# Experimental Investigation On Self Compacting Concrete By Using Granite Waste And Fly Ash

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***Abstract:*** *The self compacting concrete must contain mineral admixtures to improve the flow properties. The granite sawing waste can be utilized as mineral admixture in the self compacting concrete .the results show that the granite sawing waste and fly ash can be used to improve the properties and cost effectiveness of the self compacting concrete with the ever increasing cost of construction materials there is a need to curtail the same by using cheaper substitutes .In this work experiments were carried out for the effective replacement of cement with granite sawing waste (0%,10%,20%,30%,40%) and fly ash (0%,5%,10%,15%,20%). So it can be concluded that when loclly available granite waste is a good partial substitute to concrete and improves compressive and tensile characteristic of concrete, while simultaneously offsetting the over all cost of concrete substantially*

***Keywords:*** *Self compacting concrete, granite sawing waste, fly ash, compressive and tensile characteristics.*

## I.INTRODUCTION

Since its introduction in the later years of 1980's Self Compacting Concrete (SCC) has brought a revolutionary change in construction industry. Since the production process is much easier than the conventional concrete, it is widely used in mass concreting works, bridge constructions, metro rail constructions etc. The quality of concrete produced with SCC is much better than the ordinary concrete .Another advantage is that less skilled labour is required in order for it to be placed, finished and made good after casting. As the shortage of skilled site labour in construction continues to increase in many countries, this is an additional advantage of the material which will become increasingly important .SCC mixes always contain a powerful super plasticizer and often use a large quantity of powder materials and/or viscosity-modifying admixtures. The super plasticizer is necessary for producing a highly fluid concrete mix (low yield value) while the powder materials or viscosity agents are required to maintain stability (sufficient viscosity) of the mix, hence reducing bleeding and segregation/settlement. The powder materials used often include limestone powder, pulverised fuel ash (PFA), granulated ground blast furnace slag etc. Furthermore, coarse aggregate content is much lower in SCC mixes than in traditional vibrated concrete mixes to reduce the risk of blocking of concrete flow by congested reinforcement and narrow openings in the formwork .Excellent deformability, good stability and low risk of blockage are the basic requirements for successful casting of SCC .The hardened properties are of paramount interest to structural designers and users, and much data have also been obtained on all aspects of these. Self-compatibility testing method stipulations are not universally accepted rules.

## II. OBJECTIVE

The main objective of this experimental investigation is to study

- Physical properties of granite powder waste for its possible use as powder in SCC.
- The influence of Granite powder on fresh and hardened properties of SCC.

## III LITERATURE REVIEW

*Aarthi Karmegam, Arunachalam Kalidass, Dileepan Ulaganathan (2014)*,the The self-compacting concrete must contain mineral admixtures to improve the flow properties. The granite sawing waste can be utilized as mineral admixture in the self-compacting concrete. The results obtained by XRD and SEM methods show that there is a promising future for the use of this waste material as filler in self compacting concrete, along with fly ash. The results show that the granite sawing waste and fly ash can be used to improve the properties and cost-effectiveness of the self-compacting concrete.

*K.S. Johnsirani*, Dr. A. Jagannathan**, R. Dinesh Kumar*** (2013)*, self-compacting concrete (SCC) with fine aggregate (sand) replacement of a Quarry

Dust (QD) (0%, 25%, 50%, 75%, 100%) and addition of mineral admixtures like Fly Ash (FA) and Silica Fume (SF) & chemical admixtures like super plasticizers (SP). After each mix preparation, 45 cubes specimens and 45 cylinders specimens are cast and cured. The specimens are cured in water for 3, 7 & 28 days. The slump, V-funnel and L-Box test are carried out on the fresh SCC and in harden concrete compressive strength and split tensile strength values are determined.

