International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 11 Issue 6 ǁ June 2023 ǁ PP. 319-324

Behavior of self-compacting concrete with partial replacement of cement with cattle manure ash and fly ash

Mr. Parth S. Singh[1], Mr. Aakash Suthar[2]
[1]*Student, Master in Structural Engineering, L.J.I.E.T, Gujarat, India*
[2]*Assistant Professor, Structural Engineering Department, L.J.I.E.T, Gujarat, India*

Abstract – *In current world where there is high demand of construction and building concrete plays a main role in fulfilling the requirement. Various concrete such as High strength concrete, Pervious concrete, High performance concrete, Ultra high performance concrete are being used based on the site condition and requirement. Concrete which consolidate by its own is termed as self-compacting concrete. Self-compacting concrete is a concrete which does not require any kind of vibrators for compaction. So, in this Study Self compacting concrete is prepared by partially replacing cement with cattle manure ash and fly ash. Concrete mix of M30 grade is prepared using superplasticizer. Various fresh property of concrete such as Filling ability (Flow test), Passing ability (L-box test), Inverted slump test are conducted to check fresh property of concrete. Compressive strength is to be conducted to check the strength of concrete.*

Key Words: Self Compacting Concrete, Cattle Manure Ash, Fly Ash, Fresh property Test

---

Date of Submission: 08-06-2023 Date of acceptance: 21-06-2023

I. INTRODUCTION

In todays developing world concrete plays a lead role in field of construction and building. Various type of concrete is being used depending on the site situation and need of special concrete. One of them is self-compacting concrete which consolidate by its own. Bar congestion is a highly common issue in large, complex construction project. With vibrators, compacting concrete becomes extremely challenging. Additionally, segregation happens as the concrete is being poured into the formwork. High workable concrete is a very practical solution to this problem. The slump of highly workable concrete is greater than 650 mm to 800 mm. Their quality assurance process and testing varies from standard concrete (Slump flow test instead of conventional slump test). Self-compacting concrete is also known as self -consolidating concrete. Use of self-compacting is effective when there is no space for the vibrator to be inserted as spacing between reinforcement is less. Such case develops the need of self-compacting concrete to fulfill the need compaction which is not possible without vibrators.

II. Material properties

Various material is being used in making a special type of concrete. Need of different material is based on the requirement of property in the concrete. Here all required properties of concrete is determined and mix design of M30 grade is prepared following guidelines prepared by EFNARC.

2.1 Cement

As Cement serves the property of binding material, hence it is the most important material to be used to bind all materials. Various cement such as rapid hardening cement, Portland pozzolana cement, ordinary Portland cement are being used in construction. Here in this case, we have taken Ordinary Portland cement. There are in total three grades of this cement 33, 43 and 53. Here we have used OPC of 53 grade. For using cement, it should be confirmed by the Indian Standard Code IS269 & IS12269. According to IS 269 the minimum compressive strength of OPC should be 27MPa. The fineness of cement should be 225 m^2/kg.

2.2 Fine Aggregate

Aggregate which passes through 4.75mm sieve is said to be fine aggregate. Fine aggregate makes the concrete mix dense by filling the voids generated by coarse aggregate. Various fine aggregate such as crushed stone, sand, crushed gravel sand is used. Here we have used sand for the mix design

Table 1- Fine Aggregate Property

Properties	Outcome
Specific Gravity	2.65
Water absorption	1%

Moisture Content	-

2.3 Coarse Aggregate

Aggregate which pass through 75mm sieve and retained in 4.75 mm sieve is called as coarse aggregate. As coarse aggregate improves the strength of concrete it is used for durability and strength of concrete. Here we have used mix angular coarse aggregate of 12.5mm and 20mm.

Table 2 Coarse Aggregate properties

Properties	Outcome
Specific Gravity	2.74
Water Absorption	0.5%
Moisture Content	-

2.4 Fly Ash

Nowadays Fly is most commonly used as cement partial replacement. Fly ash is prepared by burning coal. Coal power plant or steam generating plant produces large amount of fly ash. As it replaces cement partially contributing in environmental benefits. As fly ash is easily available it makes the mix economic. It is seen that using fly ash is concrete improves the workability of concrete and strength of concrete. Here we have partially replaced cement with 15% of fly ash.

Table 3 Fly Ash

Properties	Outcome
Specific Gravity	2.42

2.5 Cattle Manure Ash

Using replacement of cement improves the carbon footprint on the environment. Cattle manure ash one of such material which is used as partial replacement of cement and. It is environment friendly. As it is prepared by burning cattle dungs, it is easily available making the concrete cost economic. It improves the workability of the concrete.

