Effects of Flyash on Compressive Strength of M50 Mix Design Concrete

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Abstract - The Ordinary Portland Cement (Opc) Is One Of The Main Ingrdients Used For The Production Of Concrete. Unfortunateluy Production Of Cement Involves Emission Of Large Amount Of Carbon Dioxide Gas Into Atmosphere, A Major Contributer For Green House Effect And The Global Warming , Hence It Is Invitable Either To Search For Another Material Or Partially Replace It By Some Other Material. The Search Of Any Other Such Material Which Can Be Used As An Altrernative For Cement Should Lead To Global Sustenable Development And Lowest Possible Environmental Impact. Concrete Property Can Be Maintained With Advance Mineral Admixtures Such As Flyash As Partial Replacement Of Cement 0 To 30%. Compressive Strength Of Concrete With Different Dosage Of Fly Ash Was Studied As Partial Replacemnet Of Cement. From The Experimental Investigations, It Has Been Observed That, The Optimum Replacement Of Flyash To Cement Without Changing Much Compressive Strength Is 10%.

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1. INTRODUCTION - ELECTRICITY IS THE KEY FOR THE DEVELOPMENT OF OUR COUNTRY. COAL IS A MAJOR SOURCE OF FUEL PRODUCTION OF ELECTRICITY GENERATION. LARGE QUANTITY OF FLYASH GET PRODUCED AND BECOME AVAILABLE AS BY PRODUCT OF COAL BASED POWER STATIONS. FLYASH IS A FINE POWDER RESULTING FROM COMBUSTION OF POWERED COAL TRANSPORTED BY THE FLU GASES OF BOILER AND COLLECTED IN THE (E.S.P) ELECTROSTATIC PRESIPITATOR.

ASH PRODUCTS - ANY COUNTRY'S ECONOMIC AND INDUSTRIAL GROWTH DEPENDS ON THE AVAILABILITY OF POWER. IN INDIA COAL IS A MAJOR SOURCE OF FUEL FOR POWER GENEATION. ABOUT 60% POWER IS PRODUCED USING COAL AS FUEL. INDIAN COAL IS HAVING LOW CALORIFIC VALUE (30 - 45%) RESULTING IN HUGE QUANTITY OF FLYASH GENERATION IN COAL BASED THERMAL POWER STTIONS. DURING 2005 -2006 ABOUT 112 MILLION TONNE OF FLYASH IS GENERATED IN 125 SUCH POWER STATIONS. WITH THE PRESENT GROWTH IN POWER SECTOR, IT IS EXPECTED THAT ASH GENERATION WILL REACH TO 175 MILLIONTONNE FLYASH PER ANNUM BY 2017.

ANY COAL BASED THERMAL POWER STATION MAY HAVE FOLLOWING TWO KINDS OF ASH-

FLYASH - THIS KIND OF ASH IS EXTRACTED FROM FLUE GASES THROUGH ESP IN DRY FORM. THIS ASH IS FINE MATERIAL AND POSSES GOOD POZOLANIC PROPERTY.

BOTTOM ASH - THIS KIND OF ASH IS COLLECTED I BOTTOM OF BOILER FURNACE. IT IS COMPERATIVELY COARSE MATERIAL AND CONTAINS HIGH UNBURNT CARBON. IT POSSES ZERO OR LITTLE POZZOLANIC PROPERTY.

THIS PAPER DEALS WITH THE USE OF FLYASH AS PARTIAL REPLACEMENT OF OPC 43 GRADE ON

2. LITRATURE REVIEW -

CAROLYNE NAMAGGA (ET.AL) "OPTIMIZATION OF FLY ASH IN CONCRETE" PUBLISHED IN 2004 WORLD COAL ASH (W.O.C.A) MAY 4-7, 2009 FOUND THAT HIGH LIME FLYASH IN CONCRETE INCREASES THE STRENGTH OF CONCRETE. THE TEST DONE BY THEM INDICATED THAT REPLACING PROPORTIONS OF CEMENT WITH HIGH LIME FLYASH WOULD PROVIDE IMPROVED STRENGTH AND A MOST EFFECTIVE SOLUTION.(1)

OBADA KAYALI " HIGH PERFORMANCE BRICK FROM FLY ASH" PUBLISHED AT 2005 WORLD COAL ASH (W.O.C.A) APRIL 11- 15, 2005 CONCLUDED THAT

. THE RESULTS WERE INDICATIVE OF THE SATISFACTORY PERFORMANCE OF THE FLYASH BRICK AS LOAD BEARING ELEMENT

. THE MECHANICAL PROPERTIES OF FLY ASH BRICKS HAVE EXCEEDED THOSE OF STANDARD LOAD BEARING CLAY BRICKS

. THERE IS EVIDENCE THAT THE MICRO STRUCTURAL FEATURE OF THE SURFACE OF FLY ASH IS ROUGHER TEXTURE. THIS CHARACTERISTIC IS RESPONSIBLE FOR INCREASE BOND STRENGTH

. THE DENSITY OF FLY ASH BRICK IS LESS

. USING FLYASH PROVIDES MUCH SAVING OF MONEY(2)

