Performance Evaluation for Flexural Strength of M30 Design Mix Concrete with Partial Replacement of Conventional Ingredients

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ABSTRACT

A comprehensive effort is made in this work to partially replace the natural river sand by stone quarry dust and cement by fly ash as an alternative in combination with admixture, for concrete ingredients which shall lead to global sustainable development and lowest possible environmental impact and will also reduce cost of construction as well.

In the present work, keeping the coarse aggregate same as that of conventional one, other ingredients such as fine aggregate and binding material i.e. cement are partially replaced. Sand is (fine aggregate) replaced 30% by stone quarry dust throughout the work and the replacement of cement is varied from 0% to 20% with an increment of 05%. Proportion selected for concrete ingredients is 1:1.2:1.8 with water-cement ratio 0.45.

Initially the work is carried out without using super plasticizer. But with the view to increase workability, super plasticizer is also used concrete is studied for flexural strength. Prisms were cast for 7 days, 14 days and 28 days to determine flexure strength of concrete.

The results for all the tests were found to be much satisfactory, which shows that the replacement of PPC with fly ash up to 30% using stone quarry dust partially as fine aggregate is suitable.

Graphs are plotted for mechanical properties with respect to percentage variation in ingredients.

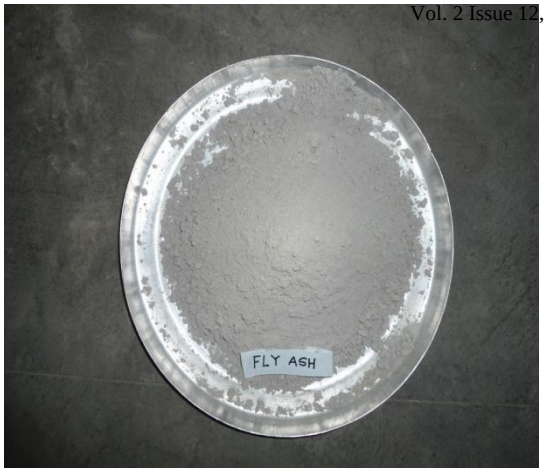
Key words- M*30, PPC, Stone Dust, sand, fly as etc.*

1. INTRODUCTION

Global warming and environment destruction have become manifest problem in recent years, heighten concern about global environmental issue, and a change over from the mass production, mass consumption, mass waste society of the past to a zero-emission society is now viewed as important. Preventing the exhaustion of natural resources and enhancing the usage of waste materials have become a significant problem of the modern world. Million tonnes of waste materials come into existence as a result of industrialisation and a lot of study has been carried out concerning the protection of natural resources, prevention of environmental pollution and contribution the economy by using these waste materials. The world needs environmentally friendly construction material. Concrete is basically made of aggregate, glued by a cement paste which is made cement and water. Each one of the primary ingredients of concrete to some extent has an environmental impact and give rises to different sustainability issues. The current concrete practice is unsustainable because, not only it consumes enormous quantities of natural resources like stones sand and drinking water, but also one billion tonne a year of cement , which is not an environment

friendly thing. The production of cement involves huge consumption of energy and emission of large quantities of carbon dioxide.

Disposal of fly ash has become great problem. It is aggravating day by day. Its disposal occupies nearly 50000 acres of precious land during their life span. Fly ash has characteristics to get heated very fast and cooling down as well. This results in drastic changes in the environment. Disposal and utilisation of fly ash has become challenge all over the world and it is need of an hour to make aware the Technical and Non-technical section of the society about utilisation of fly ash.



Chemical Constituents	Values	Units
Silica	40.18	%
Calcium oxide	1.16	%
Titanium oxide	0.04	%
Potassium oxide	0.18	%
Magnesium oxide	0.14	%
Phosphorous Pent oxide	0.19	%
Sulphur trioxide	0.04	%
sodium oxide	0.05	%
Aluminum as Al	1.42	%
Manganese Oxide	0.02	%
Chlorides as Cl	194	mg/kg
Loss on Ignition	**0.22**	**%**

2. MATERIALS AND PROPERTIES

CEMENT: The declared percentage of fly ash in the given PPC is 26.0 % (declared)

