International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Self Compacting Concrete

B. Ankaiah[1], Dr. K. Chandra Sekhar Reddy[2]

[1]PG student, Department of Civil Engineering, Siddharth Institute of Engineering & Technology, Puttur,

[2]Principal, of Siddharth Institute of Engineering & Technology, Puttur

Abstract: ***Almost all countries in the world are facing an acute decline in the availability of skilled labour in the construction industry, and hence the need of Special Concretes becomes very essential in this world where the use of concrete is just next to the water. The recent studies which were carried out on Self Compacting Concrete (SCC) and compare it with Normal Concrete (NC) First research into the new technology which we now know as Self-Compacting Concrete started in Japan in the early 1980s.In that time they are use M20,M30,M40,and they are getting Compressive and Split Tensile Strength are(24.6N/mm^2,3N/mm^2), (34.74N/mm^2,3.75N/mm^2) (45.78N/mm^2,3.93N/mm^2) respectively for28 days. Main technical advantage of SCC is improved durability, Reduction of noise level, Faster construction, Development of strength very early, The compressive strength of concrete for M50 grade at different stages with different water cement ratios are calculated among them respective w/c is adopted.***

Keywords: Self Compacting Concrete, Compressive Strength, Tensile Strength, Super Plasticizer

1. Introduction

Self – compacting concrete (SCC) is a fluid mixture, which is suitable for placing difficult conditions and also in congested reinforcement, without vibration. In principle, a self – compacting or self – consolidating concrete must:

- Have a fluidity that allows self – compaction without external energy
- Remain homogeneous in a form during and after the placing process and
- Flow easily through reinforcement

Self – consolidating concrete has recently been used in the pre – cast industry and in some commercial applications, however the relatively high material cost still hinders the wide spread use of such specialty concrete in various segments of the construction industry, including commercial and residential construction.

Compared with conventional concrete of similar mechanical properties, the material cost of SCC is more due to the relatively high demand of Cementation materials and chemical admixtures including high – range water reducing admixtures (HRWRA) and viscosity enhancing admixtures (VEA). Typically, the content in Cementation materials can vary between 450 and 525 Kg/m^3 for SCC targeted for the filling of highly restricted areas and for repair applications. Such applications require low aggregate volume to facilitate flow among restricted spacing without blockage and ensure the filling of the formwork without consolidation. The incorporation of high volumes of finely ground powder materials is necessary to enhance cohesiveness and increase the paste volume required for successful casting of SCC.

2. Materials of SCC

2.1Aggregates

The coarse aggregate chosen for SCC is typically round in shape, is well graded, and smaller in maximum size than that used for conventional concrete typical conventional concrete could have a maximum aggregate size of 40 mm or more. In general, a rounded aggregate and smaller aggregate particles aid in the flow ability and deformability of the concrete as well as aiding in the prevention of segregation and deformability of the concrete as well as aiding in the prevention of segregation. Gradation is an important factor in choosing a coarse aggregate, especially in typical uses of SCC where reinforcement may be highly congested or the formwork has small dimensions. Gap – graded coarse aggregate promotes segregation to a greater degree than well-graded coarse aggregate. As with conventional concrete construction, the maximum size of the coarse aggregate for SCC depends upon the type of construction. Typically, the maximum size of coarse aggregate used in SCC ranges from approximately 10 mm to 20 mm.

2.2 Cement

The most common cement currently used in construction is type I/II Portland pozzolana cement, the grade of cement is similar to ordinary Portland cement. This cement conforms to the strength requirement of a Type I and the C3A content restriction of a Type II. This type of cement is typically used in construction and is readily available from a variety of sources. The Blaine fineness is used to quantify the surface area of cement and fineness is more than the OPC. The surface area provides a direct indication of the cement fineness. The typical fineness of cement ranges from 400 to 500m2/kg for Type I and Type III cements, respectively. In this cement also consist of fly ash content of more than 20%.

