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Calculation of Modulus of Elasticity for Concrete Using Thermal Industrial Waste

Ronak Prakashkumar Patel
Student of final year M.E. in Construction Engineering & Management
B.V.M.Enggineering College, Vallabh vidhyanagar-Gujarat-India

Jayeshkumar Pitroda
Assistant Professor & Research Scholar, Civil Engineering Department
B.V.M.Enggineering College, Vallabh vidhyanagar-Gujarat-India

ABSTRACT

A major use for fly ash in the construction industry is in the production of high quality structural concrete. Fly ash contributes beneficial properties to the concrete while helping to maintain economy. The use of fly ash, the thermal industrial waste in concrete formulations as a supplementary cementitious material was tested as an alternative to traditional concrete. The cement has been replaced by fly ash accordingly in the range of 0%, 10%, 20%, 30% & 40% by volume for M-25 and M-40 mix. Concrete mixtures were produced, tested and compared in terms of modulus of elasticity with the conventional concrete. The test was carried out to evaluate the modulus of elasticity after 56 days. Within the scope of this study, different concrete mixtures were produced to determine the influence of fly ash derived from Maize Products (A division of Sayaji Industries Ltd) Power plant in central Gujarat, referring to the Modulus of Elasticity.

KEYWORDS: fly ash, modulus of elasticity, supplementary cementitious material

1. INTRODUCTION

In India, coal will continue to remain a major source of fuel for power generation. At present, about 60% power is produced by using coal as fuel, which results in the production of about 112 million tonnes of ash per annum. Considering the tremendous growth required in the power sector for the development of Indian economy, it is expected that ash generation will reach 175 million tonne per annum by 2012 and 225 million tonne by 2017. (Report On "Fly Ash for Cement Concrete" Ash Utilization Division-NTPC Limited)

Good availability and quality of fly ash the positive awareness is required. It should be 'A resource material' rather than 'A waste material'. Now a day's quality of coal is strictly observed. By adopting electrostatic precipitators, fly ash of consistent quality is separated and stocked. It is used as a good pozzolanic material for partial replacement of cement in concrete. A concrete mix with fly ash can provide environmental and economical benefits. Fly Ash concrete enhances the workability, compressive strength, flexural strength and also increases its pumpability, durability and concrete finishing.

Modulus of elasticity of concrete is a very important property to determine the deflection of the structural elements. Within the scope of this study, different concrete mixtures were produced to determine the influence of fly ash derived from Maize Products (A division of Sayaji Industries Ltd) Power plant in central Gujarat. The modulus of elasticity testing is used to determine the deflection of the concrete specimens that having different percentage of fly ash replacement. The testing is just carried out after 56 days of casting. The resting specimen was 150mm diameter and 300 mm height. There were total of five batches of concrete mixes, consists of every 10% increment of fly ash replacement from 0%, 10%, 20%, 30% and 40% by volume for M-25 and M-40 mix.

2. PERFORMANCE OF TESTS

2.1 Composition of concrete

2.1.1 (a) Coarse Aggregate

The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 is be use. The Flakiness and Elongation Index were maintained well below 15%.

2.1.1 (b) Fine aggregate

Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The river sand and crushed sand is be use in combination as fine aggregate conforming to the requirements of IS: 383. The river sand is wash and screen, to eliminate deleterious materials and over size particles.

2.1.2 Mix proportions

A mix M25 and M40 grade was designed as per IS 10262:2009 and the same was used to prepare the test samples. The design mix proportion is shown in Table 1.

Table 1. Concrete Design Mix Proportions

Sr. No.	Concrete type	Concrete Design Mix Proportion (By volume)				Fly ash replacement
		W /C ratio	C	F. A.	C.A.	
1	A1-M25	0.40	1.00	1.01	2.50	-
2	A2-M40	0.30	1.00	0.44	2.17	-
3	B1-M25	0.40	0.90	1.01	2.50	0.10
4	B2-M25	0.40	0.80	1.01	2.50	0.20
5	B3-M25	0.40	0.70	1.01	2.50	0.30
6	B4-M25	0.40	0.60	1.01	2.50	0.40
7	B5-M40	0.30	0.90	0.44	2.17	0.10
8	B6-M40	0.30	0.80	0.44	2.17	0.20
9	B7-M40	0.30	0.70	0.44	2.17	0.30
10	B8-M40	0.30	0.60	0.44	2.17	0.40

As the mix proportion of all different concretes are constant, a change in Modulus of Elasticity is only caused by the different % replacement of fly ash.