TUNTUNLU FAITH (ET.AL) "UTILIZATION OF FLYASH IN MANUFACTURING OF BUILDING BRICKS" PUBLISHED IN 2001 INTERNATIONAL ASH UTILIZATION SYMPONIUM, CENTER OF APPLIED ENERGY RESEARCH, UNIVERSITY OF KENTUCKY, PAPER #13 CONCLUDED THAT MATERIAL FOR THE PRODUCTION OF BUILDING IS NOT ONLY A VIABLE ALTERNATE BUT ALSO A SOLUTION TO A DIFFICULT AND EXPANSIVE DISPOSABLE PROBLEM. (3)

MOHAMMED A . ELSAGEER, STEVE GMILLAD (ET.AL) " STRENGTH DEVELOPMENT OF CONCRETE CONTAINING COAL FLY ASH UNDER DIFFERENT CURING TEMPERATURE CONDITION" PUBLISHED IN 2009 WORLD COAL ASH (W.O.C.A) CONFERENCE MAY - 4-7, 2009 IN LENINGTON, U.S.A

STRENGTH OF M50 MIX DESIGN CONCRETE.

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. AT 40 DEGREE CENTIGRADE AND 50 DEGREE CENTIGRADE, THE STRENGTH DEVELOPMENT OF CONCRETE IS SIMILAR TO THAT OF AN EQUIVALENT PORTLAND CEMENT CONCRETE AT EARLY STAGES.

. THEIR WORK INDICATES THAT FLY ASH CONCRETE COULD BE USED IN PROJECTS WHEN EARLY STRENGTH IS REQUIRED (4)

TARUN R. NAIK (ET.AL) " HIGH EARLY STRENGTH CONTAINING LARGE QUANTITIES OF FLY ASH CONCLUDED THAT

. CONCRETE MIX WITH TYPE C FLYASH CAN BE USED WITH CONFIDENCE TO PRODUCE HIGH EARLY STRENGTH

. AS THE AMOUNT OF FLY ASH USED IN A MIX INCREASES, THE WATER REQUIRED FOR THE SAME WORKABILITY DECREASES.

. FLY ASH IMPROVES THE WORKABILITY IF THE CONCRETE.(5)

AMIT MITTAL (ET.AL) " EXPERIMENTAL STUDY ON THE USE OF FLYASH IN CONCRETE" CONCLUDED THAT,, AS FLY ASH CONTENT INCREASE THERE IS REDUCTION IN THE STRENGTH OF CONCRETE.(6)

3. RESEARCH SIGNIFICANCE - THE RESEARCH REPORTED IN THIS STUDY, FLY ASH OBTAINED FROM DIFFERENT SOURCES FROM NARMADA GELLITIN, JABALPUR AND BIRINGPUR PALI, BIRSINGHPUR (M.P.) IS USED AS REPLACEMENT MATERIAL IN CONCRETE M50 DESIGN MIX. THE ULTIMATE FOCOUS OF THIS WORK IS TO ASCERTAIN THE PERFORMANCE OF CONCRETE MIX CONTAINING FLY ASH POWDER AND COMPARE IT WITH THE PLAIN M50 CONCRETE MIX OF RATIO (1:1:2.16) WITH 1.2% OF ADMIXTURE ADDED.

THIS IS EXPECTED TO PROVIDE -

1. TO PARTIAL REPLACE CEMENT CONTENT IN CONCRETE AS IT DIRECTLY INFLUENCES ECONOMY IN CONSTRUCTION.
2. ENVIRONMENTAL FRIENDLY DISPOSAL OF WASTE FLY ASH.
3. TO BOOST THE USE OF INDUSTRIAL WASTE.

4. MATERIAL CHARACTERSTICS -

THE FLYAASH OBTAINED FROM BOTH THE PLACES HAS THE FOLLOWING COMPOSITION:

CONSTITUENT	PERCENT
1. Silicon Di oxide (SiO2)	20 - 60 %
2. Aluminum oxide (AL203)	05 - 35 %
3. Unburnt fuel (Carbon)	UP TO 30%
4. Calcium Oxide (Cao)	1 - 12 %
5. Magnesium oxide (MgO)	Small amount

CONCLUDED THAT

. FLYASH CONCRETE WAS OBSERVED TO BE SIMILAR TO THAT OF AN EQUIVALENT PORTLAND CEMENT CONCRETE AT STANDARD CURING TEMPRATYRE (20 DEGREE CENTIGRADE UP TO 32 DAYS.

Sp. gr of N.G	- 2.10
Sp.gr of B.P	- 1.90
N.G passing through 90 micron	- 70%
B.P passing through 90 micron	- 80%

4.1 ORDINARY PORTLAND CEMENT (43 GRADE):

THE PHYSICAL PROPERTIES ARE SHOWN IN THE TABLE BELOW

Properties	O.P.C CEMENT
Specific gravity	3.12
Initial setting time	90 min

4.2 FINE AND COARSE AGGREGATE -

THE PHYSICAL PROPERTIES OF FNE AND COARSE AGGREGATE ARE SHOWN IN THE TAKEN BELOW.