*TaLalit Gamashta (2006)*,the developed the concrete strength by using masonry waste material in concrete mix in construction to minimize the environmental damages due to quarrying. It is highly desirable that the waste materials of concrete and bricks are further reutilized after the demolition of old structures in an effective manner especially realizing that it will help in reducing the environmental damages caused by excessive reckless quarrying for earth materials and stones. Secondly, this will reduce pressure on finding new dumping ground for these wastes, thus further saving the natural environment and eco-systems. Durability, reliability and adequate in service performance of these reused waste materials over the stipulated design life of designed structures are of paramount importance to Structural Designers. This paper critically examines such properties in reused concrete and brick masonry waste materials and suggests suitable recommendations for further enhancing life of such structures, thereby resulting in sufficient economy to the cost of buildings.

*SM.L.V. Prasad, (2007)* had studied mechanical properties of fiber reinforced concretes produced from building demolished waste and observed that target mean strength had been achieved in 100% recycled concrete aggregate replacement.

## IV MATERAL INVESTIGATION

### *1 Cement*

The cement used should confirm IS specifications. There are several types of cements available commercially in the market of which Portland cement is very common and it is well known and available everywhere. PPC 43 grade was used for this study. The physical properties of the cement tested according to standard procedure confirm to the requirement of IS 1489 Part 1. The physical properties of the cement are listed in the table 1

Table1 Physical Properties of Cement

| S.No | Characteristics | Value Obtained experimentally |
|---|---|---|
| 1 | Standard Consistency | 30% |
| 2 | Fineness of cement as retained on 90 micron sieve | 3.33% |
| 3 | Initial setting time | 30 minutes |
| 4 | Specific gravity | 3.15 |

### *2 Fine Aggregate*

Locally available river sand passing through 4.75mm sieve conforming to the recommendation of IS 383:1970 is used. Specific Gravity of fine aggregate is found and the particle size distribution is listed below in the Table 2

Table2 Particle Size distribution for fine aggregate

| Sieve Size | Weight Retained (grams) | Cumulative percentage retained | Cumulative percentage passing |
|---|---|---|---|
| 4.75mm | 75 | 2.50 | 97.50 |
| 2.36mm | 100 | 5.83 | 94.17 |
| 1.18mm | 150 | 10.83 | 89.17 |
| 600micron | 200 | 17.50 | 82.50 |
| 300micron | 500 | 34.16 | 65.84 |
| 150micron | 840 | 62.16 | 37.84 |
| 75micron | 455 | 77.33 | 22.67 |
| Pan | 680 | 100 | 0 |

Weight of fine aggregate = 3000 grams

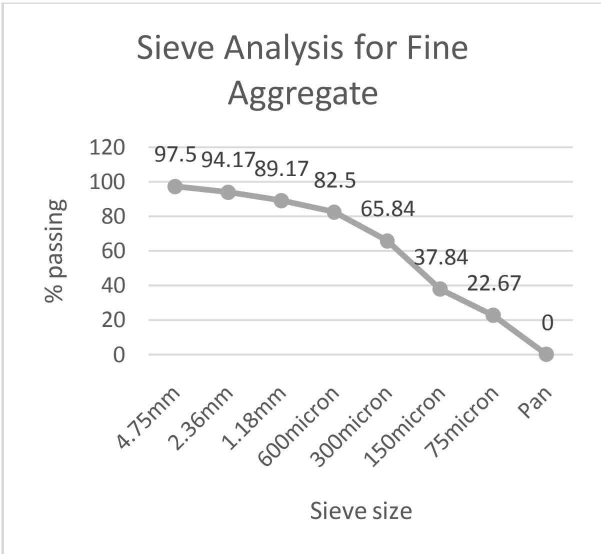


Figure 1 Sieve Analysis for Fine Aggregate

From the sieve analysis results fine aggregate is graded to Zone IV

### *3 Coarse Aggregate*

Coarse aggregate to be used for production of concrete must be strong, impermeable, durable and capable of producing a sufficient workable mix with minimum water cement ratio to achieve proper strength. Locally available coarse aggregate retaining on 4.75 mm sieve is used. Specific Gravity of coarse aggregate was found and the particle size distribution for coarse aggregate is listed below in Table 3

