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# Experimental Development on Strength Aspects of Self Compacting Concrete using Admixtures and Manufacturing Sand

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***Abstract:*** ***This get some answers concerning offers an exploratory examination on self-compacting concrete (SCC) with magnificent blend (sand) substitute of a Quarry Dust (QD) (0%, 25%, half, 75%, 100%) and expansion of mineral admixtures like Fly Ash (FA) and Silica Fume (SF) synthetic admixtures like remarkable plasticizers (SP). After each consolidate readiness, 45 3D squares examples and 4 5 chambers examples are fashioned and relieved. The examples are restored in water for 3, 7 & 28 days. The droop, V-pipe and L-Box investigate are completed on the clean SCC and in so lidify concrete compressive power and cut up elasticity esteems a re resolved. Endeavors have been made to find out about the pla ces of such SCCs and to examine the appropriateness of Quarry Dust to be utilized as fractional swap materials for sand in SCC.***

***Keywords : SCC, Fly Ash, Silica Fume, Quarry Dust, Super plasticizer, compressive strength, split tensile strength.***

## I. INTRODUCTION

Self compacting concrete (SCC) is considered as a solid whichcan be put and compacted underneath its self load wit h practically no vibration exertion, and which is at the equivalent time strong adequate to be managed without isolation or seeping of shining cement. SCC blends for the most part contain superplasticizer, high substance material of fines as well as consistency altering added substance (VMA). While the utilization of superplasticizer keeps up the smoothness, the excellent substance manages consistent quality of the join bringing about opposition against draining and isolation.

The utilization of fly cinder and impact heater slag in SCC decreases the measurements of superplasticizer expected to get comparative hang float contrasted with cement blends made with exclusively Portland concrete [1]. It is evaluated that SCC may likewise final product in up to 40% speedier structure than utilizing standard cement. The remarkable rheological places of SCC might need to be accomplished, using concoction and mineral admixtures and blend adjustments, alongside [3]:Superplasticizer (SP)

- Viscosity Modifying Agent (VMA)
- Fly ash (FA), silica fume (SF), or micro-silica particles
- Reduced water/powder ratio (powder = cement + FA + SF
- Limited coarse aggregate size and content

Noteworthy water rebate ability of SPs is urgent to give the fundamental usefulness; high smoothness, in any case, can grow the propensity of a blend to isolate. In this way keeping homogeneity is a basic issue for the superb control of SCC. Polycarboxylate Ether (PCE) based marvelous plasticizers speak to a most significant achievement in solid innovation as they can diminish the water necessity by means of as bounty as 40% and give exorbitant usefulness that can be stretched out as long as an hour for exact flowability (the width of droop float is enormous than 600mm) with the exception of the unwanted results of deferment and isolation [1]. With ideal utilization of thickness altering specialists, SCC might need to procure higher flowability and higher hunch barring isolation, and also safeguard better hang maintenance, along these lines making concrete moreover extra durable[2].

## II. OBJECTIVES OF THE STUDY

The significant objective of this examination is to decide th e proper extent of quarry dust elective and affect of excellen t proportioning of awesome plasticizers in SCC that offers t he most effortless charge of cement compressive quality.

## III. EXPERIMENTAL PROGRAM

In this examination, 45-3D shapes, 45-chambers are tried to take a gander at cement compressive power and split pliable vitality of SCC with the blend of fly fiery remains, silica smoke and exceptional proportioning ofpolycarboxyil c ether with the substitute of quarry dust. All investigate exa mples of shape with a hundred and fifty mm estimation and chambers with distance across of 150mm and 300mm long.

A. Materials used in this experiment

1) Cement

In this trial study, Ordinary Portland Cement fitting inwith I S: 8112-1989 was utilized. The substantial and mechanical homes of the concrete utilized are demonstrated in Table1.

**Table-1: Properties of Cement**

| Physical property | Results |
|---|---|
| Fineness (retained on 90-μm sieve) | 8% |
| Normal Consistency | 28% |
| Vicat initial setting time (minutes) | 75 |
| Vicat final setting time (minutes) | 215 |
| Specific gravity | 3.15 |
| Compressive strength at 7-days | 20.6 MPa |
| Compressive strength at 28-days | 51.2 MPa |

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Fly ash (Class –F type):

The buoy capability of self compacting cement relies upon the powder and glue content. Thus, so as to intensify the stream capacity, mineral admixtures, for example, fly fiery remains has been utilized. A classification 'F' flyash gained from Ennore Thermal Power Plant (Chennai, Tamil Nadu) was utilized. Table 2 gives the physical properties of the fly fiery debris.

