# A DETAILED STUDY ON M40 HARDEN PROPERTIES OF SELF COMPACTING GREEN CONCRETE BY PARTIAL REPLACEMENT OF FINE AGGREGATE WITH CRUSHED ROCK DUST AND RICE HULL ASH

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## Abstract

Self-compacted concrete is concrete that undergoes compaction with its self-weight and does not require any vibrators for compaction. In this study of self-compacted concrete of grades M40 with partial replacement of fly ash in cement and rice hull ash (RHA) and crushed rock dust (CRD) in place of fine aggregates. And we have used the RHA & CRD as filler material. By replacing FA with different proportions of RHA and CRD, at the end of 28 days of curing. For this will cast and test the cubes for compressive strength and also by using empirical equations we will calculate flexural strength and split tensile strength to obtain optimum results.

**Keywords:** Self compacted concrete, Green concrete, Compressive strength, Split tensile strength and Flexural strength.

## Introduction

With the exceptional development of producing mega structures in the area over, the selection for SCC application is growing. Many have the troubles of congestion of reinforcement in critical structural individuals. The format issues are compounded because of the immoderate danger of seismic sector, vulnerability to cyclonic storms, and massive capacity addition of the flora to a very big scale. SCC has become the great desire in such hard net internet web page environments. Ideally, the development of a concrete mixture in which placing and compaction have minimum dependence on the same old of information available on a selected net web page have to decorate the real pride of the concrete interior aspect the very last form, and consequently its durability. That is crucial using stress internal facet the go back of the improvement of self-compacting concrete (SCC). Self-consolidating concrete is taken into consideration a leap in advance in concrete technology because of its stepped forward traditional common overall performance and walking environment. It has a huge utility starting from skinny factors to bulk systems. SCC can be considered the first-class technical improvement and maximum present-day development in concrete technology over the years. SCC is the concrete of the destiny as it will update conventional concrete due to its large advantages. SCC in addition known as self-consolidating concrete or rheological concrete is a progressed concrete that doesn`t require vibration inside the course of pouring and compaction. It is able to sink under its very special weight, openly fill the formwork, and benefit whole compaction, no matter the masses of reinforcement. Concrete that hardens is homogeneous and has at the least the identical technical homes and the equal strength as traditional vibrate concrete. The rule of SCC is that the compressibility of the mixture is set up to the viscosity of the easy concrete. SCC may be artificial the usage of the same components as traditional concrete. However, a tighter tolerance is wanted to ensure tight control of the workability tendencies. The dosage of the SCC mixture is a lot greater scientific than conventional concrete. SCC require too much powder content material fabric, low coarse mix excessive grade super plasticizer, and VMA

(viscosity modifier) to provide the concrete aggregate balance and waft capability. SCC workability is a balance among fluidity, deformability, and resistance to splitting. This stability wants to be maintained for a sufficient term to permit transportation, placement, and finishing. A aggregate of tests is wanted to symbolize.

- SCC is considered a desired alternative due to its well-known homes of drift capability, passing capacity, and compatibility.
- SCC is an exceptional restore material for concrete encasement because of its ability to waft thru narrow openings. Care need to be taken to avoid shrinkage of concrete by means of including shrinkage compensating admixtures for the reason that bonding of latest concrete with the vintage concrete is a call for in repair works.

**Review of Literature**

Till now different authors are done experimental investigations on replacement of fine aggregate with various waste materials like stone dust, rice husk and etc. in the they are using various proportions like 5%,10%,20% up to 50% as partial replacement of fine aggregate and then they found compressive strength and other parameters but they not use any combination of stone dust, rice hull ash as a fine aggregate so here we are try to fill this gap by doing experimental analysis on M40 harden properties of self compacting green concrete by partial replacement of fine aggregate with crushed rock dust and rice hull ash

**Appendix**

**Table-1:-Various proportions for M40 grade of self compacting green concrete by partial replacement of fine aggregate with crushed rock dust and rice hull ash**

| M40 grade of Concrete | | | | | | |
|---|---|---|---|---|---|---|
| **MIX** | % of River Sand | RHA | % of CRD | CA | W/C ratio | Grade of Concrete |
| **SCGC 1** | 0 | 0 | 100 | 100 | 0.5 | M40 |
| **SCGC 2** | 0 | 10 | 90 | | | |
| **SCGC 3** | 0 | 20 | 80 | | | |
| **SCGC 4** | 0 | 30 | 70 | | | |
| **SCGC 5** | 0 | 40 | 60 | | | |

