# Experimental Study on Flexural Behaviour of Self Compacting Self Curing Concrete Beams

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***Abstract-*** **Main objective is to study, the effect of admixture (PEG 400) on self-compacting concrete in terms of compressive strength, split tensile strength and the flexural strength by varying the percentage of PEG by weight of cement from 0% to 2% and by normal curing method. The present study involves the use of shrinkage reducing admixture polyethylene glycol (PEG 400) in concrete which helps in self-curing and helps in better hydration and hence strength.**

**With the growing scale of the project conventional curing methods have proven to be costly affairs as there are many practical issues & they have been replaced by self-curing agents in inaccessible areas, vertical structures & water scarce areas. Scope of the study is to study the effect of PEG400 on self-curing, self-compaction concrete as an alternate for conventional water curing method.**

***Index terms-*** **Self compacting self-curing concrete, Polyethylene Glycol, compressive strength, split tensile strength.**

## I. INTRODUCTION

### SELF COMPACTING CONCRETE

Self-Compacted Concrete (SCC) is highly workable concrete with high strength and high performance that can flow under its own weight through restricted sections without segregation and bleeding. SCC is achieved by reducing the volume ratio of aggregate to cementitious material, increasing the paste volume and using various viscosity enhancing admixtures and super plasticizer. They are called High Range Water Reducers (HRWR) in American literature. It is the use of super plasticizer which has made it possible to use w/c as low as 0.25 or even lower and yet to make flowing concrete to obtain strength of the order 120 MPa or more. Building elements made of high strength concrete are usually densely reinforced. The lesser distance between reinforcing bars may lead to defects in concrete. If high strength concrete is self- compacting, the production of densely reinforced building elements from high strength concrete with high homogeneity would be an easy work

### CURING OF COCNRETE

Curing is the process of controlling the rate and extent of moisture loss from concrete during cement hydration. This can be achieved either by:

- Continuously wetting the exposed surface thereby preventing the loss of moisture from it.
- Ponding or spraying the surface with water.
- Covering the concrete with an impermeable membrane after the formwork has been removed
- By the application of a suitable chemical curing agent (wax etc.)
- Using chemicals for internal curing

### SELF CURING OF CONCRETE

The ACI-308 Code states that "internal curing refers to the process by which the hydration of cement occurs because of the availability of additional internal water that is not part of the mixing Water. "Conventionally, curing concrete means creating conditions such that water is not lost from the surface i.e., curing is taken to happen 'from the outside to inside'. In contrast, 'internal curing' is allowing for curing 'from the inside to outside' through the internal reservoirs (in the form of saturated lightweight fine aggregates, superabsorbent polymers, or saturated wood fibers) Created. 'Internal curing' is often also referred as 'Self–curing concrete'

## 2. METHODOLOGY

1 Casting of Specimens
2 Curing of Specimens
3 Testing of Specimens

4 Comprising of Test Results
5 Casting and curing of Beam Sample
6 Testing of Beam Sample
7 Preparation of Report

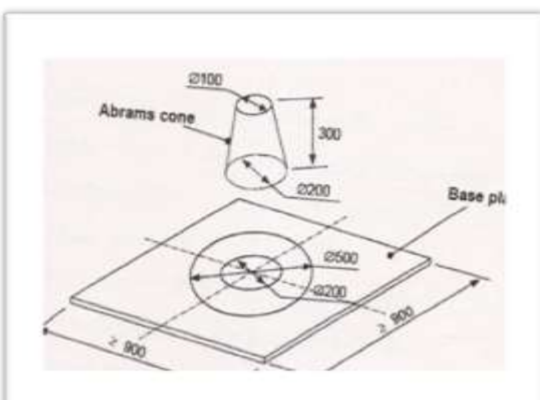
## 3. LIST OF TEST MEHODS FOR WORKABILITY PROPERTIES OF SCC

| Si. No | Methods | Property |
|---|---|---|
| 1 | Slump flows by Abrams cone | Filling ability |
| 2 | T50cm slump flow | Filling ability |
| 3 | J-ring | Passing ability |
| 4 | V-funnel | Filling ability |
| 5 | V-Funnel at T 5minutes | Segregation resistance |
| 6 | L-box | Passing ability |