Table 4 Cattle Manure Ash

Properties	Outcome
Specific Gravity	2.74

2.6 Admixture

Admixture in concrete increase workability of concrete with same water-cement ratio, increase initial setting time, delaying initial setting time, or to increase workability of concrete by reducing water content in the concrete. We have used Polycarboxylate Ether as admixture to improve workability of concrete by reducing water content in the concrete. It reduces water content in the concrete up-to 30%. Admixture with proportion of 0.1-0.4% weight of cement is generally used in concrete.

Table 5 Admixture Properties

Name	Polycarboxylate Ether
Specific Gravity	1.07
Color	Light Yellow

2.7 Water

Water Plays a vital role in hydration of cement. Quality of water makes difference in the concrete mix. It should be free from acid, weeds, salt, oils etc. For a perfect mix proper amount of water is determined.

III. Experimental Work

Fresh property test of concrete has been carried out. Test such as V-funnel, L-box test and inverted cone test are done. Mix design of M30 grade has been prepared using EFNARC guidelines and test is conducted on that concrete mix. Here OPC cement is partially replaced with fly ash and cattle manure ash. Mix proportion used for the study.

Table 6 Mix proportion for study

Mix	Cement %	Fly Ash %	Cattle Manure Ash %
Normal SCC	100%	-	-
SCC 1	70%	20%	10%

SCC 2	70%	-	30%

IV. Results

4.1 V-Funnel Test

First of all V-funnel apparatus is cleaned wisely with water. Trap door at bottom is closed and then concrete is filled in v-funnel till top and excess concrete is removed with tamping rod. Concrete is held inside for 10 sec and then trap door is opened and concrete is allowed to flow by its own. Time from door opened and v-funnel is emptied is noted.

Table 7 V-funnel result

Mix	Result (sec)
Normal SCC	9.98
SCC (20%FA+10%CMA)	8.43
SCC (30%CMA)	8.9

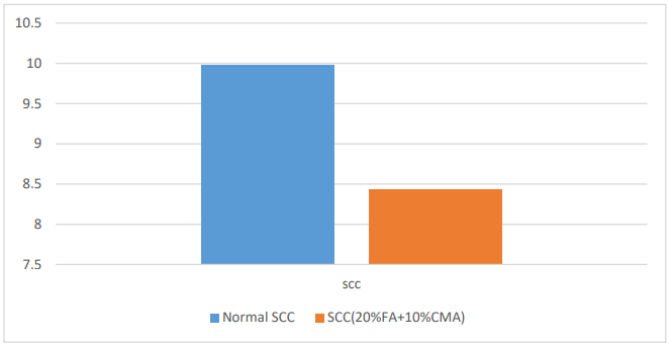

Fig 1 V-funnel result SCC (20%FA+10%CMA)

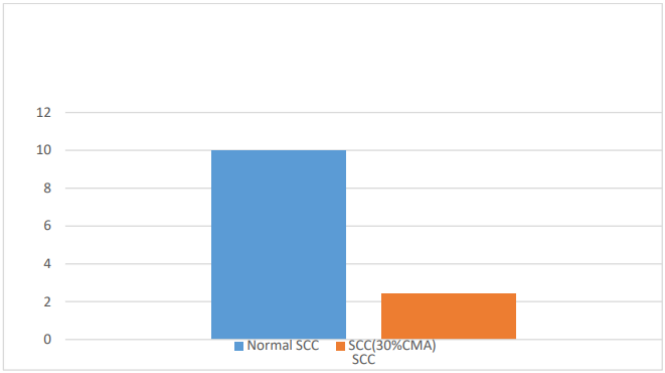

Fig 2 V-funnel result SCC (30%CMA)

4.2 L-Box Test

L-box apparatus is cleaned thoroughly with water. Trap door is closed at the beginning. Now concrete is filled inside the vertical portion till top. Concrete is held inside until 1 min and then trap door is opened and concrete is allowed to flow by its own. Test continues till concrete flow come to a rest. Now height from upright portion and height from horizontal portion is taken out and is denoted as H1 and H2 respectively.