**Experimental Investigations**

**Table-2:- M40 Grade, Cement+100% CRD+CA**

| S.NO | No of days of Curing | Load(KN) | | | Average load (KN) | Area ($mm^2$) | Compressive Strength ($N/mm^2$) |
|---|---|---|---|---|---|---|---|
| | | Sample -1 | Sample -2 | Sample -3 | | | |
| 1 | 1 | 200 | 210 | 207 | 206 | 22500 | 9.14 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | 3 | 512 | 513 | 517 | 514 | 22500 | 22.85 |
| 3 | 7 | 830 | 832 | 834 | 832 | 22500 | 37.01 |
| 4 | 14 | 914 | 913 | 918 | 915 | 22500 | 40.71 |
| 5 | 28 | 1081 | 1079 | 1080 | 1080 | 22500 | 48.03 |

**Table-3:- M40 Grade, Cement+ (90%CRD+10%RHA) +CA**

| S.NO | No of days of Curing | Load(KN) | | | Average load (KN) | Area (mm2) | Compressive Strength (N/mm2) |
|---|---|---|---|---|---|---|---|
| | | Sample-1 | Sample-2 | Sample-3 | | | |
| 1 | 1 | 175 | 180 | 177 | 177 | 22500 | 7.9 |
| 2 | 3 | 405 | 406 | 413 | 408 | 22500 | 18.17 |
| 3 | 7 | 575 | 569 | 572 | 572 | 22500 | 25.43 |
| 4 | 14 | 788 | 786 | 793 | 789 | 22500 | 35.09 |
| 5 | 28 | 1056 | 1058 | 1057 | 1057 | 22500 | 47.02 |

**Table-4:-M40 Grade: Cement+ (80%CRD+20%RHA) +CA**

| S.NO | No of days of Curing | Load(KN) | | | Average load (KN) | Area ($mm^2$) | Compressive Strength ($N/mm^2$) |
|---|---|---|---|---|---|---|---|
| | | Sample-1 | Sample-2 | Sample-3 | | | |
| 1 | 1 | 160 | 161 | 162 | 161 | 22500 | 7.15 |
| 2 | 3 | 385 | 387 | 386 | 386 | 22500 | 17.17 |
| 3 | 7 | 532 | 536 | 531 | 533 | 22500 | 23.69 |
| 4 | 14 | 732 | 737 | 736 | 735 | 22500 | 32.69 |
| 5 | 28 | 954 | 956 | 955 | 956 | 22500 | 42.49 |

**Table-5:- M40 Grade, Cement+ (70%CRD+30%RHA) +CA**

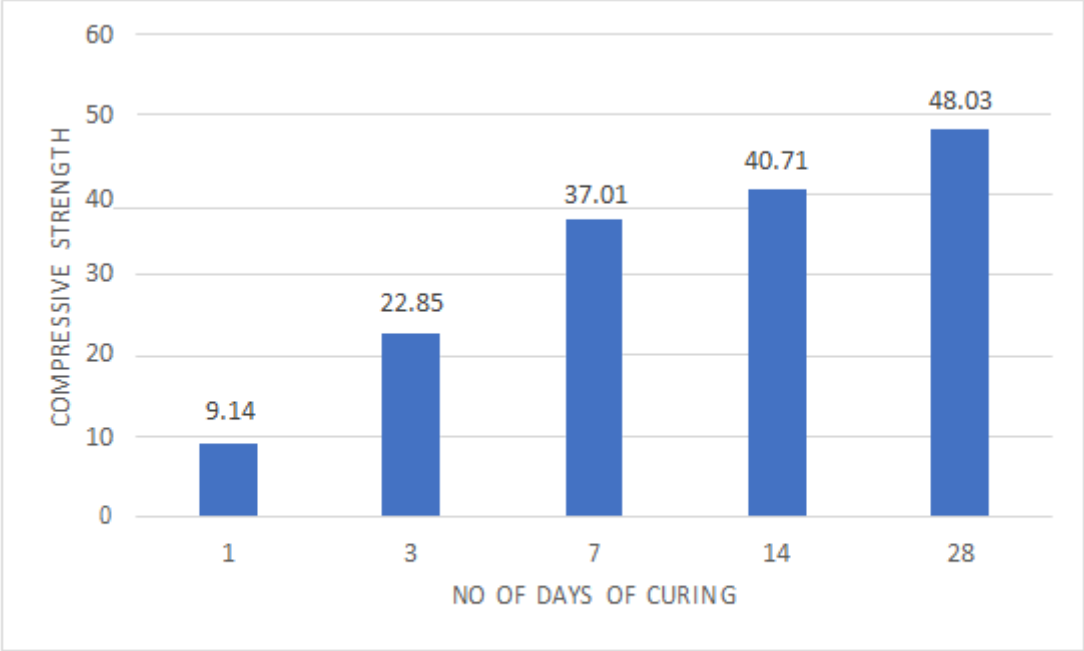
| S.NO | No of days of Curing | Load(KN) | | | Average load (KN) | Area ($mm^2$) | Compressive Strength ($N/mm^2$) |
|---|---|---|---|---|---|---|---|
| | | Sample-1 | Sample-2 | Sample-3 | | | |
| 1 | 1 | 149 | 150 | 151 | 150 | 22500 | 6.6 |
| 2 | 3 | 372 | 369 | 372 | 371 | 22500 | 16.5 |
| 3 | 7 | 629 | 632 | 632 | 631 | 22500 | 28.05 |
| 4 | 14 | 755 | 764 | 752 | 757 | 22500 | 33.66 |
| 5 | 28 | 905 | 910 | 909 | 908 | 22500 | 40.39 |