ACCEPTANCE CRITERIA FOR SELF COMPACTING CONCRETE

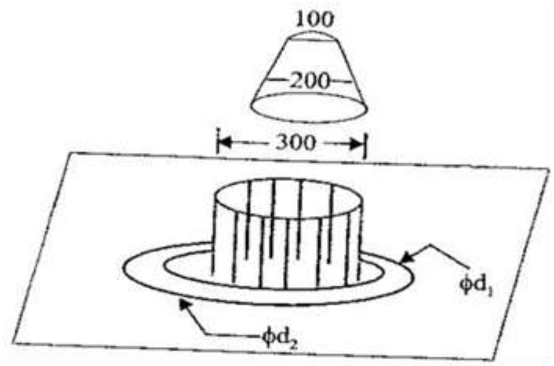
| S. No | Methods | Unit | Typical range of value | |
|---|---|---|---|---|
| | | | Mini | Max |
| 1 | Slump flows by Abrams cone | mm | 650 | 800 |
| 2 | T50cm slump flow | sec | 2 | 5 |
| 3 | J-ring | mm | 0 | 10 |
| 4 | V-Funnel | sec | 6 | 12 |
| 5 | V-funnel at T 5minutes | sec | 0 | +3 |
| 6 | L-box | (h2/h1) | 0.8 | 1.0 |

### 3.1 SUMP FLOW TEST AND T50CM TEST




RESULT: slump flow =700 mm; T 50 slump flow =4 sec

### 3.2 J-RING TEST




### 3.3 V-FUNNEL TEST AND V-FUNNEL TEST AT T5 MINUTES

RESULT: V- Funnel = 11 sec; T-5 minutes =14sec

3.4 TEST METHOD FOR L-BOX

RESULT: L-box = h2/h1
= 6.5/7.3
= 0.89

3.5 TEST RESULTS OF SCC WORKABILITY PROPERTIES

| Trail mix | Slump flow (mm) | T50 (sec) | V-funnel (sec) | V-funnel @ T5min | L-box | J-ring (mm) |
|---|---|---|---|---|---|---|
| T1 | 540 | 8 | 25 | 80sec | 0.4 | 18 |
| T2 | 560 | 6 | 20 | 60sec | 0.5 | 15 |
| T3 | 585 | 7 | 18 | 50sec | 0.5 | 12.5 |
| SCC-1 | 650 | 4 | 10 | 12sec | 0.7 | 9 |
| SCC2 | 680 | 2 | 8 | 10sec | 0.9 | 8 |
| SCC-3 | 685 | 3 | 10 | 10sec | 0.85 | 8 |

3.6 FINAL MIX PROPORTIONS FOR M30 GRADE

| CEMENT $kg/m^3$ | FLY ASH $kg/m^3$ | FINE AGG $kg/m^3$ | COARSE AGG. $kg/m^3$ | WATER (LITERS) | SP % | W/P Ratio % |
|---|---|---|---|---|---|---|
| 375 | 175 | 785 | 735 | 214.4 | 1.1 | 0.39 |

4. DETAILS OF SPECIMEN TO BE CASTED

| Specimen details | cube 7 days | 28days | cylinder 7days | 28days |
|---|---|---|---|---|
| 0% (PEG) | 3 | 3 | 3 | 3 |
| 0.5%(PEG) | 3 | 3 | 3 | 3 |
| 1.0%(PEG) | 3 | 3 | 3 | 3 |
| 1.5%(PEG) | 3 | 3 | 3 | 3 |
| 2.0%(PEG) | 3 | 3 | 3 | 3 |

5. DETAILS OF SPECIMENS FOR M30 GRADE OF CONCRETE (per m³)

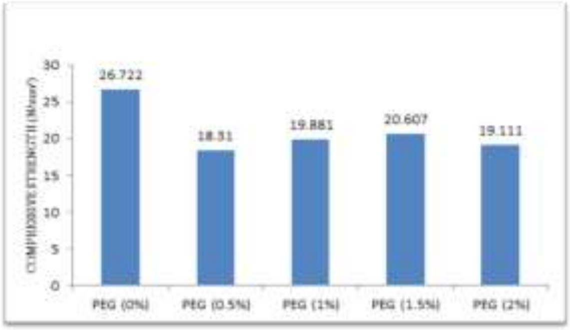
| Material | Speci men 1 | Speci men 2 | Speci men 3 | Speci men 4 | Speci men 5 |
|---|---|---|---|---|---|
| Cement Kg | 375 | 375 | 375 | 375 | 375 |
| Fly Ash kg | 175 | 175 | 175 | 175 | 175 |
| F. A (kg) | 785 | 785 | 785 | 785 | 785 |
| C.A ( kg) | 735 | 735 | 735 | 735 | 735 |
| W/C (lit) | 214.5 | 214.5 | 214.5 | 214.5 | 214.5 |
| S.P (%) | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% |
| PEG( %) | 0% | O.5% | 1% | 1.5% | 2.0% |