**Table-2: Properties of Fly Ash**

| Physical Properties | Test Results |
|---|---|
| Colour | Grey (Blackish) |
| Specific Gravity | 2.12 |

Silica Fume:

Silica fume is a waste byproduct of the production ofsilicon and silicon alloys. Silica fume is available in different forms, of which themostcommonly used now is in adensifie d form. In developed countries it is already available readily blended with cement. The details of silica fume used in this experiment are in the Table-3

**Table-3: Details of Silica Fume**

| | |
|---|---|
| **Code** | 920-D |
| **Type** | Densified (Non-Combustible) |
| **Main content** | Amorphous $Sio_2$ |

Aggregates:

Locally available natural sand with 4.75 mm maximum size was used as fine aggregate, having specific gravity, fineness modulus and unit weight as given in Table-4 and crushed st one with 12mm maximum size having specific gravity, fine ness modulus and unit weight as given in Table-4 was used as

coarse aggregate.Table-4 gives the physical properties of th ecoarse and fine aggregates.

**Table-4: Physical Properties of Coarse and Fine Aggregates**

| Property | Fine Aggregate | Coarse Aggregate |
|---|---|---|
| Specific Gravity | 2.5 6 | 2.7 |
| Fineness Modulus | 3.1 | 7.69 |
| Surface Texture | Smooth | -- |
| Particle Shape | Rounded | Angular |
| Crushing Value | --- | 17.4 0 |
| Impact Value | --- | 12.5 0 |

Super plasticizer (SP)

Theadmixture used was a superplasticizer based onviscosit y modified polycarboxylates, which was used to provide n ecessary workability. A new generation based Polycarboxy lic ether (PCE) was used, which is known as PCE (Viscosity Modified). Table-5 gives the Properties of PCE.

**Table-5: Properties of PCE**

| Name | CONXL-PCE 8860 (Viscosity Modified) |
|---|---|
| Color | Dark Amber Color |
| Solid Content | 40% |
| Ph | 8.0 |
| Specific Gravity | 1.14 |

Quarry Dust(QD)

Locallyavailable quarry dust was collected from crushing q uarry near Mailam. Quarry dust comprises of the smaller ag gregate particles, so it was sieved to 1.18mm and then used for the replacement of fine aggregate.

*Table-6: Properties of Fly Ash*

| Physical Properties | Test Results |
|---|---|
| Colour | Grey |
| Specific Gravity | 2.4 |

*Water:* Ordinary tap water is used.

*SCC Mix Design*

Several methods exist for the mix design of SCC. Thegener al purpose mix design method was first developed by Okam ura and Ozawa (1995). In this study, the key proportions for the mixes are done by volume. The detailed steps for mix d esign are described as follows:

- Assume air content as 2% (20 litres) of concrete volume.
- Calculate the coarse aggregate content by volume (28 – 3 5%) of mix volume.
- Adopt fine aggregate volume of 40 to 50% of the mortar volume.
- Replace cement with 10% Class F type fly ash and 10% si lica fume by weight of cementitious material.
- Optimize the dosages of super plasticizer (viscosity modif ied)
- Perform SCC tests.

*Mixing procedure for SCC*

Mixing procedure for SCC is described as follows:

- Binder and aggregate are mixed for one minute.
- The 1st part (70%) of water was added and mixed for two minutes.
- SP along with the 2nd part (30%) of water was added and mixed for two minutes.
- The mix was stopped and kept rest for 2 minutes.
- The mix was remixed for one minute and discharged for S CC tests

**Table-7: Mixture Proportions for Trial and SCC (Kg/m 3)**

| Materials | CC_ 0% | CC_25% | SCC_5 0% | CC_75% | SCC_10 0% |
|---|---|---|---|---|---|
| Cement | 381.6 | 381.6 | 381.6 | 381.6 | 381.6 |
| FA | 16.6 | 16.6 | 16.6 | 16.6 | 16.6 |
| SF | 16.6 | 16.6 | 16.6 | 16.6 | 16.6 |
| W/P | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 |
| Sand | 900 | 900 | 900 | 900 | - |
| Quarry Dust | - | 225 | 450 | 675 | 900 |
| CA | 700 | 700 | 700 | 700 | 700 |
| SP | 3% | 3% | 3% | 3% | 3% |

*Testing Fresh Properties of SCC*

*Slump Flow Test* Slump float check gear is appeared in Figure 1(a). Droop cone has 20 cm rear measurement, 10 cm zenith breadth and 30 cm in tallness. In this test the stoop cone shape is put definitely on the 20 cm distance across graduated hover set apart on the glass plate, loaded up with concrete and lifted upwards. The consequent breadt hof the solid unfurl is estimated in two opposite directio ns and the basic of the distances across is expressed as the u nfurl of the concrete.T50cm is the time estimated from liftin g the cone to the solid achieving a measurement of 50 cm. T he deliberate T50cm demonstrates the twisting cost or thick ness ofthesolid.