**Table-6:- M40 Grade, Cement+ (60%Crd+40%RHA) +CA**

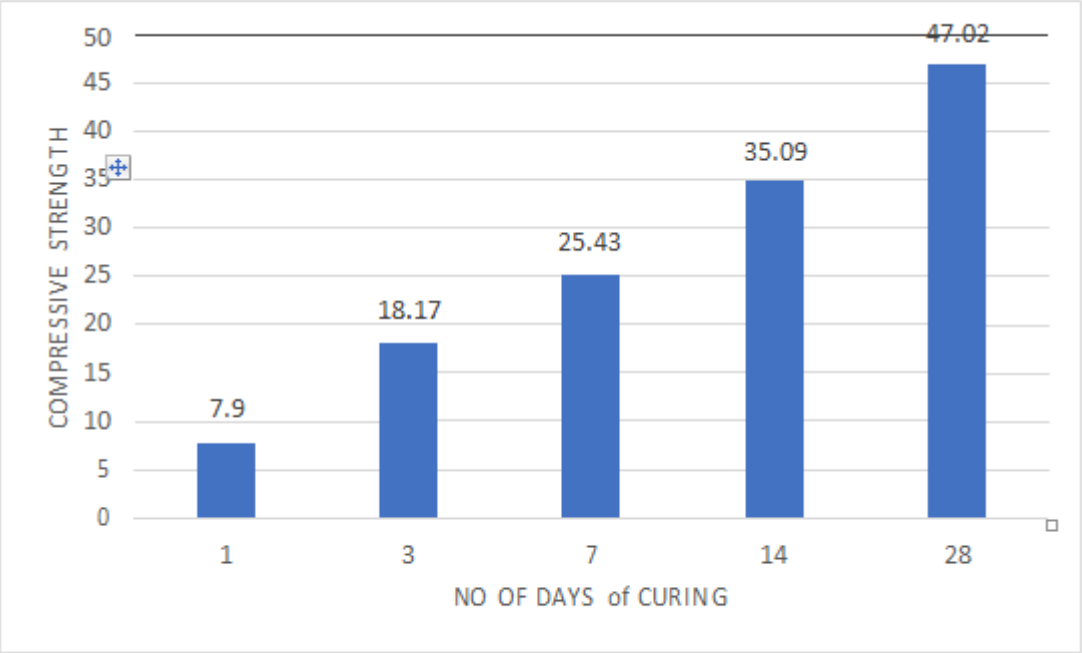
| S.NO | No of days of Curing | Load(KN) | | | Average load (KN) | Area ($mm^2$) | Compressive Strength ($N/mm^2$) |
|---|---|---|---|---|---|---|---|
| | | Sample-1 | Sample-2 | Sample-3 | | | |
| 1 | 1 | 325 | 326 | 324 | 325 | 22500 | 14.44 |
| 2 | 3 | 585 | 583 | 584 | 584 | 22500 | 25.99 |
| 3 | 7 | 699 | 704 | 700 | 701 | 22500 | 31.18 |
| 4 | 14 | 983 | 980 | 983 | 982 | 22500 | 43.65 |
| 5 | 28 | 1175 | 1180 | 1179 | 1178 | 22500 | 52.38 |