6. COMPRESSIVE STRENGTH TEST RESULTS

7 DAYS COMPRESSIVE STRENGTH TEST RESULTS

| SPECI MEN DETAI LS | WT. OF CUBE (kg) | ULT LOAD( KN) | COMP. STRENGTH( $N/mm^2$) | AVG COMP STRENGTH( $N/mm^2$) |
|---|---|---|---|---|
| PEG (0%) | 8.130 | 632 | 28.080 | 26.722 |
| | 8.200 | 622 | 27.644 | |
| | 8.125 | 550 | 24.444 | |
| PEG (0.5%) | 8.190 | 419 | 18.622 | 18.310 |
| | 8.475 | 364 | 17.066 | |
| | 8.733 | 433 | 19.244 | |
| PEG (1%) | 8.347 | 529 | 23.511 | 19.881 |
| | 8.577 | 428 | 19.022 | |
| | 8.202 | 385 | 17.111 | |
| PEG (1.5%) | 8.224 | 467 | 20.755 | 20.607 |
| | 8.302 | 411 | 18.266 | |
| | 8.570 | 513 | 22.800 | |
| PEG (2%) | 8.526 | 481 | 21.377 | 19.111 |
| | 8.154 | 311 | 13.822 | |
| | 8.217 | 498 | 22.133 | |

6.1 COMPARISION OF 7 DAYS COMPRESSIVE STRENGTH TEST

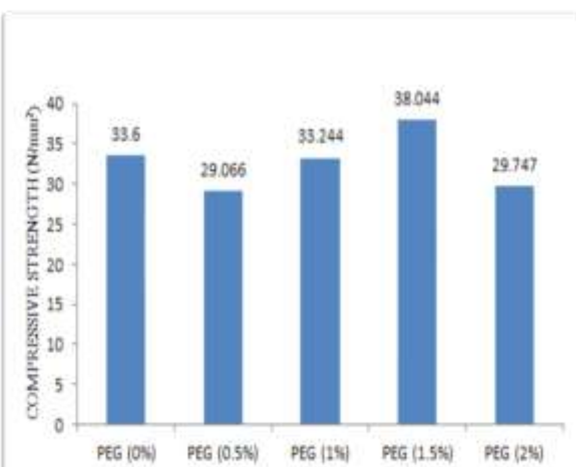



7. COMPRESSIVE STRENGTH TEST RESULT

28 DAYS COMPRESSIVE STRENGTH TEST RESULT

| SPECIMEN DETAILS | WT. OF CUBE (kg) | ULT LOAD (KN) | COMP. STRENGTH ($N/mm^2$) | AVG COMP STRENGTH ($N/mm^2$) |
|---|---|---|---|---|
| PEG (0%) | 8.202 | 761 | 33.822 | 34.029 |
| | 8.332 | 780 | 34.666 | |
| | 8.125 | 756 | 33.600 | |
| PEG (0.5%) | 8.170 | 650 | 28.889 | 29.066 |
| | 8.339 | 638 | 28.355 | |
| | 8.138 | 674 | 29.955 | |
| PEG (1%) | 8.361 | 769 | 34.177 | 33.244 |
| | 8.285 | 736 | 32.711 | |
| | 8.104 | 739 | 32.844 | |
| PEG (1.5%) | 8.323 | 832 | 36.977 | 38.044 |
| | 8.164 | 894 | 39.733 | |
| | 8.486 | 842 | 37.422 | |
| PEG (2%) | 8.258 | 665 | 29.555 | 29.747 |
| | 8.338 | 671 | 29.822 | |
| | 8.516 | 672 | 29.866 | |

