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Experimental Study on Strength of Concrete with Use of Flyash and Surkhi as Cement Replacement

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Abstract: ***This project an experimental investigation on experimental study on strength of concrete with use of flyash and surkhi as cement replacement. The mineral admixtures are added in replacement of cement by 10% and 20%. The mineral admixtures used in this work are fly ash and surkhi .The experiment was conducted on M25 grade and M30 grade concrete produced by fly ash and surkhi. The strength properties studied in this work are compressive strength, tensile strength, shear strength, flexural strength and impact strength. Also, the workability characteristics are studied through slump cone test, compaction factor test, compressive test, workability test Along with these, near surface characteristics like water sorptivity, durability; acid attack and also sulphate attack are also studied.***

Keywords: fly ash , surkhi , magnasium sulphate, sulphuric acid

I. INTRODUCTION

The important material in the construction industry is concrete over a long period of time. It has wide range of application and utilization in construction field.

Technology advancement and increasing economy leads to construction industry to grow rapidly. This growth leads to demand of massive amount of concrete to be produced to satisfy the need. This in turn leads to increase in the production of raw material which is to be used in the production of concrete.

The raw materials include cement, aggregates etc. There has been a lot of research over using fly ash and surkhi as additive in cement, admixture in concrete and cement replacement material in concrete.

Compressive strength of concrete at different proportions of cement being replaced by fly ash and Surkhi has been checked and results have been found effective and applicable. But most of the research has been limited to few percentages of cement replacement or less grades of concrete. . this materials will not solve the disposal problem but also form a substitute for conventional materials in civil engineering applications. Also using these materials will prove to be cost effective.Usage of industrial waste materials such as fly ash and surkhi in civil engineering applications not only solve disposal problem but also offer a cost-effective substitute for the conventional raw materials in the production of concrete.

II. LITERATURE REVIEW

The literature study The objective of the present work is to develop concrete with high strength, less porous, less capillarity so that durability will be reached up to a certain extent.

For this purpose, use of different pozzolanic materials like Fly ash, shale and surkhi along with concrete. An experimental programme to is planned to carry our various tests and are aimed on the followings ;determine the mix proportion with Fly ash and surkhi with concrete to achieve the desire needs.

Determine the water/ binder ratio, so that design mix having proper workability and strength. investigate different basic properties of concrete such as compressive strength, splitting tensile strength, flexural strength etc. and comparing the results of different proportioning. Determination of porosity and capillary of different proportioned concrete.

A. Objectives of work

1) To understand the actual behaviour of concrete when fly ash has been replaced by cement and to strength of concrete which is one of the important criteria of the concrete.
2) To determine the optimum level of cement in concrete elements with highest compressive strength, tensile strength, flexural strength.
3) To evaluate the effect of just replacing the cement by fly ash, surkhi used in concrete and to study these strength, of concrete under varying percentage of fly ash,surkhi as well as to study, the effect of varying curing time period

III. MATERIALS

Concrete is mixture of cement, fine aggregate, coarse aggregate, water and admixtures (if required). Here in this study fly ash is used so, in are also added for better strength. So, for this study flyash are used in different volume (10%, 20%). Also some pozzolanic material surkhi (10%, 20%) are used as replacement of cement in different percentages. So, for this study cement, fine aggregate, coarse aggregate, fly ash and surkhi

IV. METHODOLOGY

A. Mix Design

As per IS 10262 prepare a mix design of M25 and M30 grade of concrete. In this MIX design fibres, fly ash and surkhi are added in different percentage. Table no. I show the mix design of M25 and M30 grade of concrete.

TABLE I MIX DESIGN OF M25 GRADE OF CONCRETE

Cement	Water	Super plasticizer	Sand	Coarse aggregate	Density
360 Kg/m^3	162 Kg/m^3	1.97 Kg/m^3	503.12 kg/m^3	754.68	2540.37 Kg/m^3
1	0.45	0.0049	1.69	3.29	-

B. Mixing and Casting

Hand mixing is adopted for mixing of the basic materials of concrete and mixed concrete is moulded into cube, cylinders and beam for different tests.

C. Curing

After casting work is over moulded specimens are stored in room temperature for 24 hours. After this period specimens are taken out from mould carefully without damaging the surface and immersed in water for 28 days.

D. Testing

The specimen cured as stated above tested according to IS 516: 1959 code standards and ASTM C1202, ASTM C 1585 – 04. The entire strength tests were done accordingly IS 516: 1959 and other tests of Durability were done accordingly ASTM C1202 and ASTM C 1585 – 04. The results mentioned were average of the values obtained from three specimens.