Table 3 Particle Size Distribution for Coarse Aggregate

Weight of coarse aggregate = 3000 grams

| Sieve Size | Weight Retained (grams) | Cumulative percentage retained | Cumulative percentage passed |
|---|---|---|---|
| 40mm | 0 | 0 | 100 |
| 20mm | 100 | 3.33 | 96.67 |
| 16mm | 600 | 23.33 | 76.67 |
| 12.5mm | 750 | 48.33 | 51.67 |
| 10mm | 800 | 75.00 | 25.00 |
| 4.75 | 750 | 100 | 0 |

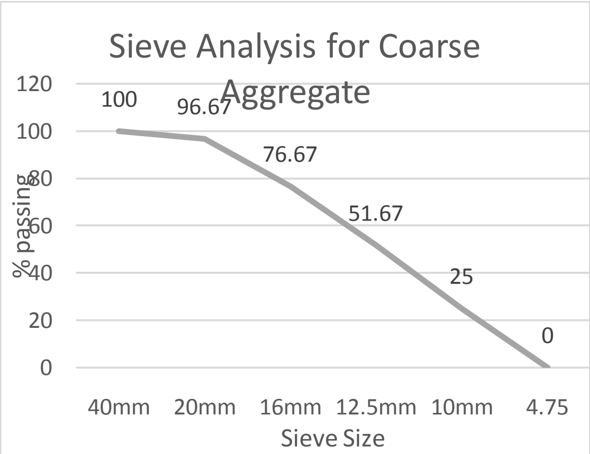


Figure 2 Sieve Analysis for Coarse Aggregate

From the sieve analysis results nominal size of coarse aggregate is 20mm

### *4 Water*

The quality of mixing water for concrete has a visual effect on the resulting hardened concrete. Impurities in water may interfere with the setting time of cement and will adversely affect the strength and durability of concrete with copper slag. Fresh and clean water which is from organic matter silt, oil, and acid material as per standards is used for casting the specimens. Water that is piped from the public supplies is used.

### *5 Granite waste*

It is obtained from granite industry near pudukottai. It is a waste product obtained during sawing process of granite rocks. this waste is creating great problem due to disposal as it is creating environmental hazards.

### *6 Flyash*

Here class F fly ash is used. these are greyish in colour.it is obtained from the thermal power plant near neyveli. It is a waste product obtained during heating of materials.

## V CONCRETE MIX DESIGN

Mix design calculations

### *A.1 Target Strength for Mix Proportion*

$f'_{ck} = f_{ck} + 1.65 \times S$

Where,

$f'_{ck}$ = Target average compressive strength at 28 days

$f_{ck}$ = Characteristic compressive strength at 28 days

S = Assumed standard deviation in $N/mm^2$ = 5 (as per table -1 of IS 10262-2009) = 30 + 1.65 x 5.0 = 38.25 $N/mm^2$

### *A.2 Selection of Water – cement ratio*

From table 5 of IS 456 the water cement ratio is adopted as 0.40

Hence w/c=0.40

### *A.3. Water Content*

From table 2 of IS 10262 the maximum water content for 20mm aggregate is 186 litre

Water content = 197 litre

### *A.4 Cement Content*

w/c ratio = 0.40

Therefore cement = 197/0.40 = 362.5 $kg/m^3$

### *A.5 Volume of Aggregates*

From table 3 of IS 10262

Volume of coarse aggregate = 0.49

Volume of fine aggregate = 1-0.49=0.51

*A.5 Mix Calculations*

a) Volume of Concrete = 1 $m^3$
b) Volume of Cement = (362.5/3.15)/1000 = 0.115 $m^3$
c) Volume of water = 0.145 $m^3$
d) Volume of aggregate = 1-0.138-0.197 = 0.665 $m^3$
e) Mass of Coarse aggregate = 0.627*0.49*2.74*1000 = 841.81 kg/ $m^3$
f) Mass of Fine aggregate = 0.627*0.51*2.74*1000 = 876.16kg/ $m^3$