Properties	Fine aggregate	Coarse aggregate
Specific gravity	2.43	2.85
Water absorption	1.0%	0.8
Fineness modulus	2.40	6.67

5. RESEARCH METHODLOGY -

THE CONCRETE MIX WAS PREPARED AS PER THE PROCEDURE GIVEN IN IS 10262:2009 FOR THE OPTOMAL DOSAGE SELECTION OF FLY ASH POWDER FROM BOTH PLACES IN THE CONCRET MIX RANGING FROM (10% TO 30%) ARE PREPARED AND COMPARED WITH M50 CEMENT CONCRETE CUBES (1:1:2.16).

W/C RATIO -0.35

MIX SPECIFICATION FOR CONCRETE

S.no	Flyash% replacement	Cement in kg	Sand in kg	Aggregate 20mm in kg	Aggregate 10mm in kg	Fly ash in kg
1	0%	6.490	6.490	8.411	5.607	0.000
2	10%	5.841	6.490	8.411	5.607	0.649
3	20%	5.192	6.490	8.411	5.607	1.298
4	30%	4.543	6.490	8.411	5.607	1.947

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PHYSICAL PROPERTY OF FLYASH:

N.G. - FLYASH OBTAINED FROM NARMADA GELATIN

B.P. - FLYASH OBTAINED FROM BIRSINGHPUR PALI

1.2 % ADMIXTURE ADDED

TOTAL NUMBER OF CUBES PREPARED WERE 21 IN NOS WHICH ARE AS GIVEN IN THE TABLE BELOW

Percentage of flyash replaced by cement	Naramada gelatin CUBES (nos)	M.P.E.B CUBES (nos) Birsinghpur pali
0 %	3	0
10 %	3	3
20 %	3	3
30 %	3	3

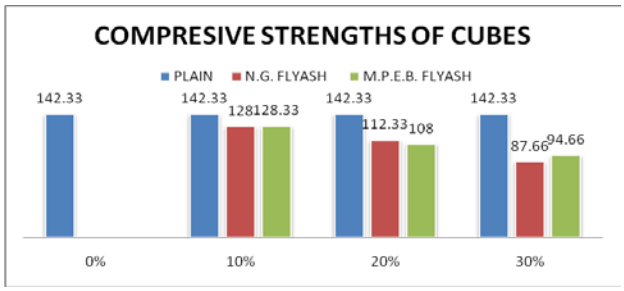
6. TEST RESULT -

COMPRESSIVE STRENGTH TEST WAS CONDUCTED TO EVALUATE THE STRENGTH DEVELOPMENT OF CEMENT CONCRETE MIX, CONTAINING VARIOUS PERCENTAGE % OF THE FLY ASH AT THE AGE OF 28 DAYS RESPECTIVELY. CUBES WERE MADE OF STANDARD SIZE (150MMX150MMX150MM)

S no	Concrete grade	% Fly ash REPLACEMENT	Weight in kg	Strength IN TONN	Flyash source
1	M50	0	9.400	145	
2	M50	0	9.450	142	
3	M50	0	9.250	140	
4	M50	10	9.100	130	N.G
5	M50	10	9.150	128	N.G
6	M50	10	9.150	126	N.G
7	M50	10	9.050	132	B.P
8	M50	10	9.000	128	B.P
9	M50	10	9.100	125	B.P
10	M50	20	9.100	110	N.G
11	M50	20	8.950	112	N.G
12	M50	20	9.050	115	N.G
13	M50	20	9.000	106	B.P
14	M50	20	9.050	108	B.P
15	M50	20	9.100	110	B.P
16	M50	30	9.000	90	N.G
17	M50	30	9.050	85	N.G
18	M50	30	9.000	88	N.G
19	M50	30	8.800	98	B.P
20	M50	30	8.900	96	B.P
21	M50	30	9.000	90	B.P

7. DISSCUSION AND CONCLUSION -

THIS STUDY WAS CARRIED OUT TO OBTAIN THE REULTS, TEST CONDUCTED ON THE FLYASH MODIFIED CEMENT CONCRETE MIX IN ORDER TO ASCERTAIN THE INFLUENCE OF FLYASH ON THE CHARACTERSTIC STRENGTH OF CONCRETE



THE RESULT OBTAINED FORM COMPRESSIVE STRENGTH TESTS CONDUCTED ON CONCRETE CONTAINING OPC AND VARIOUS PERCENTAGE OF FLY ASH FROM DIFFERENT PLACES WERE AS FOLLOWS :

1. TILL THE ADDITION OF FLYASH UPTO 10% THERE WAS LESSER CHANGE IN THE STRENGTH OF CONCRETE.
2. FLYASH FROM M.P.E.B. BIRSINGHPUR BALI IS BRIGHTER IN COLOUR
3. BLOCKS CONTAINING FLYASH ARE LIGHTER IN WEIGHT THAN THE CONCRETE CUBES CONTAINING NO FLYASH.
4. AT THE REPLCEMENT TILL 30%, FLYASH CUBES HAS SHOWN VERY LOW COMPRESSIVE STRENGTH IN COMPARISON TO CONCRETE CONTAINING NO FLYASH.

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