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Workability and Compressive Strength of Concrete with M Sand and Fly Ash

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Abstract- *In this experimental study the effects on workability and compressive strength development of M_{25} concrete with incorporating M sand and fly ash in concrete. M sand is used in place of river sand and fly used as a partial replacement material for cement. Cement is replaced with fly ash as 05%, 10%, 15% and 20% and River sand is totally replaced with M sand. Fresh concrete is tested for its workability and hardened concrete is tested for its compressive strength development. For workability study compaction factor test has been conducted and for compressive strength 150 mm cube has been cast and water cured and tested for 7^{th}, 28^{th} , 56^{th} and 91 days. The control specimen is made with River sand and OPC 43 grade cement and the Recorded results indicate that the incorporation of fly ash and M sand affects the workability of concrete and to improve the workability super plasticizer is added. The compressive strength of concrete not much affected.*

Key words: **Fly ash, M sand, concrete, workability, compressive strength.**

Chapter-I

Introduction

Concrete is the largest consuming construction material on the globe and lot of research works are going on concrete to use alternative ingredients in place of main ingredients. Industrial bye products like fly ash, rice husk ash, blast furnace slag, silica fume and nano silica are widely used in concrete now a days to produce concrete of special characteristics to suit the different requirements. Silica fume has been proved as a successful material used in concrete its fineness fills the pores of concrete effectively and results in dense concrete and also it reduces the pore volume of concrete. Fly ash is another pozzolanic material produced from thermal power plants which use coal as a fuel and the ash precipitated in electrostatic precipitators.

This is mainly a bye product of thermal power plants and its disposal is generally a major problem. It is a finer material than cement and its main constituents are silica, alumina, iron, calcium and considerable amount of magnetite. The principal properties of fly ash are its fineness and pozzolanic nature. It can be used in concrete to enhance its properties. Fly ash is less cost in compare with silica fume and nano silica.

In recent years availability of river sand is acute and does not match with actual demand and it is time to find out alternative materials for natural sand. Construction industry throughout India is facing acute shortage of natural sand and also due to heavy demand its cost rises to very high. Various steps have been taken to solve this problem one of such step is to import sand from different countries and another approach is to find out best alternative for natural sand. Gradation of sand is utmost important and it should have particle size varying from 150 microns to 4.75 mm in proper proportion.

It takes millions of years for forming natural sand and its quantity available now is not meeting the actual requirements. M sand is one of such alternative for River sand and it is artificially manufactured from crushing rocks and it is widely used now. It is manufactured in different stages of crushing of rocks first of all the rocks are crushed into stones and again the stones are crushed to fine material then in the next stage it is screened by standard screens to remove dust particles and finally it is washed to remove very fine material . As per IS 383 the sand with gradation in Zone II or Zone III are recommended for using in concrete.

Chapter - II

Materials used for this experimental study

Ordinary Portland cement of 43 grade , hard broken granite stone aggregates of size varying from 10mm to 20mm , M sand supplied from a local quarry manufactured to meet the concrete requirements , ordinary potable water with PH 7.3 fly ash class F obtained from Mettur thermal power plant and salfonated naphthalene formaldehyde condensate based super plasticizer

Physical properties of materials

Cement: the cement used here is ordinary Portland cement of brand name ZUARI 43 grade confirming to IS 12269-1977.

Table 1. Physical properties of OPC 43 Grade

Portland cement

S.No	Description	value
1	Specific gravity	3.12
2	Standard consistency	33.45%
3	Initial setting time	38 minutes
4	Final setting time	510 minutes
5	fineness	6.3%
6.	Soundness	1mm

Fly ash: Fly ash of class F obtained from Mettur thermal power plant is used in this experimental study

Table 2. Physical properties of Fly ash

S.No	Description	value
1	Specific gravity	2.75
2	fineness	3950cm²/gm on Blaine's permeability test

Water: potable water obtained from Bhavani river of PH value 7.2 is used for this experimental study

Mix design

In this experimental study concrete grade of M25 grade is considered and Mix design is done as per the guidelines given in 10262 -2009 and IS 456 -2000 to achieve a target mean strength of 33.745 **Fine aggregate**: **M Sand** available from a local quarry confirming to Zone –II of IS 383-1970 is used in this experimental study

Table 3. Physical properties of M sand

S.No	Description	value
1	Specific gravity	2.68
2	Fineness modulus	3.0
3	Water absorption	2.15%
4	Particle size range	0.15 to 4.75mm

Coarse aggregate: coarse aggregate is hard broken granite stone of gradation 4.75 to 20mm obtained from local quarry is used in this experimental study.