7.1 COMPARISION OF 28 DAYS COMPRESIVE STRENGTH TEST

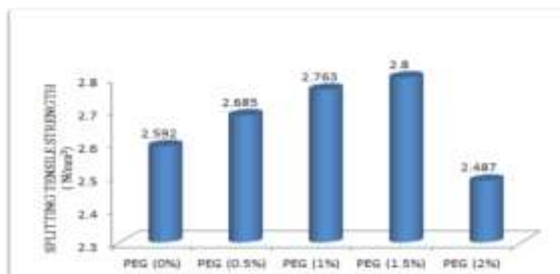



8. SPLIT TENSILE STRENGTH TEST RESULT

7 DAYS SPLITTING TENSILE TEST RESULT

| SPECIMEN DETAILS | WT. OF CUBE (kg) | ULT LOAD (KN) | COMP. ST. ($N/mm^2$) | AVG COMP STRENGTH ($N/mm^2$) |
|---|---|---|---|---|
| PEG (0%) | 12.164 | 192 | 2.716 | 2.592 |
| | 12.144 | 175 | 2.470 | |
| | 12.154 | 183 | 2.590 | |
| PEG (0.5%) | 11.986 | 192 | 2.716 | 2.685 |
| | 12.049 | 188 | 2.659 | |
| | 12.055 | 189 | 2.680 | |
| PEG (1%) | 12.210 | 211 | 2.985 | 2.763 |
| | 12.220 | 180 | 2.546 | |
| | 12.200 | 195 | 2.760 | |
| PEG (1.5%) | 11.900 | 204 | 2.886 | 2.800 |
| | 12.030 | 192 | 2.716 | |
| | 12.100 | 198 | 2.800 | |
| PEG (2%) | 12.102 | 177 | 2.510 | 2.487 |
| | 12.097 | 169 | 2.400 | |
| | 12.120 | 173 | 2.500 | |

8.1 COMPARISION OF 7 DAYS SPLITTING TENSILE TEST



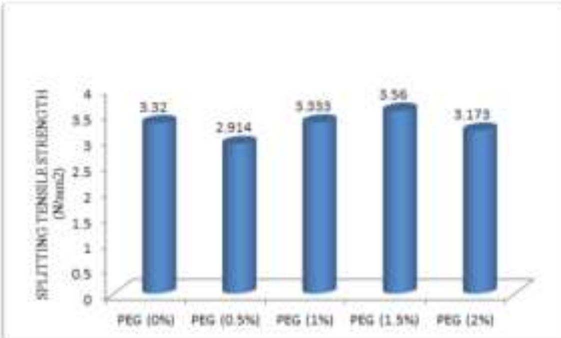

9. SPLIT TENSILE STRENGTH TEST RESULT

28 DAYS SPLITTING TENSILE STRENGTH TEST RESULT

| SPECIMEN DETAILS | WT. OF CUBE (kg) | ULT LOAD (KN) | COMP. ST. ($N/mm^2$) | AVG COMP STRENGTH ($N/mm^2$) |
|---|---|---|---|---|
| PEG (0%) | 12.074 | 240 | 3.395 | 3.320 |
| | 12.238 | 222 | 3.140 | |
| | 12.175 | 242 | 3.426 | |
| PEG (0.5%) | 11.770 | 203 | 2.876 | 2.914 |
| | 11.869 | 210 | 2.970 | |
| | 11.900 | 205 | 2.900 | |
| PEG (1%) | 11.966 | 232 | 3.282 | 3.333 |
| | 12.009 | 240 | 3.395 | |
| | 12.100 | 235 | 3.324 | |
| PEG (1.5%) | 12.067 | 254 | 3.593 | 3.560 |
| | 12.124 | 249 | 3.522 | |
| | 12.147 | 252 | 3.565 | |
| PEG (2%) | 12.235 | 222 | 3.140 | 3.173 |

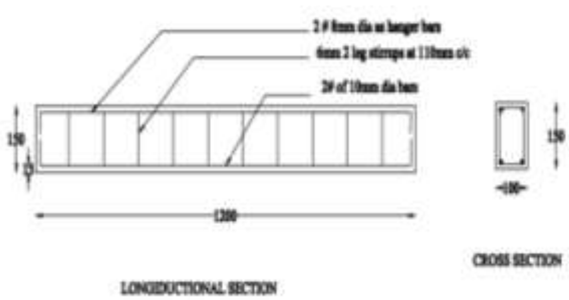
| | | | | |
|---|---|---|---|---|
| | 12.273 | 227 | 3.211 | |
| | 12.124 | 224 | 3.168 | |