**Result and Discussions**

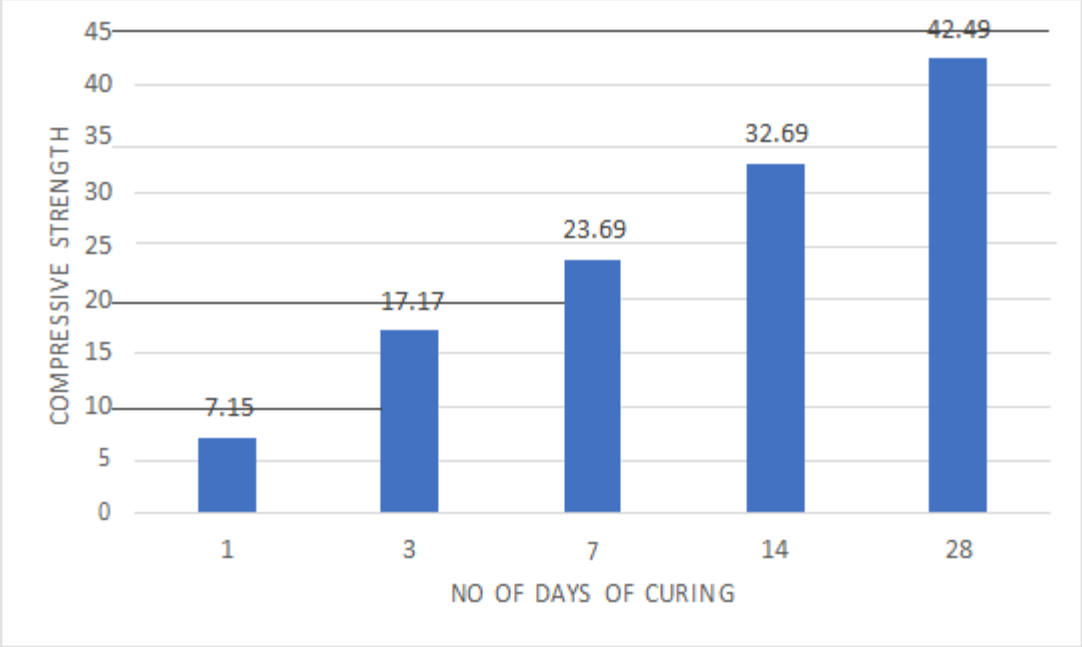
The results of this detailed study on M40 harden properties of self compacting green concrete by partial replacement of fine aggregate with crushed rock dust and rice hull ash as shown in below in the form of graphical representation



