

SELF-COMPACTING CONCRETE MIX DESIGN FOR M-30

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Abstract - Self Compacting Concrete (SCC) was first practiced in Japan which was a very special type of concrete or High Performance Concrete that could flow and fill into every corner of form work, even if congested confinement is present and itself consolidates by the virtue of its own weight completely without any special requirement of mechanical compaction, tamping etc. Self Compacting Concrete as the name says is nothing special but different from normal concrete, it is just employment of admixtures and different amount of composite materials that makes SCC acts as different as compared to normal one. It speeds up the construction, reduces the cost of labour needed, confirmed compaction, finished and wipes out the factors responsible for environmental pollution. The SCC is used for retrofitting, primarily in confinement where vibration is difficult to employ. Mix design is nothing but the making process of various suitable constituents of concrete and determining with the motive of producing concrete with relevant characteristics strength and also with required durable and economic condition.

Key Words: Retrofitting, Self-Compacting

1. INTRODUCTION

SCC can be stated as a high performance material which flows on its own without using compacting vibrators or tamping to attain desired compaction with the entire filling of formworks even when there occurs a problem by congestion between reinforcement bars. SCC can also be used in conditions where it is clumsy or not feasible to use mechanical compaction. Deformability (tendency to flow) of SCC allows it to fill the formwork without using mechanical vibration. Since it possesses precious properties, it has been widely used in bulk construction in Japan (Okamura and Ouchi, 2003), India and other countries. Now a days this concrete has gained extensive use in countries. This concrete has earned voluminous use in many countries for different applications and structural arrangements (Bouzoubaa and Lachemi, 2001). The method for achieving self-compaction involves high deformability of paste or mortar in conjugation with resistance to segregation between coarse aggregate and mortar. The feature of SCC to remain unsegregated while transporting and placing called Homogeneity. SCC flow easily as it is deformable and provide high segregation resistance by:

1. Reducing the quantity of fine particles, i.e., a limited coarse aggregate content.
2. A meager water-powder ratio where powder generally defined as cement with the addition of fly ash, Silica fumes etc.
3. The introduction of super plasticizer- as a result of the inclusion of a more quantity of fine particles, the internal material structure of SCC shows some similarity with high performance concrete has the characteristics to compact on its own in fresh stage, there by initially doesn't show any defects at earlier stages and it guards against external factors after hardening. The selection process for various suitable constituents of concrete and defining their relative and appropriate quantity with an aim of bringing forth a concrete of desired characteristic strength and also to make it feasible in terms of effective workability and economical as that in concrete mix design.

2. MIX DESIGN

2.1 Design specification

1. Characteristic Compressive strength (Required in study) at 28-days : 30Mpa
2. Max.size of aggregate: 12.5mm (rounded)
3. Degree of workability : up to 0.9(compaction factor)
4. Degree of quality : Good
5. Type of exposure : Severe

2.2 Test data of materials

1. Sp. gravity of cement :
Compressive strength of cement at 7-days : Requirements of IS269-1989(37N/mm²)
- 3 Water absorption
Coarse aggregate : 0.5%
Fine aggregate : 1.0%
4. Free surface moisture
Coarse aggregate : NIL
Fine aggregate : 2.0%
4. Fineness modulus of
Coarse aggregate : 6.15
Fine aggregate : 2.72

2.3 Steps in the Mix Proportion: Trail mix 1

1. Targeted mean strength for M30 grade concrete

$$f_{ck*} = f_{ck} + KS$$

$$f_{ck*} = 30 + 1.65 * 6.0 = 39.9N/mm^2$$

Where, Values for K = 1.65 and S=6.0

3. Selecting water % for 12.5mm max size aggregate and the sand lap-up to ZONE -II.

For W/C= 0.6, C.F-0.8, angular, sand lap-up to ZONE-11.