9.1 COMPARISION OF 28 DAYS SPLIT TENSILE STRENGTH TEST




10. DESIGN OF BEAM

- SIZE OF THE BEAM : length = 1200 mm ; width = 100 mm ; depth = 150 mm
- MATERIALS : M - 30 grate concrete ; Fe - 415 HYSD bars
- REINFORCEMENT DETAILS: provide 2 bars 10 mm diameter as main bar , provide 2 bars 8 mm diameter as hanger bar , provide 6 mm diameter two legged stirrups @ 110 mm c/c.




11. DETAILS OF THE BEAM

| SPECIMEN DETAILS | BEAM 28 DAYS | DATE OF CASTING | DATE OF TESTING |
|---|---|---|---|
| 0% (PEG) | 2 | 4-2-2020 | 4-3-2020 |
| 1.5%(PEG) | 2 | 9-2-2020 | 9-2-2020 |

14. MIX PROPORTIONS FOR CASTING OF SPECIMEN

DETAILS OF SPECIMEN FOR M30 GRADE OF CONCRETE (per m³)

| MATERIALS | beam-1 | beam-2 |
|---|---|---|
| CEMENT (kg) | 375 | 375 |
| FLY ASH (kg) | 175 | 175 |
| F A (kg) | 785 | 785 |
| C A (kg) | 735 | 735 |
| WATER (lit) | 214.5 | 214.5 |
| S P (%) | 1.1 | 1.1 |
| PEG (%) | 0 | 1.5 |

CASTING OF SPECIMEN (BEFORE CASTING)

CASTING OF SPECIMEN (AFTER CASTING)

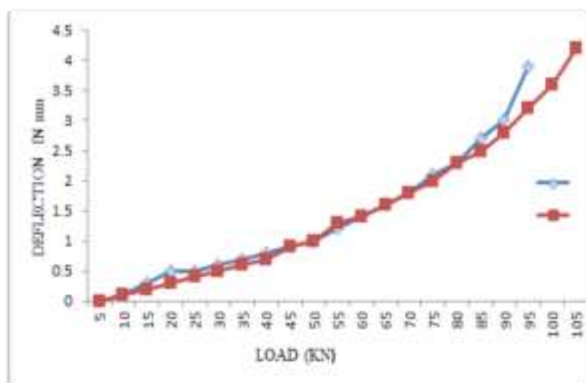
CURING OF SPECIMEN

TESTING SETUP

15. FLEXURAL STRENGTH TEST RESULTS

| S.NO | LOAD (KN) | DEFLECTION IN mm | |
|---|---|---|---|
| | | PEG (0%) | PEG(1.5%) |
| 1 | 5 | 0 | 0 |
| 2 | 10 | 0.1 | 0.1 |
| 3 | 15 | 0.3 | 0.2 |
| 4 | 20 | 0.5 | 0.3 |
| 5 | 25 | 0.5 | 0.4 |
| 6 | 30 | 0.6 | 0.5 |
| 7 | 35 | 0.7 | 0.6 |
| 8 | 40 | 0.8 | 0.7 |
| 9 | 45 | 0.9 | 0.9 |
| 10 | 50 | 1.0 | 1.0 |
| 11 | 55 | 1.2 | 1.3 |
| 12 | 60 | 1.4 | 1.4 |
| 13 | 65 | 1.6 | 1.6 |
| 14 | 70 | 1.8 | 1.8 |
| 15 | 75 | 2.1 | 2.0 |
| 16 | 80 | 2.3 | 2.3 |
| 17 | 85 | 2.7 | 2.5 |
| 18 | 90 | 3.0 | 2.8 |
| 19 | 95 | 3.9 | 3.2 |
| 20 | 100 | | 3.6 |
| 21 | 105 | | 4.2 |

16. LOAD DEFLECTION BEHAVIOUR OF THE BEAM



FAILURE OF SPECIMENS

## 17. CONCLUSION

The following conclusion was drawn from this study.