Cement = 119.63 kg/ $m^3$

Water = 145 kg/ $m^3$

Fine Aggregate = 876.16kg/ $m^3$

Coarse Aggregate = 841.81 kg/ $m^3$

Water Cement ratio = 0.40

Table 4 Mix design

| Percentage of GW replacement | Percentage of fly ash replacement | Cement Content Kg/ $m^3$ | Fine aggregate Kg/ $m^3$ | Coarse aggregate Kg/ $m^3$ | Granite waste Kg/ $m^3$ | Fly ash Kg /$m^3$ |
|---|---|---|---|---|---|---|
| 0% | 0% | 119.63 | 876.16 | 841.81 | - | - |
| 10% | 5% | 97.74 | 876.16 | 841.81 | 15.95 | 5.98 |
| 20% | 10% | 75.83 | 876.16 | 841.81 | 31.9 | 11.96 |
| 30% | 15% | 53.87 | 876.16 | 841.81 | 47.85 | 17.9 |
| 40% | 20% | 31.9 | 876.16 | 841.81 | 63.8 | 23.92 |

## VI TEST ON CONCRETE

### *1 TEST ON FRESH CONCRETE*

### *1.1 SLUMP CONE TEST*

The slump Cone test

This method of test specifies the procedure to be adopted, either in laboratory or during the process of work in the field, for determining the consistency of concrete where the nominal maximum size of the aggregate does not exceed 38mm. The internal dimensions of the mould are of bottom diameter 200mm, top diameter 100mm and height 300mm.

The mould is filled with fresh concrete in four layers, each approximately one quarter of the height and tamped with 25 strokes of the rounded end tamping rod. The strokes are distributed in a uniform manner over the cross section and for the second and subsequent layers should penetrate into the underlying layer. The bottom layer is tamped throughout its depth. After the top layer has been rodded, the concrete is struck off level with a trowel or the tamping rod. So that the mould is exactly filled. The mould is removed immediately by raising it slowly and carefully in a vertical direction. This allows the concrete to subside and the slump is measured immediately by determining the difference between the height of the mould and that of the highest point of specimen being tested. The slump measured is recorded in terms of millimetres of subsidence of the specimen.

The slump value obtained for the replacement of granite waste by 40% and fly ash by 20% is found to be 750mm.

### *1.2 COMPACTION FACTOR TEST*

This test is more precise an sensitive than the slump test an is particularly useful for concrete mixes of medium and low workability's as are normally used when concrete is to be compacted by vibration; such dry concretes are insensitive to slump test. For concrete of very low workability of the order of 0.7 or below, the test is not suitable, because the concrete cannot be fully compacted for comparison in the manner described in the test. A diagram of the apparatus used in compacting factor test is shown in the figure.

The sample of concrete to be tested is placed gently in the upper hopper. The hopper is filled level with its brim and the trap door is opened to allow the concrete to fall into the lower hopper. Certain mixes have a tendency to stick in one or both `of the hoppers. If this occurs, the concrete may be helped through by pushing the rod gently into the concrete from the top. During this process, the cylinder should be covered with trowels.

Immediately after the concrete has come to rest, the cylinder is uncovered, the trap door of the lower hopper is opened, and the concrete is allowed to fall in the cylinder. The excess concrete remaining above the level of the top of the cylinder is then cut off.

The weight of the concrete with the cylinder is then determined to the nearest 10 grams, as the weight of the partially replaced concrete. The cylinder is then refilled with concrete from the same sample in layers and these layers are compacted heavily or vibrated so as to obtain full compaction.

The top surface of the fully compacted concrete is carefully struck off level with the top of the cylinder compacting factor is defined as the ratio of the weight of partially compacted concrete to the weight of fully compacted concrete. A convenient time for releasing the concrete from the upper hopper has been found to be 2 minutes after the completion of mixing.