a) Water % per 1m³= 208 l/m³

b) Sand % total aggregate by absolute volume = 62%

c) C.F = 0.9

4. Determination of cement % = .38

$$\text{Water} = 199.2l/m^3$$

$$\text{The cement content} = 199.4 \text{ kg/m}^3$$

5. Determination of both aggregate contents for the max aggregate size of 12.5 mm, the amount of trapped air in the wet concrete is 3%, taking this in to concern and applying equations for the same.

$$V = [W/SW + C/SC + FA / (P * SFA)] * 1 / 1000;$$

$$V = [W/SW + C/SC + CA / ((1-p) * SCA)] * 1 / 1000;$$

$$0.97 = [199.24 + (524.31 / 3.01) FA / (0.506 * 2.613)] * 1 / 1000.$$

$$FA = 788.77 \text{ kg/m}^3$$

$$0.97 = [199.24 + (524.31 / 3.01) + CA / ((1 - 0.506) * 2.625)] * 1 / 1000.$$

$$CA = 773.06 \text{ kg/m}^3.$$

The mix proportion then becomes

The obtained contents of cement, sand, aggregate and

Cement	Sand	C.A	Water
524.31kg	874.62kg	687.2kg	199.24
1	1.67	1.31	0.38

water for 1m³ are listed below.

$$\text{Cement} = 524.31 \text{ kg}$$

$$\text{Sand} = 788.77 \text{ kg}$$

$$\text{Coarse aggregate} = 773.06 \text{ kg}$$

$$\text{Water} = 199.24 \text{ kg}$$

Conversion to SCC test specimens

The normal concrete are modified as per EFNARC specifications and different trail mixes are produced. By considering the fresh properties and harden properties of the mixes we finally conclude at the SCC mix proportion:

$$\text{Cement } \frac{208 \text{ l}}{m^3} = 524.31$$

$$\text{Fine aggregate} = 788.77$$

$$\text{Coarse aggregate} = 773.06$$

$$\text{Total aggregate} = (788.77 + 773.06) = 1561.83$$

$$\text{Lets Take } 56\% \text{ of T.A as F.A} = 199.24 \text{ kg/m}^3$$

$$F.A = 1561.830 * 0.56 = 874.62 \text{ Kg/m}^3$$

$$C.A = 687.2 \text{ kg/m}^3$$

The modified proportion is

Cement	Sand	Coarse aggregate	Water
524.31kg	788.77kg	773.06kg	199.24
1	1.5	1.47	0.38

Further in the trail mix-1 cementation material is taken as 270kg/ m³ of cement, 148.5kg/ m³

(55%) of fly ash,

108kg/ m³ (40%) of GGBS

2.7kg/ m³ (1% addition) of silica fumes are used.

The W/C material is 0.38

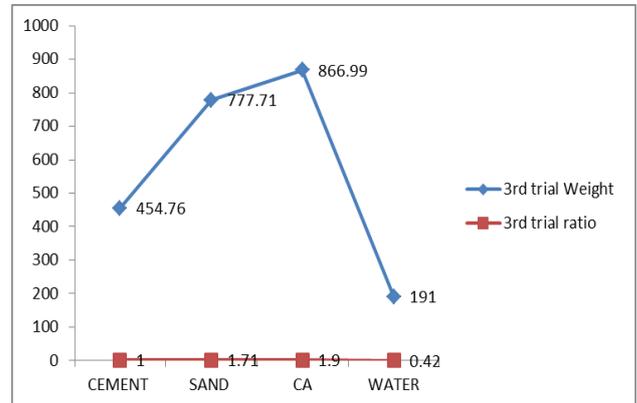
The fine aggregate/total aggregate is 62%

