



## Strength Studies on Concrete by Partial Replacement of Cement with Egg Shell Powder and Silica Fume

*P. Himaja<sup>1</sup>, D. Mohammed Rafi<sup>2</sup>*

<sup>1</sup>PG Scholar, Dept of Civil, ALTS, AP, India

<sup>2</sup>Assistant Professor, Dept of Civil, CRIT, AP, India

### ABSTRACT—

Concrete is the one of the most widely used construction material throughout the world. Hence it has been labelled as the backbone to the infrastructure development of nation. To fulfill the requirement of industries here we have replaced partially the constituent materials of concrete by using waste material. It was carried out to evaluate the properties of concrete by replacing the cement by egg shell powder and silica fume by varying the percentage of 2.5%, 5%, 7.5%, 10% egg shell powder and silica fume. A comparison of partially replaced concrete with conventional concrete was also include into the study. Comparison of weights of natural concrete with partially replaced concrete after 7, 14 and 28 days of curing was included. The mix design arrived for an M25 mix. As I know the carbon dioxide produced by cement industry causes environmental pollution and global warming. In 1000 Kg of cement manufacturing process approximately 900Kg of carbon dioxide is emitted. In order to reduce the cement production into atmosphere waste by products are used admixture in study so that environmental pollution and natural resources consumption is reduced. In India, egg shell powder which in calcium and silica fume is thrown away as waste. In the present study, use of egg shell powder and silica fume as a partial replacement of cement and various properties like workability, compressive strength and spilt tensile strength was determined. Keep silica fume and eggshell percentage equal and finding strength of blocks.

**Keywords—** Concrete, Infrastructure, egg shell powder, Silica fume, Cement, Global Warming, Calcium.

### I. INTRODUCTION

Cement is the costliest and energy intensive component of concrete. The unit cost of concrete can be reduced by partial replacement of cement with egg shell powder and partial replacement of cement with micro silica fume. Egg shell increases the solid waste which is a major issue for environment. The utilization of egg shell powder and silica fume instead of throwing it as a waste material can be partly used on economic grounds with partial replacement of cement.

It has been used particularly in mass concrete applications and large volume placement to control expansion due to heat and also helps in reducing cracking at early ages. Silica fume is by product of producing silicon metal or ferrosilicon alloys. One of most beneficial use of silica fume in concrete because it's chemical and physical properties. Concrete containing silica fume can have high strength and can durable.

It is the action of human being that determines the worth of any materials having potentials for gainful utilization remain in the category of waste until its potential is understood and put to right use. Egg shell powder and silica fume is one such example, which has been treated as a waste material in India.

This project comprises of replacing of cement (OPC,53grades) for different percentage of egg shell and Silica fume and then testing them for their compressive strength.

### II. CHEMICAL COMPOSITION OF THE RICE HUSK ASH

Oxide contents	Percentage (%)
CaO	50.5
SiO <sub>2</sub>	0.09
Al <sub>2</sub> O <sub>3</sub>	0.04
MgO	0.02
Fe <sub>2</sub> O <sub>3</sub>	0.25
Na <sub>2</sub> O	0.18
P <sub>2</sub> O <sub>5</sub>	0.23

SrO	0.14
NiO	0.0015
SO <sub>3</sub>	0.56
C1	0.22

TABLE-1- CHEMICAL COMPOSITION OF THE RICE HUSK ASH

### III. CHEMICAL COMPOSITION OF SILICA FUME

Oxide Content s	Percentage (%)
CaO	0.31
SiO <sub>2</sub>	90.20
Al <sub>2</sub> O <sub>3</sub>	0.13
Fe <sub>2</sub> O <sub>3</sub>	0.14
MgO	0.74

TABLE-2-CHEMICAL COMPOSITION OF SILICA FUME

### IV. MIX PROPORTION RATIO

Cement	Fine aggregate	Coarse aggregate	water
439	657.03	1110.53	196.16
1	1.48	2.54	0.46