2.1.3 Specific data of the cement

The most common cement used is an Ordinary Portland Cement (OPC). The Ordinary Portland Cement of 53 grade (Hathi OPC) conforming to IS:8112-1989 is be use. Specific gravity, consistency tests, setting tests, compressive strengths, etc. are conducted on cement. The results are tabulated in Table 2.

Table 2.Properties of HATHI Cement (OPC 53 grade)

Sr. No.	Physical properties of cement	Result	Requirements as per IS:8112-1989
1	Specific gravity	3.15	3.10-3.15
2	Standard consistency (%)	28%	30-35
3	Initial setting time (hours, min)	35 min	30 minimum
4	Final setting time (hours, min)	178 min	600 maximum
5	Compressive strength- 7 days	38.49 N/mm2	43 N/mm2
6	Compressive strength- 28 days	52.31 N/mm2	53 N/mm2

2.1.4 Storage of the test samples

After casting, the samples (cylinders, diameter = 150 mm, height = 300 mm) were led in the moulds for 24 hours, stripped and cured in water until the age of 56days.

2.1.5 Testing the Modulus of Elasticity: (IS 516 – 1959)

Modulus of elasticity of concrete is a very important property to determine the deflection of the structural elements. Deflection of concrete beams and slabs is a common building movement. It also mentioned that the deflection is the result of the flexural strains that develop under dead and live loads and this may occur cracking in the tensile zone. The modulus of elasticity testing is used to determine the deflection of the concrete specimens that having different percentage of fly ash

replacement. The testing is just carried out after 56 days of casting. The resting specimen was 150mm diameter and 300 mm height. The Modulus of Elasticity can be calculated by the difference of the measured stresses and strains on an upper level (i.e. 1/3 of the value of compressive strength) and a lower level (i.e. 0.5 N/mm2). Fig 1 shows the setup of Modulus of Elasticity.

Fig 1: Setup of Modulus of Elasticity

3. RESULTS

The results of the measurement are shown in Table 3.

Table 3 Result of Modulus of Elasticity after 56 days

Mix Type	Modulus of Elasticity (MPa) after 56 days
A1-M25	17777
B1-M25	14000
B2-M25	12857
B3-M25	10833
B4-M25	8214
A2-M40	18667
B5-M40	16428
B6-M40	12000
B7-M40	10909
B8-M40	10000

In Figure 2 are given the measured Modulus of Elasticity.

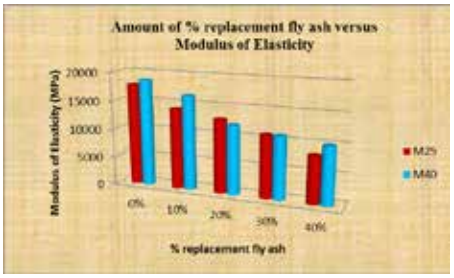

Fig. 2: Amount of % replacement fly ash versus Modulus of Elasticity

5 CONCLUSION

Based on limited experimental investigation concerning the modulus of elasticity of concrete, the following conclusions are drawn:

(a) Modulus of elasticity decreases with % replacement of fly ash.
(b) Use of fly ash in concrete can save the disposal costs and produces a 'greener' concrete for construction.
(c) This research concludes that fly ash can be used as Construction Material.

REFERENCES

[1] Bhatty, JI., J Gajda, PE., Botha, F. and MM Bryant, PG. 2006. Utilization of Discarded Fly Ash as a Raw Material in the Production of Portland cement. Journal of ASTM International, Vol. 3, No. 10. | [2] Goh, Chia-Chia., Show, Kuan-Yeow and Cheong, Hee-Kiat. 2003. Municipal Solid Waste Fly Ash as a Blended Cement Material. Journal of Materials in Civil Engineering, Vol. 15, No. 6, pp. 513-53-23. | [3] Gopalakrishna, S., Rajamane, N.P., Neelamegam, M., Peter, J.A. and Dattatreya, J.K. 2001. Effect of partial replacement of cement with fly ash on the strength and durability of HPC. The Indian Concrete Journal, pp. 335-341. | [4] A. Oner , S. Akyuzb, R. Yildiza,(2004)"An experimental study on strength development of concrete containing fly ash and optimum usage of fly ash inconcrete" Cement and Concrete Research , Vol.35, Issue 6, pp 11651171 | [5] Report on "Fly Ash for Cement Concrete" Ash Utilization Division-NTPC Limited |