2.3 Fly Ash

Fly ash (or) pulverized fly ash is a residue from the combustion of pulverized coal collected by mechanical separators, from the fuel gases of thermal plants. The composition varies with type of fuel burnt, load on the boiler and type of separation. The fly ash consists of spherical glassy particles ranging from 1 to 150 micron in diameter and also passes through a 45-micron sieve.

2.4 Super Plasticizer

Super plasticizer is essential for the creation of SCC. The job of SP is to impart a high degree of flow ability and deformability, however the high dosages generally associate with SCC can lead to a high degree of segregation. Conplast SP 430 is utilized in this project, which is a product of FOSROC Company having a specific gravity of 1.222. Super plasticizer is a chemical compound used to increase the workability without adding more water i.e. spreads the given water in the concrete throughout the concrete mix resulting to form a uniform mix. SP improves better surface expose of aggregates to the cement gel. Super plasticizer acts as a lubricant among the materials. Generally in order to increase the workability the water content is to be increased provided a corresponding quantity of cement is also added to keep the water cement ratio constant, so that the strength remains the same.

2.5 Water

Potable water is used for mixing and curing.

3. S.C.C. Tests

3.1Compressive Strength of Concrete

Place the cube in the compression-testing machine. The green button is pressed to start the electric motor. When the load is applied gradually, the piston is lifted up along with the lower plate and thus the specimen application of the load should be 300 KN per minute and can be controlled by load rate control knob. Ultimate load is noted for each specimen. The release valve is operated and the piston is allowed to go down. The values are tabulated and calculations are done.

4.2 Split Tensile Strength

A concrete cylinder of size 150mm dia×200mm height is subjected to the action of the compressive force along two opposite edges, by applying the force in this manner .The cylinder is subjected to compression near the loaded region and the length of the cylinder is subjected to uniform tensile stress.

4. Mix Design

Different trail mixes with different w/c such as 0.3, 0.4, 0.45 were conducted. Depending upon the compressive and tensile strength values the mix proportion for M50 grade concrete is obtained with appropriate w/c. the final mix design is given below

4.1 Steps taken in the mix proportioning: final mix design

If the water cement ratio changes the strength of concrete can changes. Similarly by adding different w/c best value should be calculated according to the mix design and calculations are shown

1. Target mean strength for M50 grade concrete

$fck^* = f_{ck} + K_s$

$fck^* = 50 + 1.65\times5.0 = 58.25 N/mm^2$

Where,

K = probability factor for various tolerances (5%) = 1.65 from table 10.4

S= Standard deviation for different degrees of control (Good) =5.0 from table 10.6

2. The water cement ratio required for the target mean strength of 58.25Mpa is 0.35.
3. Selection of water and sand content for 20mm maximum size aggregate and the sand confirming to ZONE-II.

For W/C-0.6,C.F-0.8,angular, sand confirming to ZONE-II

(A)Water content per cubic meter of concrete =182 l/m3 =175 l/ m^3

(B) Sand content as percentage of total aggregate by absolute volume = 58%=60%

(C)C.F. = 0.8 and take W/C =0.42

Corrections

Change in condition	Water	Sand
W/C(0.6-0.42 = 0.18)	0	-3.6%
C.F =0	0%	0
Rounded	-17kg	-8%
Zone -2	0	0

The corrected water content per cubic meter of concrete

(182+ (0)) – 17 = 165 l/ m3

The corrected sand content as percentage of total aggregate by absolute volume

58 % - 11.4% = 46.4%

4. Determination of cement content Water/cement =0.42

Water = 165.00 l/m3

The cement content 165/0.42 = 392.85kg/m3

5. Determination of coarse and fine aggregate contents for the specified maximum. Aggregate size of 20 mm, the amount of entrapped air in the wet concrete is 3%, Taking this in to account and applying equations

V= [W/SW+C/SC+ fa/ (P×SFA)]×1/1000;

V= [W/SW+C/SC+Ca/ ((1-p)×SCA)]×1/1000;

1.00= [165+ (392.85/2.9)+fa / (0.464×2.65)]×1/1000.