Table1: CHEMICAL COMPOSITION OF FLY ASH

SAND

TABLE 2: PHYSICAL PROPERTIES OF SAND

Sr. No.	Property	Average
1	Specific Gravity	2.66
2	Fineness Modulus	3.1
3	Water Absorption	0.5%
4	Surface Texture	Smooth
5	Particle Shape	Rounded

Sr. No.	Property	Average
1	Specific Gravity	2.85
2	Fineness Modulus	7.67
3	Water Absorption	0.60%
4	Particle shape	Angular
5	Crushing value	17.40
6	Impact Value	12.50

COARSEAGGREGATE

TABLE 3: PHYSICAL PROPERTIES OF COARSE AGGREGATE

3. EXPERIMENTAL PROGRAM

The Experimental Program was carried out in four stages:

Stage 01 **:-** Determination of physical properties of ingredients.

Stage 02 **:-** Mix Design for M30 Concrete as per Indian standard recommended method of concrete mix design (IS 10262 - 1982)

Stage 03 :- Experimental work conducted on concrete by using conventional ingredients only.

Stage 04 : Experimental work conducted on concrete by replacing cement with fly ash and sand with stone quarry dust with 0.5 % super plasticizer.

Experimental work conducted on concrete by using conventional ingredients

Preparation of Specimens

Constant parameters

- Mix proportion of concrete selected - 1:1.2:1.8
- Type of cement: PPC
- Type of aggregate
  - i) Sand < 4.75mm
  - ii) Coarse Aggregates < 25 mm
- Period of curing - 7, 14, 28 days
- Water cement ratio – 0.45

4. Experimental work conducted on concrete by replacing cement with fly ash and sand with stone quarry dust with 0.5 % super plasticizer.

Preparation of Specimens

Constant parameters

- Mix proportion of concrete selected - 1:1.2:1.8
- Type of cement: PPC
- Type of aggregate
  - i) Sand < 4.75mm
  - ii) Stone Quarry Dust 150μ - 4.75 mm
  - iii) Coarse Aggregates for flexural test < 20mm Period of curing: 7, 14, 28 days
- Super plasticizer - 0.5 %.
- Water cement ratio - 0.45

Variable Parameters

- Cement replaced by fly ash from 0% to 20% at the increment of 5%.

Test

- For each test two prism of dimension 500 mm x 100 mm x 100 mm size were cast and tested to determine flexural strength.

TABLE 4 : DETAILS OF MIX DESIGNATIONS

Mix Designation	Binding materials		Fine aggregate		Coarse aggregate	Admixture
	Cement	Fly ash	Sand	Stone quarry dust		Super Plasticizer
F 05	95%	5%	70%	30%	100%	0.5%
F 10	90%	10%	70%	30%	100%	0.5%
F 15	85%	15%	70%	30%	100%	0.5%
F 20	80%	20%	70%	30%	100%	0.5%

TABLE 5 : COMPACTION FACTOR TEST RESULTS

Sr. No.	Mix Designation	Compaction Factor
1	F 05	0.76
2	F 10	0.73
3	F 15	0.70
4	F 20	0.67

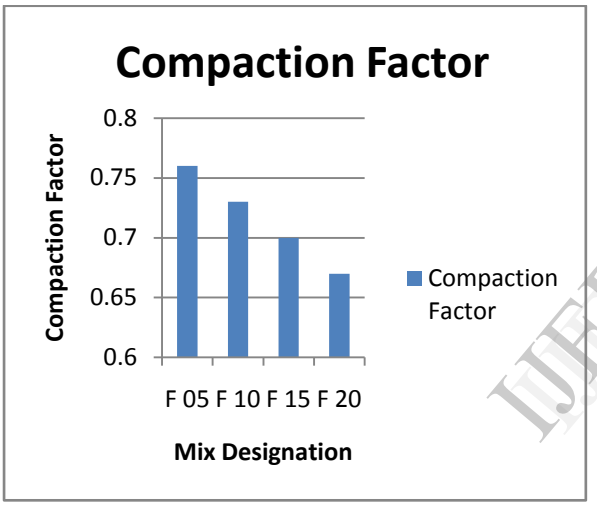


Fig.1 : Compaction factor test

TABLE 10: EFFECT OF FLY ASH ON FLEXURAL STRENGTH OF CONCRETE(Mpa)

