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Experimental Study on Self Compacting Concrete Having Grade M70

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Abstract: ***Self-compacting concrete (SCC) is a flowing concrete mixture that is able to consolidate under its own weight. The highly fluid nature of SCC makes it suitable for placing in difficult conditions and in sections with congested reinforcement. Use of SCC can also help minimize hearing-related damages on the worksite that are induced by vibration of concrete. Another advantage of SCC is that the time required to place large sections is considerably reduced. When the construction industry in Japan experienced a decline in the availability of skilled labour in the 1980s, a need was felt for a concrete that could overcome the problems of defective workmanship. This led to the development of self-compacting concrete, primarily through the work by Okamura[1]. A committee was formed to study the properties of self-compacting concrete, including a fundamental investigation on the workability of concrete, which was carried out by Ozawa et al[2]. at the University of Tokyo. The first usable version of self-compacting concrete was completed in 1988 and was named "High-Performance Concrete", and later proposed as "Self Compacting High-Performance Concrete". In Japan, the volume of SCC in construction has risen steadily over the years[3]. Data indicate that the share of application of SCC in the precast concrete industry is more than three times higher than that in the ready-mixed concrete industry. This is attributable to the higher cost of SCC. Keywords— Self-compacting concrete, workability, Fly ash, Micro silica, super plasticizer and VMA. Applications of SCC results in a large payoff in not requiring vibration to achieve consolidation and the low noise level to meet stringent environmental requirements in urban and suburban construction sites. Less labour and speedier construction will result in substantial cost savings, less traffic disruption and risk reduction. Better durability and high strength will allow the engineers to design and build bridges to last a century and beyond.***

I. INTRODUCTION

In this project, an experimental study on self-compacting concrete is made for M70 grade by using super plasticizer and this self-compacting concrete produce by using M70 grade a poly carboxylate ether base super plasticizer .The material to be used this experimental study, are cement (53grade), aggregate (having size & lt; 20mm & small as possible up to 12mm for congested reinforcement). Chemical admixture (polycarboxylate ether (PCE)) to improve workability. This project is beneficial for, faster construction, reduction in site manpower, thinner concrete sections, and self-working environment. Self-Compacting Concrete (SCC) to fulfill all these requirements, the research to develop new type concrete become a major interest in the most country. In Japan, researchers have successfully developed a new type of concrete named Self-Compacting Concrete (SCC). This new concrete not only satisfied the two basic requirements of concrete but also create the new properties of concrete that are very workable, flowable and self-compacting. From definition, SCC is a type of concrete that can be compacted into every. Corner of formwork, purely by means of its own weight and without the need for vibrating compaction. SCC classified in High

Performance Concrete which defines as follow- " Fresh: self-compactable and flow able " Early age: Avoidance from initial defects 1.1.3 Reason for the Development of SCC The main factors for the development of SCC are to achieve high durable, flowable, workable and, self-compacting of concrete and to solve the weakness

METHODOLOGY

A. Complexities Involved In Making SCC

Normal strength concrete itself is a complex material. High strength and high-performance concrete with low water\ binder ratio add to the complexity. Making self-compacting concrete, particularly of high strength, adds further to the complexity. Generally, self- compacting concrete is used in situations for concrete requiring high strength say over 40Mpa or more.

B. New Generation Plasticizers

From various studies for production of SCC it was found to use poly-carboxylate based super plasticizer (pc).this next generation super plasticizer or what is sometimes called hyper plasticizer is more is more efficient than naphthalene or melamine based super plasticizer with respect to plasticizing property and slump retention property.

C. Viscosity Modifying Agent

Another important material required for production of scc.is viscosity modifying agent

(VMA).one of the methods of improving the stability of flowing Scc is to increase the paste content by using a large amount of filler active or inert of late, however, attempts are being made to reduce the fines content (the paste content)with a view to reducing shrinkage.