Table 8 L-box result

Mix	Result
Normal SCC	0.95
SCC (20%FA+10%CMA)	0.814
SCC (30%CMA)	Blocked

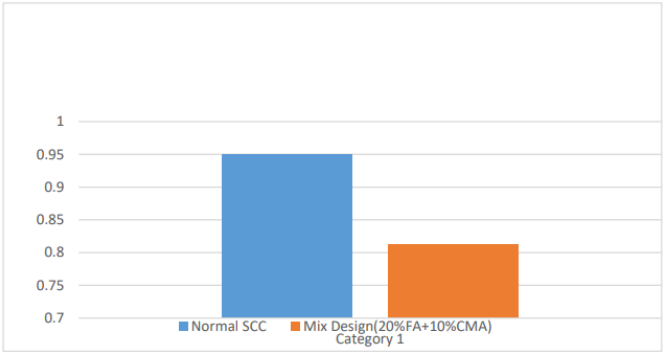

Fig 3 L-box result SCC (20%FA+10%CMA)

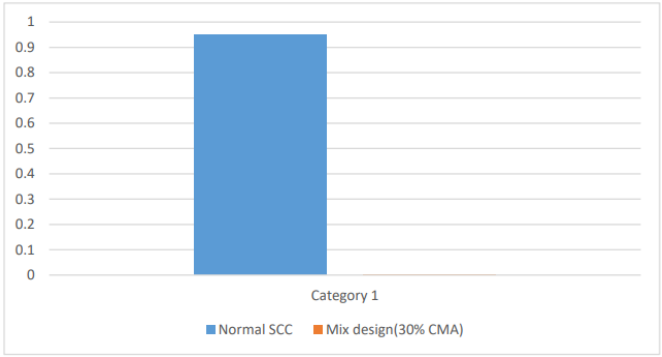

Fig 4 L-box result SCC (30%CMA)

4.3 Inverted Cone Test

Cone rinsed properly with water is used. Here in this test large opening side is kept at top and narrow opening of cone is kept at bottom. Now narrow opening is closed with trap. Concrete is filled inside the cone from top large opening side. After 30sec trap door is opened and concrete is allowed to flow by its own. Here the area covered by flowing concrete is measured.

Table 9 Inverted cone result

Mix	Result (mm)
Normal SCC	650
SCC (20%FA+10%CMA)	615
SCC (30%CMA)	500

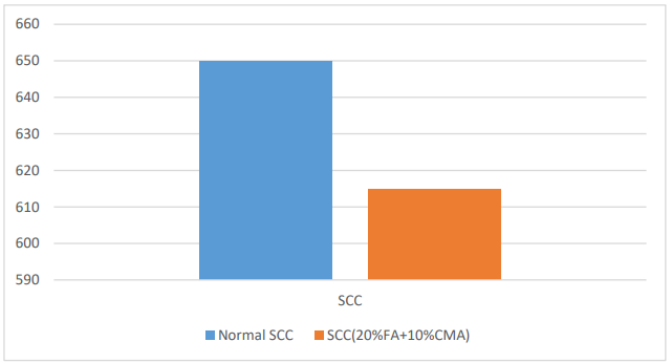

Fig 5 Inverted cone result SCC (20%FA+10%CMA)

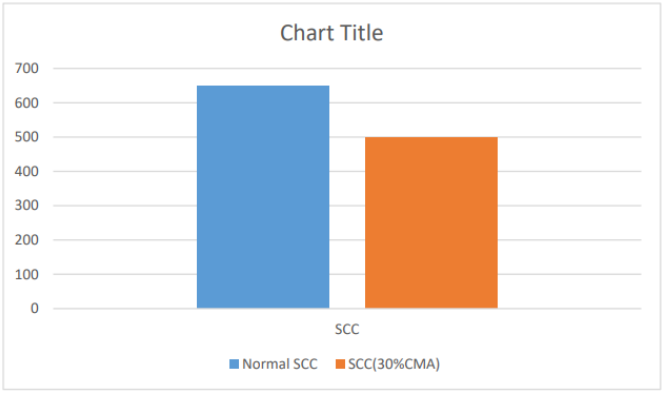

Fig 6 Inverted cone result SCC (30%CMA)

4.4 Compressive Strength test

In total 20 cube has been casted of 150x150x150 mm. Where 6 cube has mix of only cement, sand and aggregate.