TABLE-3- MIX PROPORTION RATIO

### V. SLUMP TEST OF CONCRETE FOR REPLACING RICE HUSK ASH AND SILICA FUME POWDER

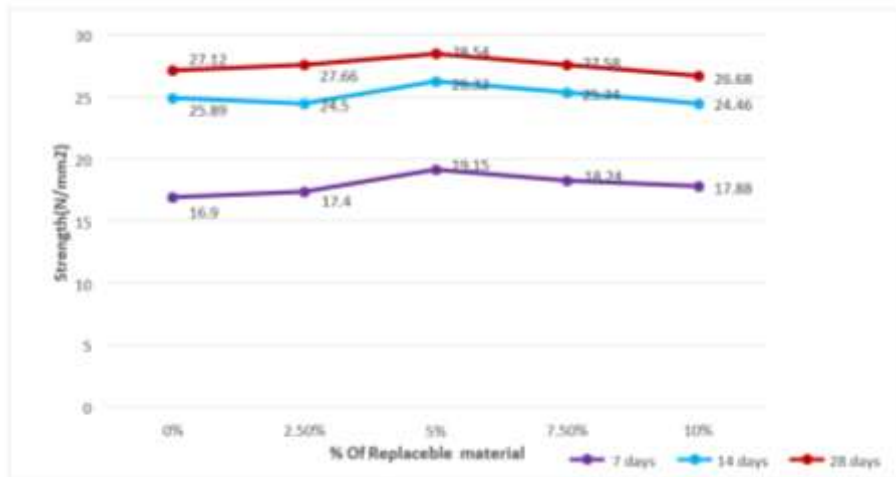
S.NO	MIX DESIGN	SLUMP VALUS M25	SLUMP DESIGATION
1	Nominal	90	True slump
2	Mix (2.5%)	85	True slump
3	Mix (5%)	75	True slump
4	Mix (7.5%)	70	True slump
5	Mix (10%)	60	True slump

TABLE-4- SLUMP TEST OF CONCRETE FOR REPLACING EGG SHELL AND SILICA FUMEPOWDER

### VI. COMPRESSIVE STRENGTH FOR 7,14, AND 28 DAYS

S. No	% Of Replaceable Material	Area(mm <sup>2</sup> )	Strength(N/mm <sup>2</sup> )		
			7 days	14 days	28 days
1	Nominal	22500	16.9	25.89	27.12
2	Mix (2.5%)	22500	17.4	24.5	27.66
3	Mix (5%)	22500	19.15	26.32	28.54
4	Mix (7.5%)	22500	18.24	25.34	27.58
5	Mix (10%)	22500	17.88	24.46	26.68

TABLE-5- COMPRESSIVE STRENGTH FOR 7,14, AND 28 DAYS

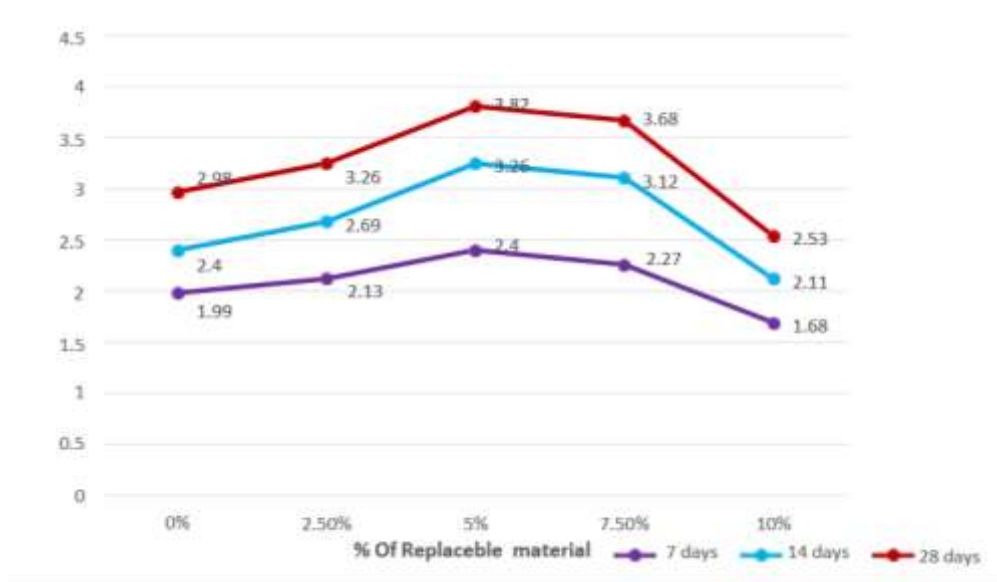


GRAPH-1-COMPRESSIVE STRENGTH FOR 7,14, AND 28 DAYS

## VII. SPLIT TENSILE STRENGTH FOR 7,14, AND 28 DAYS

S. No	% Of Replaceable Material	Strength(N/mm2)		
		7 days	14 days	28 days
1	Nominal	1.99	2.41	2.98
2	Mix (2.5%)	2.13	2.69	3.26
3	Mix (5%)	2.4	3.26	3.82
4	Mix (7.5%)	2.27	3.12	3.68
5	Mix (10%)	1.68	2.11	2.53