*V-Funnel Test*

V-Funnel check device is appeared in Figure (b). In this tes t tempt entryway is shut at the base of V-Funnel andV-Funne lis totally loaded up with shimmering concrete.V-Funneltie sthe time estimated from opening the snare entryway and c mplete exhausting the channel. Once more, the V-Funnel is loaded up with concrete,put something aside for5 minutes a nddraw entryway is opened. V-Funnel time is estimated aga in and this proposes V-Funnel time at T5min.

*L-Box Test*

L-Box test gear is appeared in Figure 1(c). In this test, clea n cement is filled in the vertical zone of L-Box and the doo r is lifted tolet the solid totake the path of least resistance in totheeven segment.The highest pointf the solid at thequit of even part speaks to h2 (mm) and at the vertical part speakst o h1(mm). The proportion h2/h1 speaks to blocking proport ion.

**Figure 1: (a) Slump cone, (b) L-Box, (c)V-Funnel**

Casting & Curing

Foreach mix of SCC 9 no of specimens were casted and test ed for compressive. Before these strength studies the slump flow, V-Funnel and L-Box tests were done to study the wor kability properties of SCC to access the filling ability and p assing ability of SCC. The fresh property test should fall un der the limits specified by EFNARC as shown in the Table-7.

**Table-7: Limitationsspecified byEFNARC**

| Test methods | Units | Mini. | Maxi. | Property |
|---|---|---|---|---|
| Slump flow | mm | 650 | 800 | Filling ability |
| T50 | Sec | 2 | 5 | Filling ability |
| L box | h2/h1 | 0.8 | 1 | Passing ability |
| V funnel | Sec | 6 | 12 | Filling ability |
| V-funnel at T5minutes | Sec | 0 | +3 | Segregatio n resistance |

Byvarying the volume of fine and coarse aggregate in them ix design, several trial mixes were made and the one satisfyi ng the fresh concrete properties as per EFNARCguidelinesis selected as an optimum mix.The trial mixes made and their fresh concrete properties and workability tests.

**Table-8: FreshProperties of Trialand SCC Mixes**

| Mix | wp | Slump (mm) | V-funnel (Sec) | V-funnel T5min (Sec) | L-Box h2/h 1 | T50 (Sec) |
|---|---|---|---|---|---|---|
| TRIAL 1 | 0.45 | - | - | - | - | - |
| TRIAL 2 | 0.4 | - | - | - | - | - |
| TRIAL 3 | 0.38 | - | - | - | - | - |
| TRIAL 4 | 0.36 | 550 | - | - | - | 15 |
| SCC 0% | 0.35 | 750 | 7.45 | 10.90 | 0.8 | 3.20 |
| SCC 25% | 0.35 | 725 | 8.35 | 11.30 | 0.8 | 3.20 |
| SCC 50% | 0.35 | 720 | 9.38 | 12.5 | 0.8 | 3.55 |
| SCC 75% | 0.35 | 500 | NOT SATISFIED | | | |
| SCC_100 % | 0.35 | 450 | NOT SATISFIED | | | |

## IV. MECHANICAL PROPERTIES

Compressive strengthtest and split tensilestrength test are conductedon hardened concrete at 3, 7 and 28 days and resu lts are tabulated in Table -9 & 10.Both the tests are shown i n the Figure-2 and Figure-3 below:

**Fig-2 Split tensile strength test**

Fig-3 Compressive strength test

*Table-9: Compressive Strength of Cube (MPa)*

| Mix | 3 days | 7 days | 28days |
|---|---|---|---|
| SCC_0% | 13.8 | 20.4 | 32.35 |
| SCC_25% | 14.6 | 21.1 | 34.62 |
| SCC_50% | 12.2 | 19.8 | 30.27 |
| SCC_75% | 10.3 | 15.10 | 27.65 |
| SCC_100% | 9.6 | 13.25 | 25.08 |

