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EFFECT OF HCL CONCENTRATION ON NORMAL CONCRETE AND ADMIXTURED CONCRETE MADE WITH AND WITHOUT MANUFACTURED SAND

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ABSTRACT

Concrete is considered to be the most widely used and versatile material of construction all over the world. One of the important ingredients of conventional concrete is natural sand or river sand, which is on the verge of exhausting due to abundant usage. In India, the conventional concrete is produced by using natural sand obtained from riverbeds as fine aggregate. However, due to the increased use of concrete in almost all types of construction works, the demand of natural or river sand has been increased. To meet this demand of construction industry excessive quarrying of sand from river beds is taking place causing the depletion of sand resources. Thus the scarcity of natural sand has forced to find the suitable substitute. The cheapest and the easiest way of getting substitute for natural sand is by crushing natural stone to get artificial sand of desired size and grade which would be free from all impurities. Robo sand is an alternative for the common river sand. In this project an attempt is made to provide concise information on the performance of Robo sand as a natural sand replacement material in concrete. Experimental data on compressive, tensile, flexural strengths, acid durability tests have been provided. The performance of concrete containing robo sand has been compared to those containing natural sand in concrete. Concrete modified with robo sand perform comparatively better than normal concrete with and without admixtures like GGBS & Silica fume. The performance of concrete containing robo sand in acid attack better compared to those containing natural sand in concrete.

KEYWORDS: Face Detection, Face Recognization, Identity, Computer Vision.

INTRODUCTION

Concrete is the most widely used construction material in the world. It is a composite construction material made primarily with aggregate, cement and water. The word concrete comes from the Latin word “concretus” (meaning compact or condensed), the perfect passive participle of “concrescere”, from “con”-(together) and “crescere”-(to grow).Concrete solidifies and hardens after mixing with water and placement due to a chemical process known as hydration. The water reacts with the cement, which bonds the other components together, eventually creating a robust stone-like material. There are many formulations of concrete, which provide varied properties and concrete is the most-used man-made product in the world. There are many types of concrete available, created by varying the proportions of the main ingredients below. In this way or by substitution for the cementitious and aggregate phases, the finished product can be tailored to its application with varying strength, density, or chemical and thermal resistance properties.Now a day’s concrete is being used for wide varieties of purposes to make it suitable in different conditions. In these conditions ordinary concrete may fail to exhibit the required quality performance or durability. In such cases, admixture is used to modify the properties of ordinary concrete so as to make it more suitable for any situation.Admixture is defined as a material, other than cement, water and aggregates, which is used as an ingredient of concrete and is added to the batch immediately before or during mixing. Generally admixtures are of two types.

CHEMICAL ADMIXTURES:

- Accelerators
- Retarders

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- Water reducing agents
- Super plasticizers.
- Air entraining agent

MINERAL ADMIXTURES:

- Natural Pozzolanas
- Clay and shales
- Opalinecherts
- Diatomaceous earth
- Volcanic tuffs and pumicites.
- Artificial Pozzolanas
- Fly Ash
- GGBS
- Silica fume
- Rice Husk Ash
- Metakaolin
- Surkhi

MATERIALS AND ITS PROPERTIES

The materials used in our project and their physical properties are as follows

CEMENT:

Cement is a binder and is defined as a finely ground inorganic material which, when mixed with water, forms a paste which sets and hardens by means of hydration reactions and processes which, after hardening retains its strength and stability even under water.

Table 1: Approximate composition limits of Portland cement

Oxide	Content (%)
CaO	60-67
SiO_2	17-25
Al_2O_3	3.0-8.0
Fe_2O_3	0.5-0.6
MgO	0.1-0.4
Alkalies (K_2O,Na_2O)	0.4-1.3
SO_3	1.3-3.0

COARSE AGGREGATE:

The coarse aggregate are granular materials obtained from rocks and crushed stones. They may be also obtained from synthetic material like slag, shale, fly ash and clay for use in light-weight concrete.

- Specific Gravity G = 2.75
- Water Absorption = 0.26%

FINE AGGREGATE:

The sand obtained from river beds is used as fine aggregate. The fine aggregate along with the hydrated cement paste fill the space between the coarse aggregate. The common shape of river sand is cubical or rounded with smooth surface texture.

- Specific gravity of fine aggregate = 2.575

ROBO SAND:

Robo sand is manufactured sand which is eco-friendly solution that serves as perfect substitute for the fast depleting and excessively mined river sand.Robo sand with size 0-4.75 mm is suitable for all concrete preparations and is used across all segments such as independent houses, builders, concrete batching plants and infrastructure concrete works.

Specific Gravity of Robo Sand = 2.84

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The manufacturing process of the robo sand is as follows:

SILICA FUME:

Silica fume is a by-product resulting from the reduction of high purity quartz with coal or coke and wood chips in an electric arc furnace during the production of silicon or Ferro silicon alloys. The silica fume, which condenses from the gases escaping from the furnaces has very fine spherical particles having diameter of 0.1 micro meter.