F.A =860.14kg/ m^3

1.00= [165+ (392.85/2.9) +Ca/ ((1-0.464)×2.7)]×1/1000.

C.A =1012.36kg/ m^3.

The mix proportion then becomes

Cement	Sand	Coarse aggregate	Water
392.85kg	860.14kg	1012.36kg	165lit
1	2.18	2.57	0.42

The obtained contents of cement, sand, aggregate and water per cubic meter of concrete are listed below.

Cement	= 392.85kg
Sand	=860.14kg
Coarse aggregate	
Water	= 165lit

Converting into SCC Proportions

The normal concrete mix proportions are modified as per EFNARC specifications and different trail mixes and caste. By considering the fresh properties and harden properties of the mixes we finally arrived at the SCC mixed proportions as

Cement	= 392.85kg
Sand	=860.14kg
C. aggregate	= 1012.36kg
Total aggregate (T.A)= 860.14+1012.36=1872.5	
Taking 55% of T.A as F.A	
Fine aggregate	=1872.5× 0.55 =1030kg/ m^3
Coarse aggregate	= 842.5kg/ m^3

The modified proportion is

Cement	Sand	Coarse Aggregate	Water
392.85kg	1030kg	842.5Kg	165lit
1	2.62	2.14	0.42

Further in the trail mix-2 cementation material is taken as235.71kg/ $m^3$of cement, 157.14kg/ m^3 (40%) of fly ash is used.

The water/cementation material is 0.42
The fine aggregate/total aggregate is 58%

The contents of cement, fly ash, fine aggregate, coarse aggregate, waters SP430 and VMA are listed below

Cement	= 235.71Kg/ m^3
Fly ash	=157.14 Kg/ m^3
Fine aggregate	=1030.0
Coarse aggregate =	842.5 Kg/ m3
Water	= 165 lit/ m^3
SP 430	= 10.92 lit/ m^3
VMA	= 1.53 lit/ m^3

SP 430 dosage = 2.5% of cementation materials

VMA = 0.35% of cementation materials.

Ratios of mix proportions by weight:

Mix	*Grade of Cement*	*Cement*	*F.A*	*C.A*	*Fly Ash*	*Sp 430 dosage*	*VMA Dosage*
SCC	M50	1	2.62	2.14	0.4	0.059	0.0062

5. Result

Compressive strength and tensile strength values are listed below in tabular column

Trail Mix	Compressive Strength (N/mm2)				Tensile Strength (N/mm^2)	
	3 day	7 days	14 days	28 days	7 days	28 days
1	16.5	37	46.5	60	2.72	3.201
2	17	36.5	47	59	2.4	3.528
3	17	36	46	57.5	2.342	3.45
Final	18.5	38.5	47.6	59.5	2.452	3.657

6. Conclusions

Based on the investigation conducted for the study of behavior of self-compacting concrete the following conclusions are arrived.

As no specific mix design procedures for SCC are available mix design can be done with conventional BIS method and suitable adjustments can be done as per the guidelines provided by different agencies.

Final Mix:

Compressive Strength of hardened concrete after 3 day	= 18.5N/mm^2
Compressive Strength of hardened concrete after 7 days	= 38.5 N/mm^2
Compressive Strength of hardened concrete after 14 days	= 47.6 N/mm^2
Compressive Strength of hardened concrete after 28 days	59.5 N/mm2
Tensile Strength of hardened concrete after 7 days	= 2.452 N/mm^2
Tensile Strength of hardened concrete after 28 days	= 3.657 N/mm^2

References

[1] Concrete Technology text book by M.S.Shetty, 6th edition, S. Chand Publications.
[2] IS 12269:1987, Ordinary Portland cement 53 Grade.
[3] IS 10086:1982, Specification for moulds for use in tests of cement and concrete.
[4] IS 10262:2009, Concrete Mix Proportioning Guidelines.