Table 4. Physical properties of coarse aggregate

S.No	Description	value
1	Specific gravity	2.71
2	Fineness modulus	6.2
3	Water absorption	0.80%
4	Particle size range	4.75mm to 20mm

N/mm²at 28 days of water curing the concrete Mix proportion is as follows 1 : 1.38 : 2.84 and water cement ratio fixed as 0.465

Table 5. Mix designation for River sand and normal coarse aggregate

Mix designation	MC
Cement	100% OPC 43 Grade
Fly ash	0%
River sand (fine aggregate)	100% Ordinary local sand
Coarse aggregate	100% Normal coarse aggregate from local quarry

Table 6. Mix designation for various ratios of fly ash and M sand

Mix design	M1	M2	M3	M4	M5
cement	100%	95%	90%	85%	80%
Fly ash	0%	5%	10%	15%	20%
M sand (fine aggregate)	100% M sand from local quarry				
Coarse aggregate	Normal coarse aggregate from local quarry				

Chapter -III

Scope of the test

The constituent ingredients are mixed in a pan mixer for suitable duration of time and to ensure workability super plasticizer added upto 1.2%. The fresh concrete is tested for workability by compaction factor test immediately after mixing of concrete. Then the concrete is cast into 150 mm cubical moulds and for each mix ratio 3 cubes are cast for each test. The specimens are stored in room temperature and demoulded after 24 hours then allowed to cure by water curing by immersing in a water tank at a

temperature around 21 degree Celsius. The cubes were tested for its compressive strengths according to BS1881 PART 116 – 1983. The testing was done for 7th, 28th, 56th and 91st days.

Table 7. Experimental results

Mix designation	MC	M1	M2	M3	M4	M5
Compacting factor	0.90	0.90	0.89	0.86	0.83	0.81
7days Compressive strength in N/mm2	20.10	23.50	24.31	24.00	22.89	17.32
28 days Compressive strength in N/mm2	26.82	30.65	31.87	29.87	27.38	24.85
56 days Compressive strength in N/mm2	32.38	33.48	35.63	32.92	30.89	26.92
91 days Compressive strength in N/mm2	37.56	40.23	41.52	39.85	37.65	31.26