TABLE-6-SPLIT TENSILE STRENGTH FOR 7,14, AND 28 DAYS



GRAPH-2- Split tensile Strength For 7,14, And 28 Days

## CONCLUSIONS

- The compressive strength of conventional concrete is 27.12 N/mm<sup>2</sup> while adding 5% of egg shell powder and silica fume the compressive strength increases by 5%.

- The egg shell powder and silica fume is replaceable up to 10% in concrete because the compressive strength is more than conventional concrete near 5% while egg shell powder and silica fume is added i.e (adding of egg shell powder the compressive strength is 28.54N/mm<sup>2</sup>, the compressive strength of conventional concrete is 27.11 N/mm<sup>2</sup>)
- The split tensile strength of conventional concrete is 2.98 N/mm<sup>2</sup> while adding 5% of eggshell powder and silica fume the split tensile strength increases by 28.5%.
- The split tensile strength may increases up to 28.5% of egg shell powder and silica fume adding in concrete.
- The split tensile strength of concrete while adding 5% of egg shell powder and silica fume is 3.82 N/mm<sup>2</sup>, the split tensile strength of conventional concrete is 2.98 N/mm<sup>2</sup>.
- By increasing the egg shell powder and silica fume of 5% in conventional concrete the workability of the concrete is increasing.
- The compressive strength of conventional concrete is 28.54 N/mm<sup>2</sup> while adding 5% of silica fume the compressive strength increases by 5%.
- The compressive strength of concrete while adding 5% of egg shell and silica fume is 28.54 N/mm<sup>2</sup>, the compressive strength of conventional concrete is 27.12 N/mm<sup>2</sup>.
- The split tensile strength of conventional concrete is 2.98 N/mm<sup>2</sup> while adding 5% of egg shell powder and silica fume the split tensile strength increases by 28.5%.
- The split tensile strength may increases up to 5% of egg shell powder and silica fume adding in conventional concrete.
- The split tensile strength of conventional concrete while adding 5% of egg shell powder and silica fume is 2.98 N/mm<sup>2</sup>, the split tensile strength of conventional concrete is 3.82 N/mm<sup>2</sup>.
- By increasing the egg shell powder and silica fume in conventional concrete the workability of concrete is increasing.

## REFERENCES

- Bureau of Indian standards, IS 10262:2009, Concrete Mix Proportioning Guidelines. Bureau of Indian standards, IS 12269:1987, OPC-53 Grade Cement.
1. Amarnath Yerramala, Properties of cement with eggshell powder as cement replacement, The Indian Concrete Journal October 2014.
  2. D Gowsika, Experimental Investigation of Egg Shell powder as partial replacement with cement in concrete, International Journal of engineering Trends and technology (IJETT), Volume 14 November 2 Aug 2014.
  3. Praveen Kumar R, Experimental Study on Partial Replacement of cement with Eggshell powder, International journal of innovations in engineering and technology, Volume 5, ISSN:2319-1058
  4. Vijaya Sarathy .R and Jose Ravindraraaj B (2015), Experimental Study on Partial Replacement of cement with Egg shell powder – International Journal of Innovation in engineering and technology.
  5. Ssrankokila, Ksargunam (2014) Experimental Investigation of Egg shell powder as Partial Replacement with Cement in concrete- International Journal of Engineering.
  6. Jayasankar .R Mahindran N, Ilangovan R (2010) Studies on concrete Using egg shell powder, International Journal of Civil and structural Engineering , Vol. 1 Issue No 3. Pp 362-373.
  7. J.Karthik , M Petchiyammal (2012), Experimental Study on usage of eggshell as Partial Replacement for cement in concrete, Global Journal of Advanced Research in Education Technology, Vol.1 Issue1, pp 7-11.