6 cubes of mix having 20%FA and 10%CMA and 6 cubes having 30% CMA

Table 10 Cube quantity

Mix	7^{th} day	28^{th} day	Total
Normal SCC	3	3	6
SCC 1	3	3	6
SCC 2	3	3	6

Table 11 Compressive test result

Mix	7^{th} day result	28^{th} day result
Normal SCC	14.5	30.7
SCC 1	12.9	20.4
SCC 2	10.25	18.4

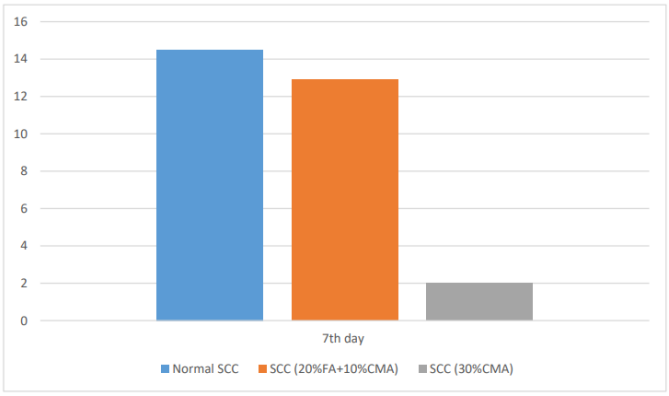

Fig 7 Compressive test result 7^{th} day

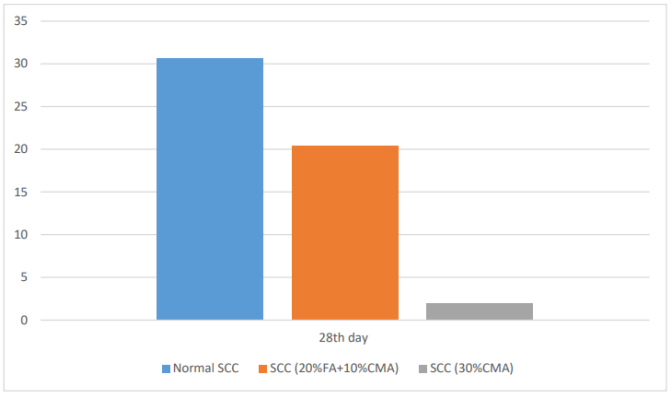

Fig 8 Compressive test result 28^{th} day

Fig 9 Cube failure under compression

V. CONCLUSIONS

In this study various mix has been tested. Fresh Property and harden property test are been conducted on various mix. Test results and conclusions are as follows:

- The fresh property of concrete is improved by using partial replacement of cement.
- Enhances concrete's ability to flow and fill, which enhances the material's performance. Because The construction period is shorter at SCC since its new properties are excellent.
- Having superior filling ability results in a better finish from an aesthetically standpoint.
- Cement can be replaced in part with fly ash and cattle dung ash to lessen the environment's carbon footprint.
- Inducing 20%FA and 10%CMA shows improvement in fresh property of concrete.
- Replacing 30%cement with CMA shows lesser result than mix having FA and CMA.
- For compressive strength it is seen that replacing cement with 20%FA and 10%CMA shows lesser strength than normal self-compacting concrete at 7th and 28th day test.
- And for Compressive strength of mix having 30%CMA has least strength of all three mix at 7th and 28th day test.

REFERENCES

[1]. R. Ramya Swetha, M. Swaroopa Rani ”Behavior of self-compacting concrete using agriculture waste as partial replacement of cement for M30 grade” Springer, 2021
[2]. Abhishek Jain , Rajesh Gupta , Sandeep Chaudhary “Sustainable development of self-compacting concrete by using granite waste and fly ash” Elsevier, 2020
[3]. Shazim Ali Memon , Muhammad Ali Shaikh , Hassan Akbar “Utilization of Rice Husk Ash as viscosity modifying agent in Self Compacting Concrete” Elsevier, 2010
[4]. Erhan Guneyisi “Fresh properties of self-compacting rubberized concrete incorporated with fly ash” Springer, 2009
[5]. Hossein Sasanipour , Farhad Aslani , Javad Taherinezhad ” Effect of silica fume on durability of self-compacting concrete made with waste recycled concrete aggregates” Elsevier, 2019
[6]. Tarun R. Naik, Rakesh Kumar, Bruce W. Ramme, Fethullah Canpolat “Development of high-strength, economical self-consolidating concrete” Elsevier, 2012
[7]. Yun Wang Choi, Yong Jic Kim, Hwa Cheol Shin, Han Young Moon “An experimental research on the fluidity and mechanical properties of high-strength lightweight self-compacting concrete” Elsevier, 2004
[8]. A.K.H. Kwan, S.K. Ling “Filler technology for improving robustness and reducing cementitious paste volume of SCC” Elsevier, 2017
[9]. Salim Barbhuiya “Effects of fly ash and dolomite powder on the properties of self-compacting concrete” Elsevier, 2011
[10]. Tayyeb Akram, Shazim Ali Memon, Humayun Obaid “Production of low cost self compacting concrete using bagasse ash” Elsevier, 2008