V. RESULTS AND DISCUSSION

A. Slump Test

Sr. No.	Name of sample	Grade of concrete	% of F.A	% of SURKHI.	Strength (N/mm^2)
1	F0s0	M25	0	0	97
2	F1S0	M25	10	0	94
3	F2S0	M25	20	0	101
4	F0S1	M25	0	10	99
5	F0S2	M25	0	20	94
6	F5S5	M25	5	5	98
7	F5S10	M25	5	10	95
8	F10S5	M25	10	5	100
9	F10S10	M25	10	10	96
10	F0s0	M30	0	0	95
11	F1S0	M30	10	0	98
12	F2S0	M30	20	0	97
13	F0S1	M30	0	10	95
14	F0S2	M30	0	20	93
15	F5S5	M30	5	5	98
16	F5S10	M30	5	10	94
17	F10S5	M30	10	5	101
18	F10S10	M30	10	10	99

B. Compressive Strength

Compressive strength of concrete at 7 days of curing

Sr. No.	Name of sample	Grade of concrete	% of F.A	% of SURKHI.	Strength (N/mm^2)
1	F0s0	M25	0	0	20.57
2	F1S0	M25	10	0	19.56
3	F2S0	M25	20	0	20.07
4	F0S1	M25	0	10	20.58
5	F0S2	M25	0	20	19.76
6	F5S5	M25	5	5	20.57
7	F5S10	M25	5	10	20.49
8	F10S5	M25	10	5	20.06
9	F10S10	M25	10	10	20.20
10	F0s0	M30	0	0	23.97
11	F1S0	M30	10	0	23.00
12	F2S0	M30	20	0	23.41
13	F0S1	M30	0	10	24.26
14	F0S2	M30	0	20	23.85
15	F5S5	M30	5	5	23.59
16	F5S10	M30	5	10	24.12
17	F10S5	M30	10	5	23.52
18	F10S10	M30	10	10	23.27

Compressive strength of concrete at 28 days of curing

Sr. No.	Name of sample	Grade of concrete	% of F.A	% of SURKHI.	Strength (N/mm^2)
1	F0s0	M25	0	0	31.66
2	F1S0	M25	10	0	30.24
3	F2S0	M25	20	0	30.89
4	F0S1	M25	0	10	31.67
5	F0S2	M25	0	20	30.04
6	F5S5	M25	5	5	31.06
7	F5S10	M25	5	10	31.53
8	F10S5	M25	10	5	30.87
9	F10S10	M25	10	10	31.08
10	F0s0	M30	0	0	36.88
11	F1S0	M30	10	0	35.46
12	F2S0	M30	20	0	36.02
13	F0S1	M30	0	10	37.33
14	F0S2	M30	0	20	36.71
15	F5S5	M30	5	5	36.03
16	F5S10	M30	5	10	37.12
17	F10S5	M30	10	5	36.19
18	F10S10	M30	10	10	35.8

C. Split Tensile Strength

Tensile strength of concrete at 7 days of curing

Sr. No.	Name of sample	Grade of concrete	% of F.A	% of SURKHI.	Strength (N/mm^2)
1	F0s0	M25	0	0	2.12
2	F1S0	M25	10	0	2.02
3	F2S0	M25	20	0	2.00
4	F0S1	M25	0	10	2.17
5	F0S2	M25	0	20	2.01
6	F5S5	M25	5	5	2.10
7	F5S10	M25	5	10	2.04
8	F10S5	M25	10	5	2.0
9	F10S10	M25	10	10	2.04
10	F0s0	M30	0	0	2.40
11	F1S0	M30	10	0	2.35
12	F2S0	M30	20	0	2.39
13	F0S1	M30	0	10	2.41
14	F0S2	M30	0	20	2.39
15	F5S5	M30	5	5	2.01
16	F5S10	M30	5	10	2.40
17	F10S5	M30	10	5	2.00
18	F10S10	M30	10	10	2.05