Chart 1. Compaction factor test results

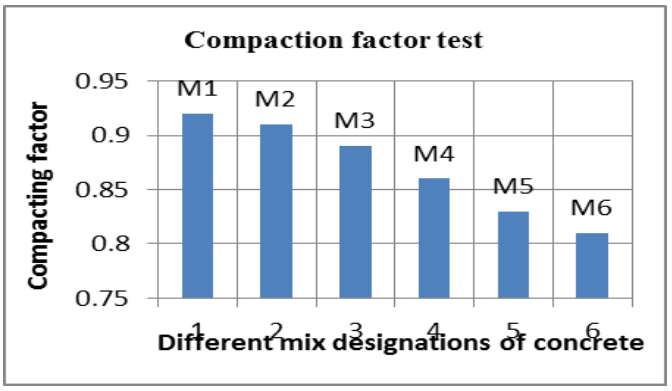


Chart 2. 7th Day compressive strength

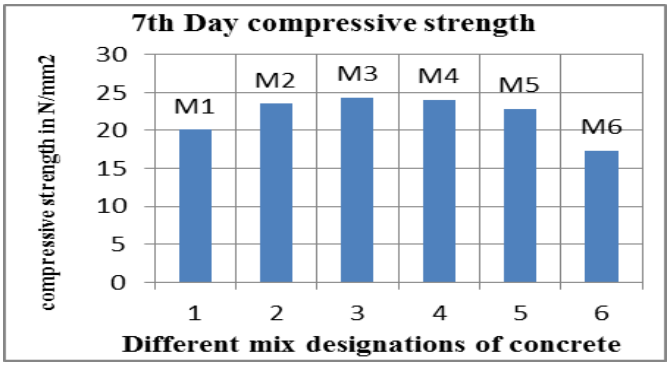


Chart 3. 28th Day compressive strength

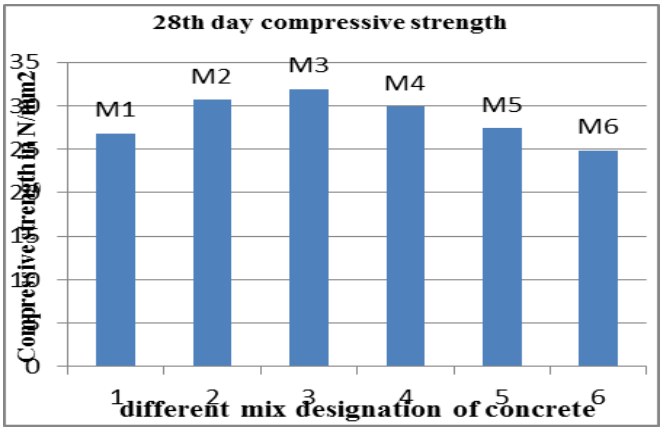


Chart 4. 56th Day compressive strength

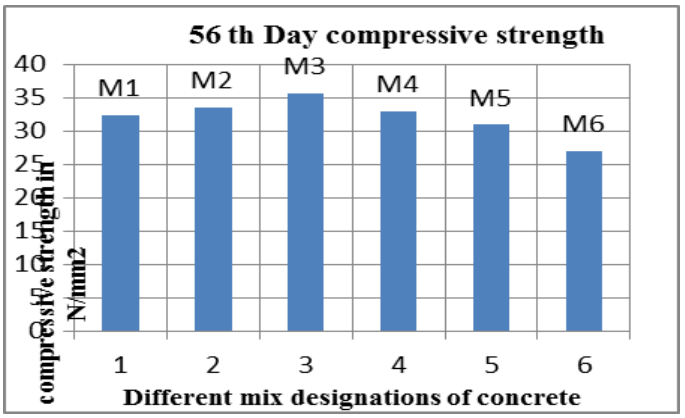
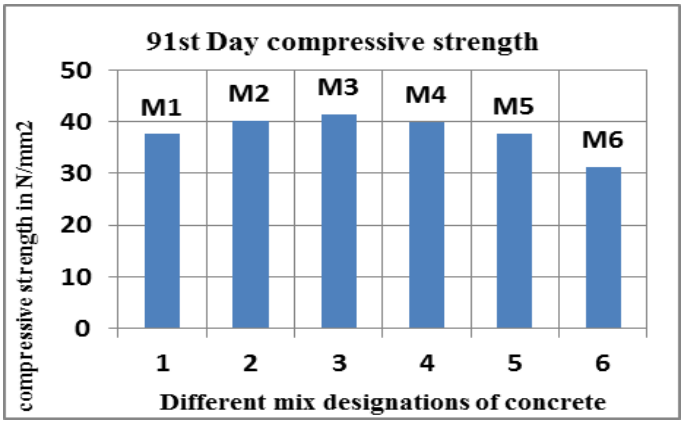


Chart 5. 91st Day compressive strength



Chapter -IV

Results and discussion

Effect of fly ash

The fresh concrete workability is maintained more or less constant by introducing super plasticizer and the hardened concrete is tested for compressive strengths. the compressive strengths slightly improved when increase in the volume of fly ash and upto 15% replacement of cement

with fly ash, then the value is slightly start to reduce for further increase in the volume of fly ash and when the replacement reaches 25% its value reduced to lesser than the target mean strength.

Effect of M sand

The compressive strength results shows that River sand when replaced with M sand 100% does not having much influence on the compressive strength of concrete. The workability affected by M sand is improved and maintained less constant by the addition of super plasticizer.

Chapter -V

Conclusions

In this experimental study it is observed that utilisation of M sand instead of natural River sand does not affect the compressive strength of concrete

Replacing cement with high volume fly ash upto 15% slightly increase the compressive strength beyond that the increase in volume of fly ash will gradually reduce the compressive strength.

Workability is reduced with addition of fly ash and M sand and this can be maintained by adding super plasticizer.

M sand can be used as a best alternative for River sand.

Chapter - VI

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