- Strength of the specimen with 1.5% of PEG400 increased when compared to the conventional specimen.
- From the 7 days compressive strength results the specimen with 1.5% of PEG400 increased with conventional specimen with 0.5% of PEG400 by 12.54%
- From the 7 days splitting tensile strength results the specimen with 1.5% of PEG400 increased with conventional specimen with 0.5% of PEG400 by 4.28%
- From the 28 days compressive strength results the specimen with 1.5% of PEG400 increased with conventional specimen with 0.5% of PEG400 by 30%
- From the 28 days splitting tensile strength results the specimen with 1.5% of PEG400 increased with conventional specimen with 0.5% of PEG400 by 22%
- The flexural behaviour of beam with 1.5% PEG performed well when compared to the specimen with 0% PEG.
- The ultimate load for beam specimen with 1.5% PEG was increased by 23.53% when compared with control specimen.
- The ultimate deflection of 1.5% PEG specimen was increased by 35.48% when compared to control specimen

## REFERENCES

[1] Prof. PamnaniNanak j, Dr. A.K. Verma, Dr. D.R. Bhatt darshana r (February 2014) “Self Curing Self Compacting Concrete: A Sustainable Avenue of Making Concrete” Journal of international academic research for multidisciplinary – Volume2, Issue 1, ISSN: 2320-5083, pp: 112-123.

[2] Patel manishkumar dahyabhai, prof. jayeshkumar r. pitroda (October 2013) “self-curing concrete: new technique for concrete curing” journal of international academic research for multidisciplinary Volume 1, Issue 9, pp: 539-544.

[3] Pamnani Nanak J., Verma A.K., Bhatt Darshana R,( December 2013) “Comparision between Mechanical Properties of M30 Grade Self Compacting Concrete For Conventional Water Immersion and Few Non- Waterbased Curing Techniques” International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-3, Issue-2,pp:265-272.

[4] Vidivelli B, T. Kathiravan, T. Gobi (July 2013) “Flexural Behaviour of Self Compacting and Self Curing Concrete beams” International Journal of Engineering Mathematics & Computer Science ISSN: 2321 – 5143, Vol 1, Issue 2, pp: 64-77.

[5] M.Mithra, P.Ramanathan, Dr.P.Muthupriya, Dr.R.Venkatasubramani (April 2012) “Flexural Behavior of Reinforced Self Compacting Concrete Containing GGBFS” International Journal of Engineering and Innovative Technology (IJEIT) Volume 1, Issue 4, ISSN: 2277-3754, pp: 124-129.

[6] Jagannadha Kumar M.V, M. Srikanth, K. Jagannadha Rao, (Sep-2012) “strength characteristics of self-curing concrete” IJRET: International Journal of Research in Engineering and Technology - Volume: 01 Issue: 01, ISSN: 2319-1163, pp: 51-57.

[7] Krishna Murthy.N, Narasimha Rao A.V, Ramana Reddy I .Vand Vijaya sekhar Reddy.M ((September 2012) “Mix Design Procedure for Self Compacting Concrete” IOSR Journal of Engineering (IOSRJEN), ISSN: 2250-3021, Volume 2, Issue 9, pp: 33-41.

[8] Khaleel O.R, s. a. al-mishhadani, and h. Abdul razak (2011) “The Effect of Coarse Aggregate on Fresh and Hardened Properties of Self-Compacting Concrete (SCC)” science direct, pp: 805–813.

[9] Mucteba Uysal, Mansur Sumer (May 2011) "Performance of self-compacting concrete containing different mineral admixtures" Science Direct, pp: 4112-4120.

[10] Heba A. Mohamed (2011) "Effect of fly ash and silica fume on compressive strength of self-compacting concrete under different curing conditions" Ain Shams Engineering Journal Issue: 2, pp: 79-86.

[11] Selvamony C., Ravikumar M.S., Kannan S.U., Basil Gnanappa S.( July 2010) "Study on Investigations on Self-compacted Self-curing Concrete using Limestone Powder and Clinkers" International Journal on Design and Manufacturing Technologies Vol.3, No.2, pp: 103-108.

[12] Hadiwidodo Y.S, S. Mohd (2008) "Review of Testing Methods for Self Compacting Concrete" ICCBT - A - (05) – pp: 69-82.

[13] Hui Zhao, Wei Sun, Xiaoming Wu, Bo Gao, (March 2012) "The effect of coarse aggregate gradation on the properties of self-compacting concrete" sciverse science direct, pp: 109-116.