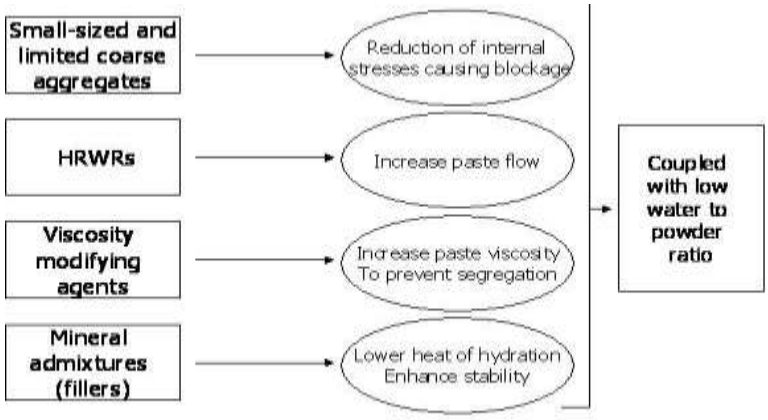
D. BASF: The chemical company.

EXPERIMENTAL STUDY ON SELF COMPACTING CONCRETE

HAVING GRADE M70

1) Masterglenium sky 8233(formerly Glenium B233): High –performance super plasticizer based on PCE (polycarboxylic ether) for concrete

2) Description: Masterglenium sky 8233 is an admixture of a new generation based on modified polycarboxylic ether. The product has been primarily developed for applications in high-performance concrete where the highest durability and performance is required. cementslenium sky 8233 is free of chloride & low alkali.it is compatible with all types of cement. Recommended uses Production of hemodynamic concrete High-performance concrete for durability High early and ultimate strength concrete Precast & amp; prestressed concrete containing pozzlans such as microsllica, GGBFS, PFA, including high volume fly ash concrete.



MIX DESIGN AND PROPORTION Mix Design of M70 Grade

STEP 1: STIPULATIONS FOR PROPORTIONING

a) Grade designation: M70

b) Type of Cement: OPC53 grade conforming to IS12269 [IS456 pg: 13, 5.1]

c) Maximum nominal size of aggregate: 10mm

d) Minimum Cement content: 320Kg/m3 [IS456 Table: 5]

e) Maximum Water Cement ratio: 0.40 [IS456 Table: 5]

f) Workability: Collapsible

g) Exposure condition: Severe (for reinforcement concrete) [IS456 pg: 18, 3]

h) Method of concrete: Pumping

j) Degree of supervision: Good

k) Type of aggregate: Angular aggregate
m) Maximum Cement content: -
n) Chemical Admixture type: Super plasticizer (Polycarboxylate ether) [Liquid form]
STEP 2: TEST DATA FOR MATERIALS
a) Cement used: OPC 53 Grade conforming to IS 12269
b) Specific gravity of Cement: 3.15
c) Chemical Admixture: Super plasticizer conforming to IS 9103
d) Specific gravity of
1) Coarse aggregate: 2.74
2) Fine aggregate: 2.74
e) Water absorption:
1) Coarse aggregate: 1.06
2) Fine aggregate: 1.32
f) Setting time of Cement:
1) Initial time: 135 min
2) Final time: 310 min

STEP 3: TARGET STRENGTH FOR MIX PROPORTIONING

f6□′ = f6□ + 1.65 S

Where;

f6□′ = Target average compressive strength @ 28 days

f6□ = Characteristic compressive strength @ 28 days

S = Standard deviation
From table 8, Standard deviation S = 5N/mm2 [IS456]
Therefore;
Target strength = 70+ (1.65 x 5)
= 78.25 N/ mm2
STEP 4: SELECTION OF WATER CEMENT RATIO
From Table 5 of IS456, Maximum Water Cement ratio = 0.40
Based on experience, adopt Water Cement ratio as 0.35
STEP 5: SELECTION OF WATER CONTENT
From table 2,
Maximum Water content for 10mm aggregate = 208 liter
As Super plasticizer is used, the water content can be reduced up to 20 % and above.
Based on trials with super plasticizer water content reduction of 20% has been achieved.
Hence arrived Water content = 208 x 0.8
STEP 6: CALCULATION OF CEMENT CONTENT
Therefore, 0.35 for Water Cement ratio for M70 grade
Water Cement ratio = 0.35
= 166
Cement content =
= 475 Kg / m3
From table 5 of IS 456,
Minimum Cement content for “Severe” exposure condition = 475Kg / m3
STEP 7: PROPORTION OF VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE CONTENT
From table 3, Volume of Coarse aggregate corresponding to 10mm size aggregate and Fine aggregate (Zone II) for water cement Ratio of 0.50 = 0.46.
In the present case, Water Cement ratio is 0.35.Therefore, Volume of Coarse aggregate is required to be increased to decrease the Fine aggregate content. As the Water Cement ratio is lower by 0.10 the proportion of Volume of Coarse aggregate is increased by 0.02(@ the rate of -/+ 0.01 for every ± 0.05 change in Water Cement ratio)
Therefore corrected proportion of Volume of Coarse aggregate for the Water Cement ratio of 0.35 = 0.49
For pumpable concrete, these values should be reduced by 10%.
Therefore, Volume of Coarse aggregate = 0.49
Volume of Fine aggregate content =1 – 0.49
= 0.51