Tensile strength of concrete at 28 days of curing

Sr. No.	Name of sample	Grade of concrete	% of F.A	% of SURKHI.	Strength (N/mm^2)
1	F0s0	M25	0	0	3.19
2	F1S0	M25	10	0	3.01
3	F2S0	M25	20	0	3.09
4	F0S1	M25	0	10	3.15
5	F0S2	M25	0	20	3.03
6	F5S5	M25	5	5	3.10
7	F5S10	M25	5	10	3.15
8	F10S5	M25	10	5	3.08
9	F10S10	M25	10	10	3.10
10	F0s0	M30	0	0	3.60
11	F1S0	M30	10	0	3.49
12	F2S0	M30	20	0	3.58
13	F0S1	M30	0	10	3.72
14	F0S2	M30	0	20	3.63
15	F5S5	M30	5	5	3.66
16	F5S10	M30	5	10	3.71
17	F10S5	M30	10	5	3.61
18	F10S10	M30	10	10	3.58

D. Flexural strength

Flexural strength of concrete at 7 days of curing

Sr. No.	Name of sample	Grade of concrete	% of F.A	% of SURKHI.	Strength (N/mm^2)
1	F0s0	M25	0	0	3.08
2	F1S0	M25	10	0	2.94
3	F2S0	M25	20	0	3.01
4	F0S1	M25	0	10	3.08
5	F0S2	M25	0	20	2.96
6	F5S5	M25	5	5	3.08
7	F5S10	M25	5	10	3.07
8	F10S5	M25	10	5	3.00
9	F10S10	M25	10	10	3.59
10	F0s0	M30	0	0	3.45
11	F1S0	M30	10	0	3.51
12	F2S0	M30	20	0	3.63
13	F0S1	M30	0	10	3.57
14	F0S2	M30	0	20	3.53
15	F5S5	M30	5	5	3.87
16	F5S10	M30	5	10	3.01
17	F10S5	M30	10	5	3.52
18	F10S10	M30	10	10	3.49

Flexural strength of concrete at 28 days of curing

Sr. No.	Name of sample	Grade of concrete	% of F.A	% of SURKHI.	Strength (N/mm^2)
1	F0s0	M25	0	0	4.74
2	F1S0	M25	10	0	4.50
3	F2S0	M25	20	0	4.63
4	F0S1	M25	0	10	4.70
5	F0S2	M25	0	20	4.50
6	F5S5	M25	5	5	4.74
7	F5S10	M25	5	10	4.72
8	F10S5	M25	10	5	4.63
9	F10S10	M25	10	10	4.66
10	F0s0	M30	0	0	5.53
11	F1S0	M30	10	0	5.31
12	F2S0	M30	20	0	5.4
13	F0S1	M30	0	10	5.59
14	F0S2	M30	0	20	5.50
15	F5S5	M30	5	5	5.44
16	F5S10	M30	5	10	5.56
17	F10S5	M30	10	5	5.43
18	F10S10	M30	10	10	5.37

E. Rapid Chloride Permeability Test

Sr. No.	Name of sample	Grade of concrete	% of F.A	% of SURKHI.	Charge passed In Coulombs (c)	Chloride Permeability
1	F0s0	M25	0	0	2012	moderate
2	F1S0	M25	10	0	1870	low
3	F2S0	M25	20	0	1702	low
4	F0S1	M25	0	10	1760	Low
5	F0S2	M25	0	20	1720	Low
6	F5S5	M25	5	5	2023	Low
7	F5S10	M25	5	10	1877	Low
8	F10S5	M25	10	5	1806	low
9	F10S10	M25	10	10	1709	Low
10	F0s0	M30	0	0	1800	Low
11	F1S0	M30	10	0	1856	low
12	F2S0	M30	20	0	1767	low
13	F0S1	M30	0	10	1703	Low
14	F0S2	M30	0	20	1700	Low
15	F5S5	M30	5	5	1879	Low
16	F5S10	M30	5	10	1757	Low
17	F10S5	M30	10	5	2019	moderate
18	F10S10	M30	10	10	1878	Low

F. Water Sorptivity Test

Sr. No.	Name of sample	Grade of concrete	% of F.A.	% of Surkhi	Dry Wt in Grams (W1)	Wet Wt in grams (W2)	Sorptivity Value in $mm/min^{0.5}$
1	F0s0	M25	0	0	831	832	0.01072
2	F1S0	M25	10	0	823	825	0.0190
3	F2S0	M25	20	0	839	840	0.00715
4	F0S1	M25	0	10	832	833	0.00561
5	F0S2	M25	0	20	827	830	0.0016
6	F5S5	M25	5	5	819	821	0.00434
7	F5S10	M25	5	10	830	832	0.01034
8	F10S5	M25	10	5	829.12	830	0.00534
9	F10S10	M25	10	10	832	833	0.00456
10	F0s0	M30	0	0	826.78	829.9	0.00467
11	F1S0	M30	10	0	879	880	0.0176
12	F2S0	M30	20	0	834	835	0.00346
13	F0S1	M30	0	10	812	815	0.00540
14	F0S2	M30	0	20	897	890	0.00439
15	F5S5	M30	5	5	843	845	0.00348
16	F5S10	M30	5	10	854.76	855	0.00512
17	F10S5	M30	10	5	876	879	0.0113
18	F10S10	M30	10	10	812	813	0.00234