Compaction factor for 40% replacement of granite waste and 20% replacement of fly ash replacement is obtained as **0.85**

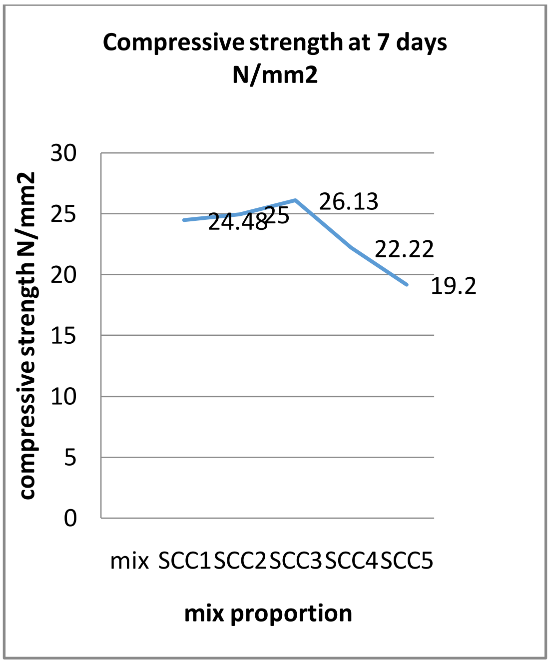


FIG 3

### *2 TEST ON HARDENED CONCRETE*

### *2.1 COMPRESSIVE STRENGTH TEST*

Table 5 Compressive strength Test on concrete with various ratio

| Concrete mix | Compressive strength at 7 days N/mm$^2$ | Compressive strength at 14 days N/mm$^2$ | Compressive strength at 28 days N/mm$^2$ |
|---|---|---|---|
| SCC1 | 24.48 | 29.59 | 32.88 |
| SCC2 | 25.00 | 30.02 | 33.36 |
| SCC3 | 26.13 | 31.32 | 34.80 |
| SCC4 | 22.22 | 27.18 | 30.20 |
| SCC5 | 19.20 | 25.2 | 28.00 |