STEP 8: MIX CALCULATION

The mix calculations per unit Volume of Concrete shall be as follows:

a) Volume of Concrete = 1m3

b) Volume of Cement =

= 0.150 m3

c) Volume of Water =

= 0.208 m3

d) Volume of chemical admixture (Super plasticizer @ 2.0 % by mass of cementitious material) =

= 0.003 m3

e) Volume of all in aggregate = [a - (b + c + d)]

= [1- (0.150 + 0.208 + 0.003)]

= 0.638 m3

f) Mass of Coarse aggregate = e x Volume of Coarse aggregate x Specific gravity of Coarse aggregate x 1000

= 0.638 x 0.49 x 2.74 x 1000

= 856 kg

g) Mass of Fine aggregate = e x Volume of Fine aggregate x Specific gravity of Fine aggregate x 1000

= 0.638 x 0.51 x 2.74 x 1000

= 891 kg

STEP 9: MIX PROPORTION FOR TRIAL NUMBER 1.

Cement = 475 kg / m3

Water = 166 kg / m3

Fine aggregate = 891 kg (IS 650:1991)

Coarse aggregate = 856 kg

Chemical admixture = 3.8 kg / m3

Water Cement ratio = 0.35

Hence, the proportion is 1 : 1.8 : 1.8

RESULT AND DISCUSSION

Fresh and Hardened state properties of Self -compacting concrete

Test results on fresh concrete the workability test i.e. Slump flow test, V-funnel test, L-box test results obtained for different fly ash replacement with cement i.e. (0%, 5%, 10% & 15%) With constant water-cement ratio (0.25.) The results of the SCC Mixes prepared and summarized in table 2 and 3.The characteristics results are given in table 3.

Slump Flow (SF) increases as the fly ash increases. For w/c 0.25, slump flow increases from 665mm to 668mm (0.45%). T500, V-funnel, T5 values are increasing with fly ash replacement increases. For w/c 0.25 T500 time increases from 3.84 to 3.85 sec (0.26%),V-funnel time increases from 8.20 sec to 8.32 sec (1.46%), T5 time increases from 10.60sec to 10.66 sec(0.56%) a. It is observed that workability Value increases increase in fly ash content 0 to 15%..L-box value increases 0.968 to 0.969 as the flash value increases in 0 to 15%. Compressive strength increases as the fly ash replacement increase from 0 to 15%for w/c ratio 0.25 from 0 to 15%. 7days Compressive strength increases from 53.10Mpa to 53.87 (1.45%). Whereas 28days Compressive strength increases from 81.65Mpa to 82.87Mpa (1.49%). (Figure 7) Split tensile strength for w/c ratio 0.25. When fly ash replacement increases from 0 to 15% 7days Split tensile strength increases from 3.44Mpa to 3.45MPa (0.29%). Whereas 28days Split tensile strength increases from4.06 MPa to 4.07MPa (0.24%). Flexural strength for the w/c0.25.When fly ash replacement increases from 0 to 15%. 7days

Flexural strength decreases from 5.72MPa to 5.73MPa (0.174%).Whereas 28days Flexural strength decreases from 6.20MPa to 6.30Mpa (1.62%). It is observed that Compressive strength and Split tensile strength decreases at a higher rate for 7days strength when compared to 28days strength, whereas the Flexural strength increases at a higher rate for 28days strength when compared to 7days strength.