Mix Designation	7 Day	14 Day	28 Day
F 05	2.22	4.08	6.68
F 10	1.95	4.32	5.86
F 15	1.81	3.90	5.43
F 20	1.66	3.80	4.98

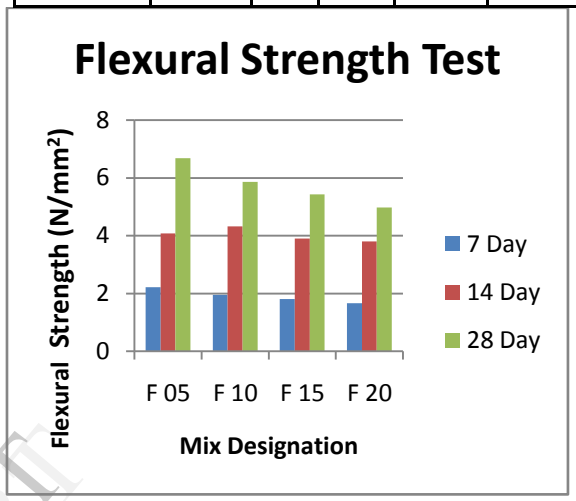


Fig.2: Variation in flexural strength of concrete

5. DISCUSSION

- Specific gravity of stone quarry dust is higher than sand.
- Water absorption of stone quarry dust is higher than that of sand.
- Rough texture and angular shape of stone quarry dust the concrete makes less workable.
- Due to addition of fly ash workability of concrete is reduced to very low, hence there is need of super plasticizer.
- flexural strength of concrete goes on decreasing with the increase in percentage of added fly ash.

6. CONCLUSION

From the experimental investigation it can be concluded that

- Concrete mix M30 (Design Mix 1:1.2:1.8) gives satisfactory mechanical properties like Flexural strength up to 10 % replacement of

cement by fly ash and 30 % replacement of sand by stone quarry dust with 0.5 % super plasticizer.

- Concrete mix with above ingredients can be called as green concrete which should be promoted for its use which indirectly helps to save environment and economy.

REFERENCES

[1] J. Prabhakar, P. Devadas Manoharan and M. Neelamegam (2011), "Effect of Fly Ash On Durability and Performance of Concrete", *The Indian Concrete Journal*, Page No. 9-15.

[2] Nadir, N. S. and Bhavikatti, S. S., (2007). "Stone Quarry Dust and Alternative for Sand in Concrete", *Second National Conference on Materials and Structures (MAST),* NIT Warangal.

[3] Radhikesh P. Nanda, Amiya K. Das, Moharana N.C.(2010), "Stone Crusher Dust as a Fine Aggregate in Concrete for Paving Blocks", *International Journal of Civil and Structural Engineering* Volume 1 No. 3,Page no. 613-620.

[4] R. Hangovana, N. Mahendrana and K. Nagamanib (2008), "Strength and Durability Properties of Concrete Containing Quarry Rock Dust as Fine Aggregate", *APRN Journal of Engineering and applied sciences*, Vol. 3 No. 5 Page no. 20-26.

[5] Sahu A. K., Sunil Kumar, and Sachan, A. K., (2003), "Crushed Stone Waste as Fine Aggregate for Concrete", *The Indian Concrete Journal*, 845-848.

[6] S. Keerthinarayana and R. Sri Nivasan (2010), "Study on Strength and Durability of Concrete by Partial Replacement of Fine Aggregate Using Crushed Spent Fire Bricks", *Buletinul Institutului Politehnic Din IASI*. Page no 51-62.

[7] Shetty, M. S. (2008). "Concrete Technology (Text book)*", S. Chand and Company Ltd*., New Delhi.

[8] IS: 383-1970, Specification for coarse and fine aggregates from natural sources for concrete Bureau of Indian Standards, New Delhi.

[9] IS: 2386-1963 Part I to VII. Indian standard methods for test for aggregate for concrete. Bureau of Indian standards, New Delhi.

[10] IS: 516-1959, Indian Standard methods of test for strength of concrete. Bureau of Indian standards, New Delhi.

[11] IS: 10262-2009 and SP: 23:1982 Recommended guidelines for concrete mix. Bureau of Indian standards, New Delhi.