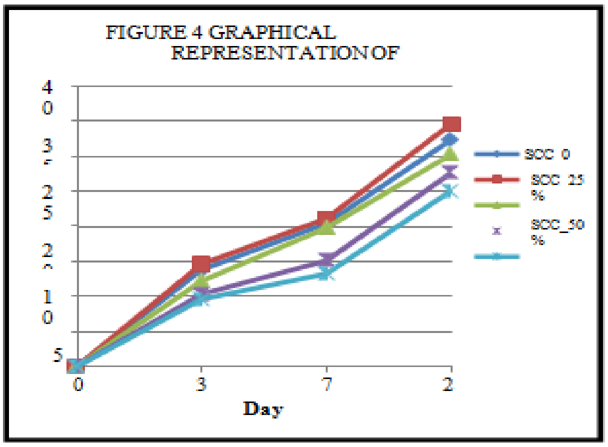
*Table-10: Split Tensile Strength of Cylinder (MPa)*

| Mix | 3 days | 7 days | 28days |
|---|---|---|---|
| SCC_0% | 1.08 | 1.31 | 2.25 |
| SCC_25% | 1.15 | 1.47 | 2.36 |
| SCC_50% | 1.04 | 1.36 | 2.2 |
| SCC_75% | 1.02 | 1.28 | 2.06 |
| SCC_100% | 1.00 | 1.08 | 1.74 |

## V.RESULTS AND DISCUSSION

Table-9&10 shows themechanical strength obtained fordiffe rent mixes. The SCC_25% series has shown the best perfor mance at 3 days, 7 days and 28 days.

- While replacing fine aggregate to quarry dustthestrengt h values are decreases gradually after 25% of replacem ent of quarry dust.
- In the case of replacement of 100% of quarry dust there will highly decrease in the compressive strength and te nsile values of both cube and cylinder specimens.



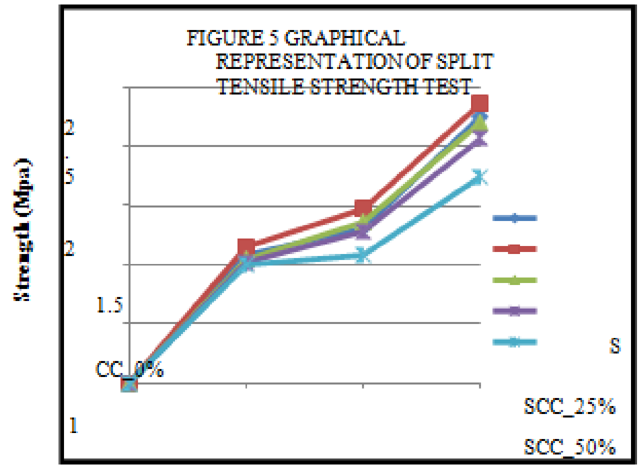




**Figure-4 and Figure -5 shows the graphical representati on of the compressive strength of cube and split tensile s trength of cylinder respectively.**

## VI. CONCLUSION

From the trial examination on Self Compacting Concrete with top notch blend option of quarry dust, changing the fly fiery debris and silica seethe for bond through weight establishment the accompanying end are made

- In set up the utilization of mineral admixtures raised the general execution of SCC in crisp country and also cou nteracted the utilization of VMAs. SCC might need to b e created withouttheutilization of VMA wasoncepractice d in this examination. Such type of SP is perceived asne w age perfect plasticizers, which diminishes the charge of VMA.
- At the water/bond proportion of 0.4, stoop drift test, V-pipe check and L-box test impacts have been found to b e palatable, for example passing capacity, filling potenti al and isolation obstruction are well inside the points of confinement exclusively for blends SCC_0%,SCC_25% & SCC50% for various SCC blends it doesn't comfortable in light of the fact that quarry residue has unnecessary fineness, its utilization in the solid is controlled because of developing water request.
- The impacts of the solidified homes of SCC, for example, compressive power and split strain quality had demonstrated that the higher power has been purchased for SCC_25% consolidate of about 34.62 Mpa and 2.36 Mpa separately.
- While best mix substitute of quarry residue increments withthe slowdiminishes in the power esteemsafteroption of 25% of quarry dust. On account of a hundred percent option of quarry dust there will be unmistakably declin e in the compressive power of solid shape and splitelasti c power of chamber.
- Optimum W/C proportion was once picked as 0.40 by methods for weight, the proportion observably past or considerably less than this may cause isolation and bloc king propensity in SCC blends.

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