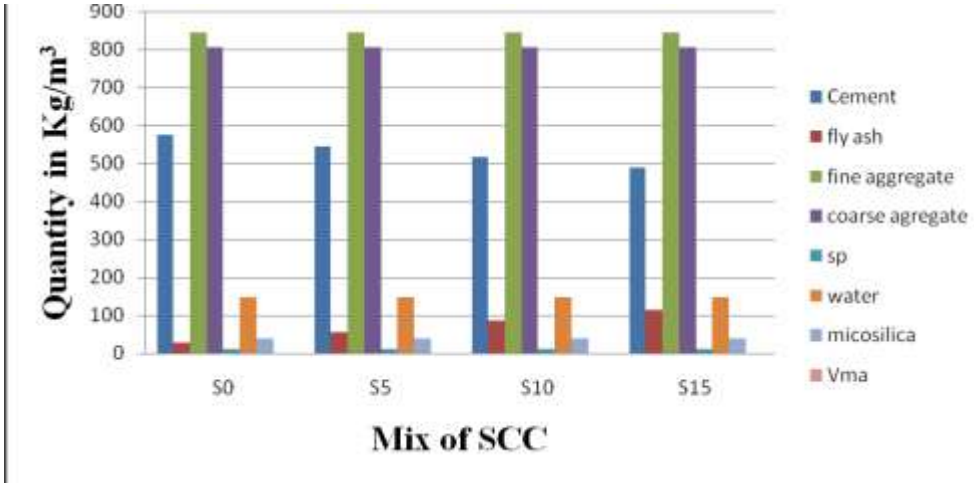


Fig: 1 Mixes of SCC showing the quantity of ingredients (Mix VS Quantity).

