          | 7.11  | 6.89   | 6.86    | 6.95 |
| SCC5 | 5          | 6.67  | 6.44   | 6.44    | 6.52 |

### Policy Debate

In this investigation, the self-compacting concrete flexural strength test is conducted by incorporating glass fibres in different percentages. The 28-day experiments were conducted. The flexural intensity increased to 41.29 percent at 28 days with 3 percent of glass fibres.

### VI. Conclusion

The following conclusions were drawn in this experimental analysis on self-compacting concrete using crushed fibres. The overall compressive strength of 42.37 N/mm² was obtained by adding fibres 3 percent of concrete, the percentage increase of the compressive strength over concrete. The overall split tensile strength of 1.51 N/mm² was obtained by adding fibres 3% of concrete, the percentage increase of the split tensile strength over the reference concrete is 13.21%. The overall flexural strength of 7.63 N/mm² was obtained by adding fibres 3% of concrete, the percentage of flexural strength improvement over reference concrete is 41.29%. The difficulties found in this project are rapid initial concrete setting due to the super plasticizer-based Poly Carboxylic Ether (PCE). Testing the impact of super plasticizer dosage on Marsh cone. To reducing result although rising percentage of super plasticizer. Because of the fly ash land, the effect would be a decrease compared to the initial level. Inserting VMA Glenium stream -2 (.1%) gives precise workability.

### VII. References

1. Jin Tao, Yong Yuan and Luc Taerwe, Compressive Strength of Self Compacting Concrete during High Temperature Exposure ASCE
2. M.A Hossain and M.Lachemi, Bond Behaviour of SCC with Mineral and Chemical Admixtures Cement and Concrete Research
3. Sudharsan, N, & Saravanaganesh, S. (2019). Feasibility studies on waste glass powder. International Journal of Innovative Technology and Exploring Engineering, 8(8), 1644–1647.
4. M. Valcuende and C. Parra – Natural Carbonation of Self Compacting Concrete Construction and Building Materials
5. Philippe Turczy, Ahmed and Khalil, Cracking Tendency of Self Compacting Concrete Subjected to Restrained Shrinkage ASCE
6. Young Hoon Kim and Mary Beth, LlShear Characteristics and Design for High Strength Self Compacting Concrete – ASCE
7. J, M Khatib – Performance of Self Compact Concrete containing Flyash Construction and Building Materials
8. Vidhya, K., & Kandasamy, S. (2013). Study on properties of bricks manufactured using fly ash and pond ash. Pollution Research, 32(2), 405–409.
9. Sudharsan, N., & Palanisamy, T. (2018). A comprehensive study on potential use of waste materials in brick for sustainable development. Ecology, Environment and Conservation, 24, S339–S343.
10. Vidhya, K., & Kandasamy, S. (2014). Study on the flexural strength of coal ash brick masonry wall elements. Journal of Structural Engineering (India), 41(4), 410–419.
11. Sudharsan, N & Sivalingam, K. (2019). Potential utilization of waste material for sustainable development in construction industry. International Journal of Recent Technology and Engineering, 8(3), 3435–3438.
12. Vidhya, K., & Kandasamy, S. (2016). Experimental Investigations on the Properties of Coal-Ash Brick Units as Green Building Materials. International Journal of Coal Preparation and Utilization, 36(6), 318–325.
13. N. Sudharsan, T. Palanisamy, S. C. Yaragal, (2018), Environmental sustainability of waste glass as a valuable construction material - A critical review. Ecology, Environment and Conservation, 24 pp. S331–S338.