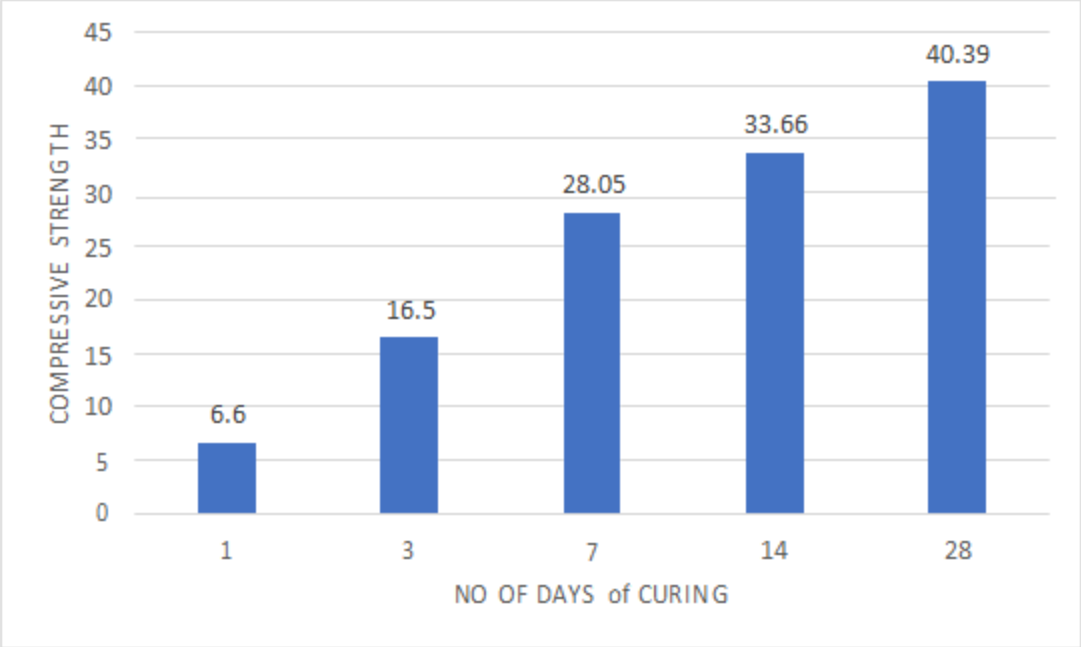

Graph-1: $M_{40}$ grade of concrete with 100% CRD



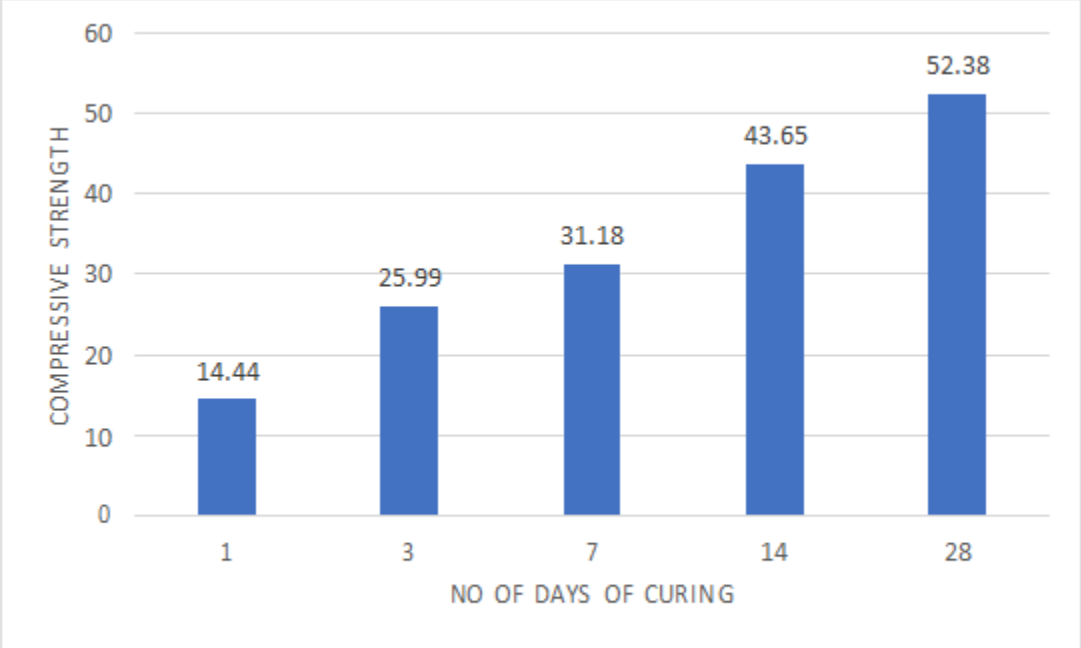

Graph-2: $M_{40}$ grade of concrete with 90%CRD & 10%RHA




Graph-3: $M_{40}$ grade of concrete with 80% CRD & 20% RHA




Graph-4: $M_{40}$ grade of concrete with 70% CRD & 30% RHA




Graph-5: $M_{40}$ grade of concrete with 60% CRD & 40% RHA

- Calculation of flexural strength
  - ❖ $K = 0.7\sqrt{fck}$

- According to the study, the split tensile strength of concrete is considered as 1/10th of compressive strength
  - ❖ Flexural strength for 60%CRD & 40%RHA after 28days of curing for M40 grade of concrete
    $= 0.7*\sqrt{52.38}$
    $= 5.06\ N/mm^2$
  - ❖ Split tensile strength for 60%CRD & 40%RHA after 28days of curing for M40 grade of concrete
    $=1/10\ *52.38$

**Conclusion**

❖ The following conclusions are arrived at based on the experimental investigations carried out in this study:

1. Compressive Strength of M40 grade of concrete is 52.38 N/mm2 at 60% CRD & 40% RHA.
2. Flexural strength was calculated by using IS code provisions, based on correlations the flexural strength was calculated as $0.7x\sqrt{fck}$. And we got optimum strength of concrete at 60% CRD & 40% RHA for 28 days
   - Fck of M40 = 52.38 $N/mm^2$ therefore Flexural strength for M40 grade of concrete = $0.7*\sqrt{52.38} = 5.06\ N/mm^2$
3. Split tensile strength was calculated by using IS code provisions, based on correlations the split tensile strength of concrete is considered as $1/10^{th}$ of compressivestrength. Therefore
   - Fck of M40 = 52.38 N/mm2 therefore split tensile strength for M40 grade of concrete = $1/10\ *52.38 = 5.2N/mm^2$
4. We have done the experiment with replacement of FA up to 60% CRD & 40% RHA. And we observed that by increasing content of the RHA as a filler material the compressive strength of M40 grades of concrete increases and also this project work needs further experimental analysis up to what extent the compressive strength will increase by increasing the RHA content as a filler material.

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