G. Acid Attack

Sr. No.	Name of sample	Grade of concrete	% of F.A.	% of Surkhi	Wt. of cube before immersin g in H_2SO_4 (gm)	Wt. of cube after immersin g in H_2SO_4 (gm)	Strength h of cube before acid test (N/mm^2)	Strength h of cube afrter acid test (N/mm^2)	% of decrease of strength
1	F0s0	M25	0	0	8280	7890	68.09	63.65	6.48
2	F1S0	M25	10	0	8213	7683.24	67.89	62.98	6.20
3	F2S0	M25	20	0	8160.9	7567.6	67.70	63.81	6.65
4	F0S1	M25	0	10	8231.3	7634.03	67.99	63.77	6.34
5	F0S2	M25	0	20	8324.8	7692.23	68.2	64.12	6.23
6	F5S5	M25	5	5	8354.67	7589.12	70.02	63.03	6.01
7	F5S10	M25	5	10	8123.4	7598.05	67.75	64.87	6.12
8	F10S5	M25	10	5	8236.02	7601.5	70.43	64.87	5.90
9	F10S10	M25	10	10	8324.4	7635.09	68.54	68.03	6.23
10	F0s0	M30	0	0	8321	7669.2	70.10	67.14	6.23
11	F1S0	M30	10	0	8223	7681.43	70.35	69.27	6.43
12	F2S0	M30	20	0	8239.02	7645.07	71.23	68.08	5.99
13	F0S1	M30	0	10	8256.2	7690.21	70.03	68.11	6.90
14	F0S2	M30	0	20	8356.9	7676	69.92	67.35	6.16
15	F5S5	M30	5	5	8300	7768.05	70.43	68.23	6.34
16	F5S10	M30	5	10	8298.3	7639.15	71.65	68.34	7.01
17	F10S5	M30	10	5	8342	7689.21	70.32	69.51	6.43
18	F10S10	M30	10	10	8289.08	7623.07	71.67	70.02	6.23

H. Sulphate Attack

Sr. No.	Name of sample	Grade of concrete	% of F.A.	% of Surkhi	Wt. of cube before immersin g in H_2SO_4 (gm)	Wt. of cube after immersin g in H_2SO_4 (gm)	Strength h of cube before acid test (N/mm^2)	Strength h of cube afrter acid test (N/mm^2)	% of decrease of strength
1	F0s0	M25	0	0	8280	7890	68.09	63.65	2.48
2	F1S0	M25	10	0	8213	7683.24	67.89	62.98	2.20
3	F2S0	M25	20	0	8160.9	7567.6	67.70	63.81	2.65
4	F0S1	M25	0	10	8231.3	7634.03	67.99	63.77	2.34
5	F0S2	M25	0	20	8324.8	7692.23	68.2	64.12	2.23
6	F5S5	M25	5	5	8354.67	7589.12	70.02	63.03	3.01
7	F5S10	M25	5	10	8123.4	7598.05	67.75	64.87	2.12
8	F10S5	M25	10	5	8236.02	7601.5	70.43	64.87	2.90
9	F10S10	M25	10	10	8324.4	7635.09	68.54	68.03	2.23
10	F0s0	M30	0	0	8321	7669.2	70.10	67.14	3.23
11	F1S0	M30	10	0	8223	7681.43	70.35	69.27	3.43
12	F2S0	M30	20	0	8239.02	7645.07	71.23	68.08	2.99
13	F0S1	M30	0	10	8256.2	7690.21	70.03	68.11	2.90
14	F0S2	M30	0	20	8356.9	7676	69.92	67.35	3.16
15	F5S5	M30	5	5	8300	7768.05	70.43	68.23	2.34
16	F5S10	M30	5	10	8298.3	7639.15	71.65	68.34	3.01
17	F10S5	M30	10	5	8342	7689.21	70.32	69.51	2.43
18	F10S10	M30	10	10	8289.08	7623.07	71.67	70.02	2.23

VI. CONCLUSIONS

A. The workability is found to be decreasing with increase in replacement level
B. The 28-day strength dropped when cement was partially replaced with fly ash without adjustment in the w/b ratio.
C. However, high strength concrete with 28-day compressive strength . ,tensile strength , flexural test of could be obtained with w/b ratio of 0.31 and with 20% fly ash.
D. The result indicate the replacement of fly ash up to 20%the value of strength is high but the results of surkhi up to 20% is lower then 10%
E. Concrete becomes less workable as the SURKHI percentage increases meaning that more water is required to make the mixes more workable this means that SURKHI concrete has higher water demand
F. The compressive strength generally increases with curing period and increases with increased amount of SURKHI
G. acid attack of concrete control up to 20% of replacement of fly ash compared to convetional concrete.