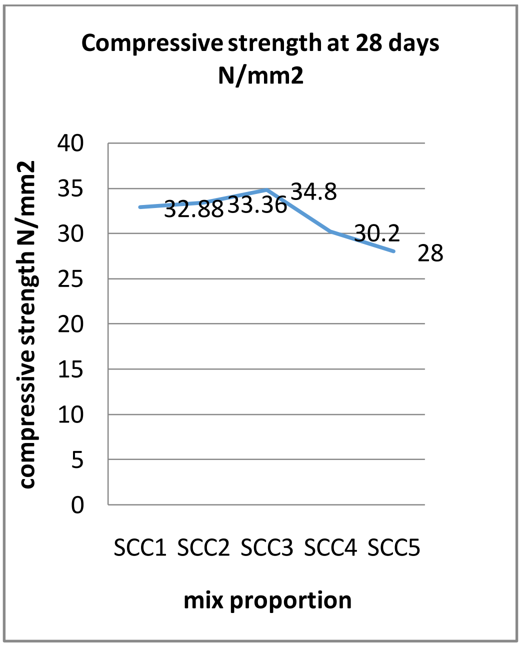


FIG 4

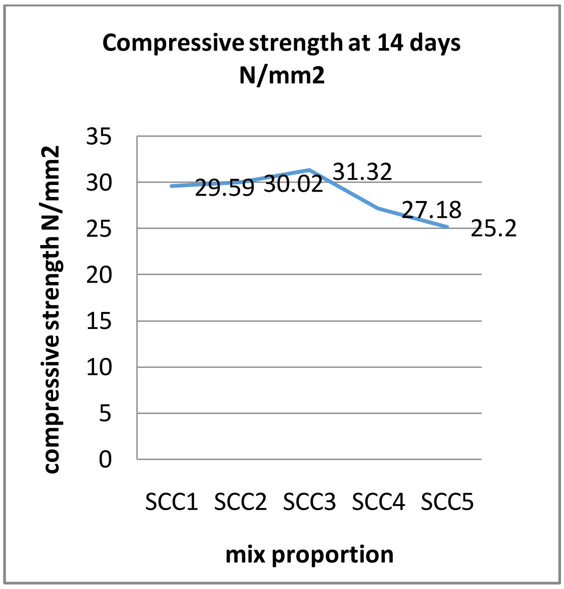


FIG 5

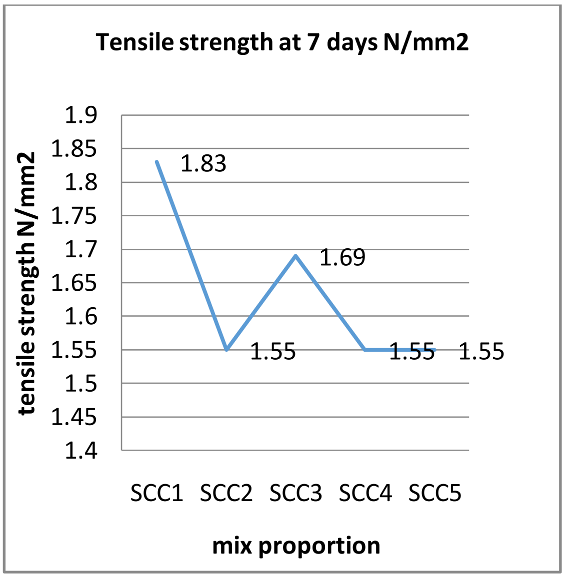


FIG 6

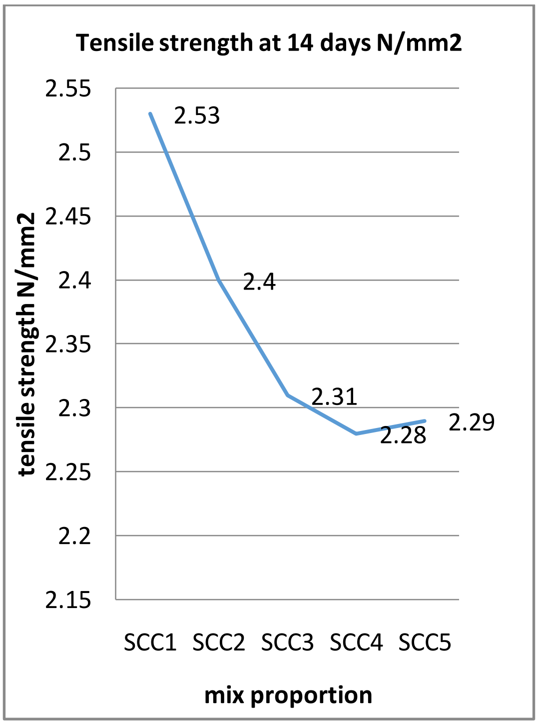


FIG 7

### *2 SPLIT TENSILE STRENGTH*

Table 5 Tensile Strength test on conventional concrete

| Conventional Concrete | Tensile strength at 7 days N/mm$^2$ | Tensile strength at 14 days N/mm$^2$ | Tensile strength at 28 days N/mm$^2$ |
|---|---|---|---|
| SCC1 | 1.83 | 2.53 | 2.82 |
| SCC2 | 1.55 | 2.4 | 2.63 |
| SCC3 | 1.69 | 2.31 | 2.55 |
| SCC4 | 1.55 | 2.28 | 2.52 |
| SCC5 | 1.55 | 2.29 | 2.5 |

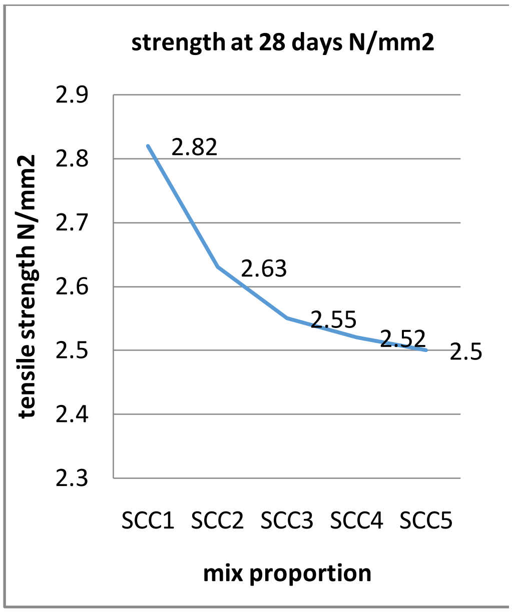


FIG 8

## VII CONCLUSION

The described results show that good deformability in the self compacting concrete mix can be obtained by reducing the water powder ratio and the granite having greater than 30% of fly ash hence it can be partly used as a substitute material for cement.

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