The contents of cement, fly ash, GGBS, silica, fine and coarse aggregate, water,

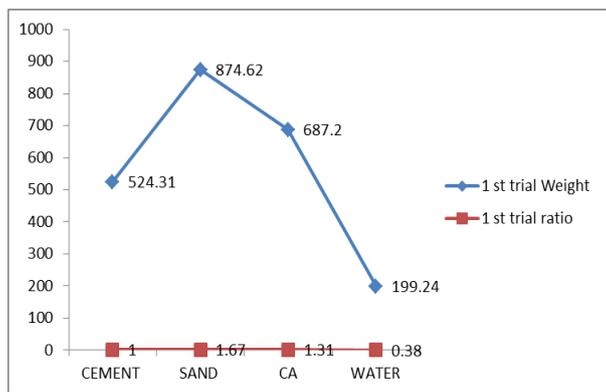
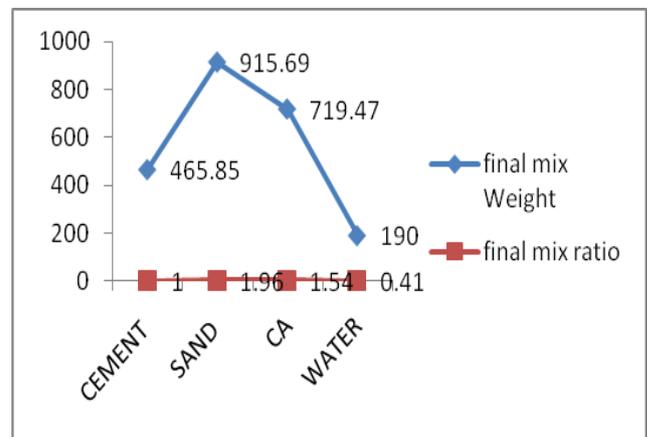
SP 430, VMA are listed below.

- Cement = 270kg/ m³
- Fly ash = 148.5kg/ m³
- GGBS = 108kg/ m³
- Micro silica = 2.7kg/ m³
- Fine aggregate = 788.77kg/ m³
- Coarse aggregate = 773.06kg/ m³
- Water = 200.98 lit/ m³
- SP 430 = 13.23 lit/ m³
- VMA = 1.85lit/ m³

2.5 Trial Mix3



2.5 Final Mix

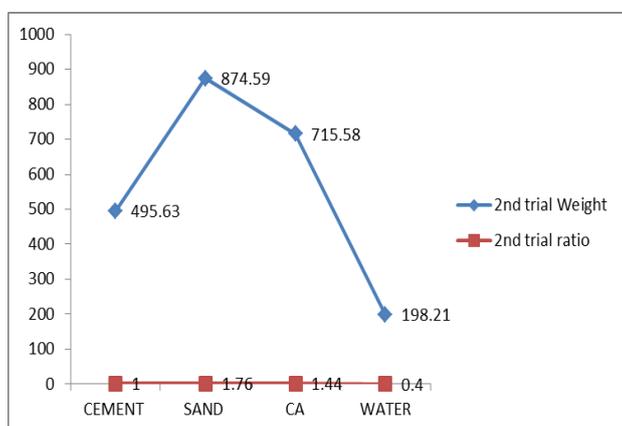


SP430 dosage =2.5% of cementation materials

VMA = 0.35% of cementation materials

Similarly Two More Trial Mixes are used on different proportion.

2.4 Trial Mix 2



2.5 Ratios of Mix Proportion by weight

Mix of Cement	Grade	Cement	F.A	C.A	Fly Ash	GGBS	Micro Silica	Sp 430 dosage	VMA Dosage
SCC	M30	1.0	3.81	3	0.55	0.4	0.01	0.050	0.007

3. Result & Discussion:

- a. As there are no such specification are given for mix design procedures of SCC, hence study mixes are casted on the basis of Indian Standards and suitable adjustments can be done as per the previous studies and guidelines by various concern agencies.
- b. Trail mixes are casted for maintaining flow ability, self compatibility and obstruction clearance

For Final Mix:

Compressive Strength of hardened concrete after 1 day	= 17.0 N/mm ²
Compressive Strength of hardened concrete after 3 days	= N/ 20 mm
Compressive Strength of hardened concrete after 7 days	.0 ² = N/ 26 mm
Compressive Strength of hardened concrete after 28 days = 40.0	.5 ² N/ mm ²

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