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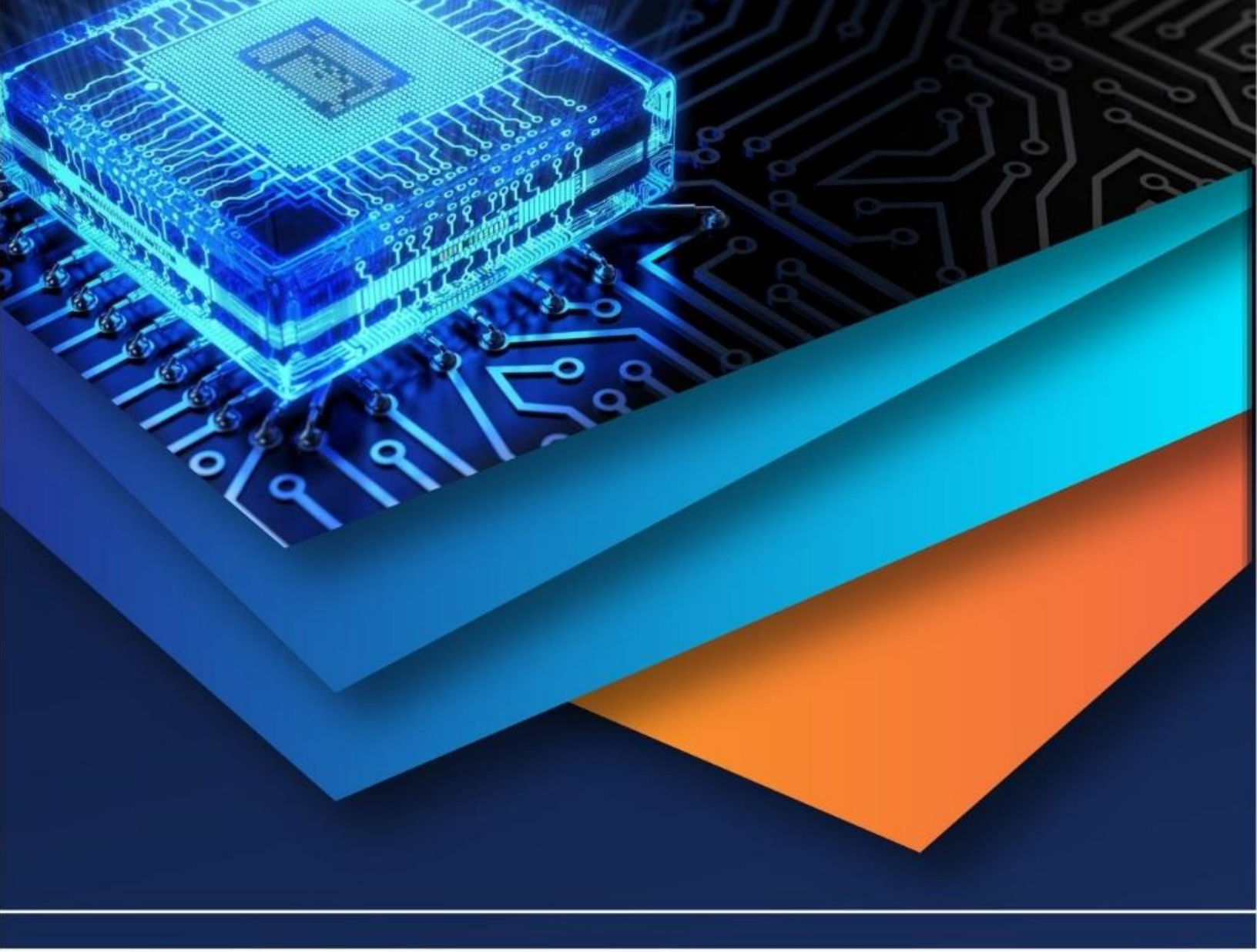

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