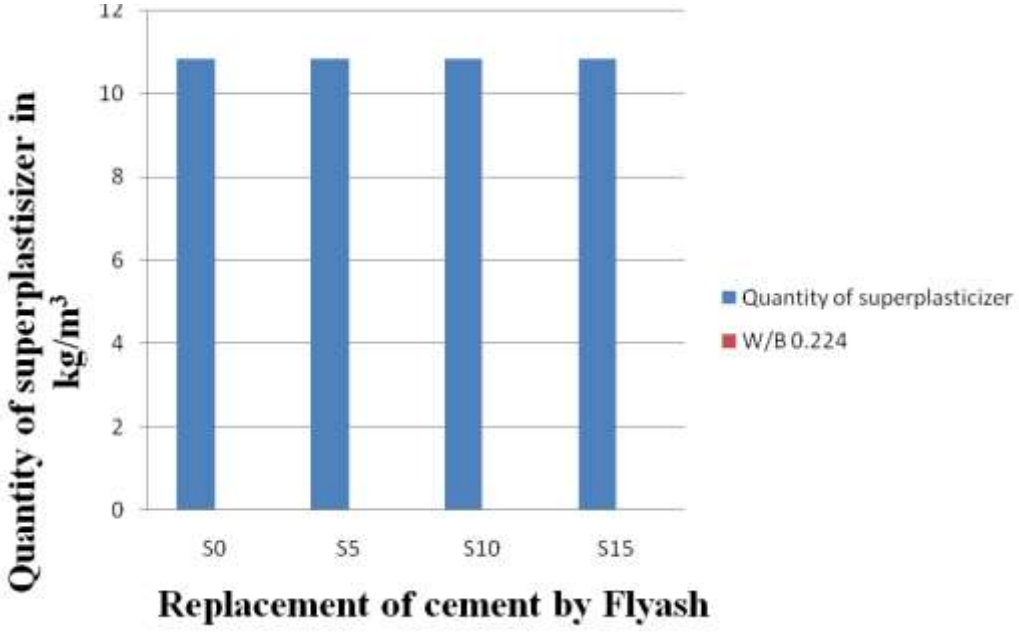


Fig 2 Replacement of cement by Flyash VS quantity of Superplasticizer

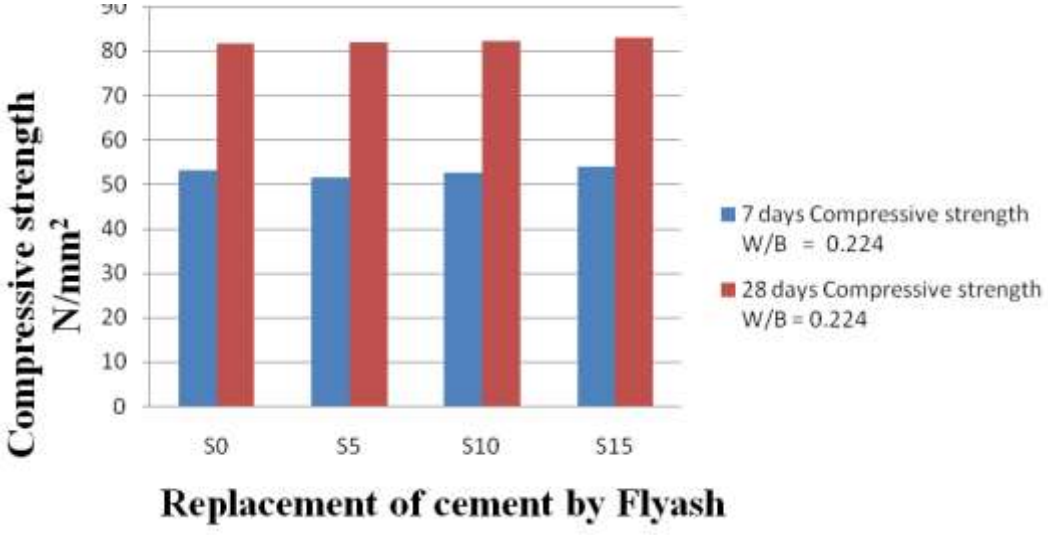


Fig3 Replacement of cement by fly ash VS Compressive strength.

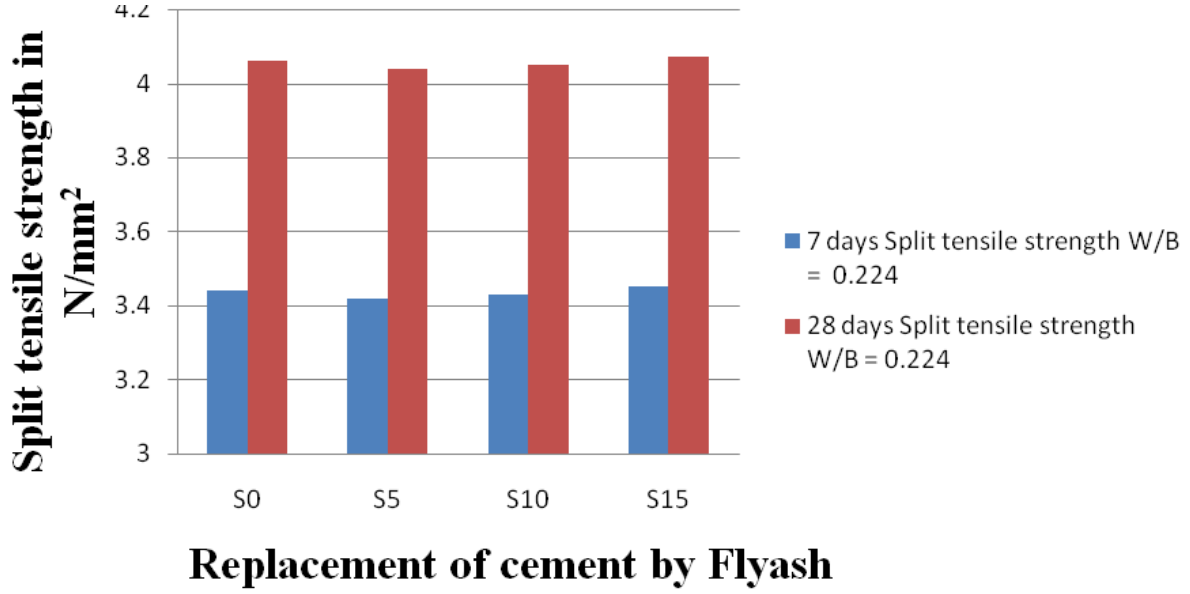


Fig4 Replacement of cement by fly ash VS Split tensile strength.

CONCLUSION

After study and experiment of SCC, we conclude that the concrete changes its properties from low strength to good with increasing strength. In everyday terms, when poured, SCC is an extremely fluid mix with the following distinctive practical features - it flows very easily within and around the formwork, can flow through obstructions and around corners ("passing ability"), is close to self-levelling (although not actually self-levelling), does not require vibration or tamping after pouring, and follows the shape and surface texture of a mold (or form) very closely once set. As a result, pouring SCC is also much less labor-intensive compared to standard concrete mixes.

Self Compacting Concrete (SCC) technology can save time, cost, enhance quality, durability and moreover it is a green concept. Since the concrete is capable of self-consolidating and reaching the difficult areas in molds, manual variables in terms of placing and compacting concrete are nil. This factor ultimately yields defectless, better-quality concrete structures.

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