PHYSICAL PROPERTIES:

Color: Generally the color of silica fume ranges from light to dark grey. Because SiO_2 is colorless, the color is determined by non silica components. Higher the carbon content in silica fume, the darker the color of silica fumes.

Density: The Specific gravity of silica fume is about 2200kg/m^3, as compared to 3100kg/m^3 for normal Portland cement. Variations in density are attributed to the non silica fume components of the various silica fumes.

Table 2: The general chemical composition of silica fume

Chemical composition	Percentage
SiO_2	85-95
Al_2O_3	0.25-0.7
Fe_2O_3	0.58-3.86
CaO	0.2-0.7
MgO	0.2-1.0
Na_2O+K_2O	0.5-2.0
S	0.05-0.2
SO_3	0-0.3
C	0-3.5
LOI	2-4

GROUND GRANULATED BLAST FURNACE SLAG (GGBS):

GGBS us a by-product from the blast-furnaces used to make iron. These operate at a temperature of about 1,500 degrees centigrade and are fed with a carefully controlled mixture of iron-ore, coke and limestone. The iron ore is reduced to iron and the remaining materials form a slag that floats on top of the iron. This slag is periodically tapped off as a molten liquid and if it is to be used for the manufacture of GGBS it has to be rapidly quenched in large volumes of water. The quenching optimizes the cementitious properties and produces granules similar to a coarse sand.

Table 3: Physical Properties of GGBS

Color	Off white
Specific Gravity	2.9
Bulk Density	1200 kg/m^3
Fineness	1200 m^2/kg

MIX DESIGN FOR M2O GRADE CONCRETE:

Mix Design was done by Indian Standard Recommended Method (IS 10262 - 1982)

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MIX DESIGN:

(a) Design Stipulations:

- Characteristic Compressive Strength required in field at 28 days =20 MPa
- Maximum Size of Aggregate = 20mm
- Degree of Workability = 0.90 compacting factor
- Degree of Quality control = Good
- Type of Exposure =Mild

TEST RESULTS& GRAPHS:

The following are the test results of the fresh and hardened concrete.

NORMAL CONCRETE:

Quantities of materials for M_{20} Grade of Normal Concrete

Table 4: Quantities of materials per m^3

Cement	Water	Fine Aggregate	Coarse Aggregate
400kg	180lt	580 kg	1120 kg

FRESH PROPERTIES:

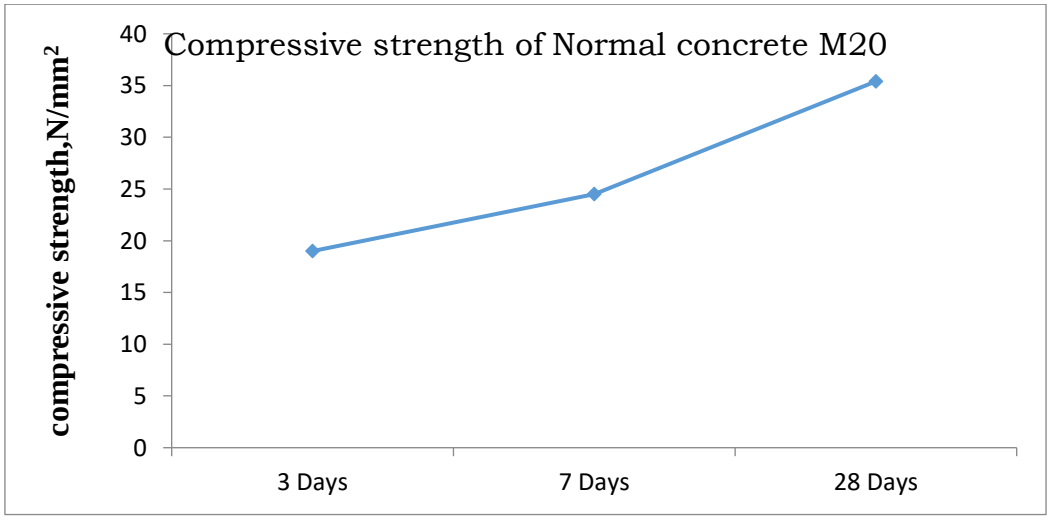
Table 5: Fresh Properties of Normal concrete

Slump	20mm
Compaction factor	0.911

HARDENED PROPERTIES:

Table 6: Hardened Properties of Normal concrete

No. of Days	Compressive strength (N/mm^2)	Tensile strength (N/mm^2)	Flexural strength (N/mm^2)
3 days	19	1.2	2.8
7 days	24.5	2.05	3.73
28 days	35.4	3.1	4.01



Graph1: Compressive strength of Normal Concrete

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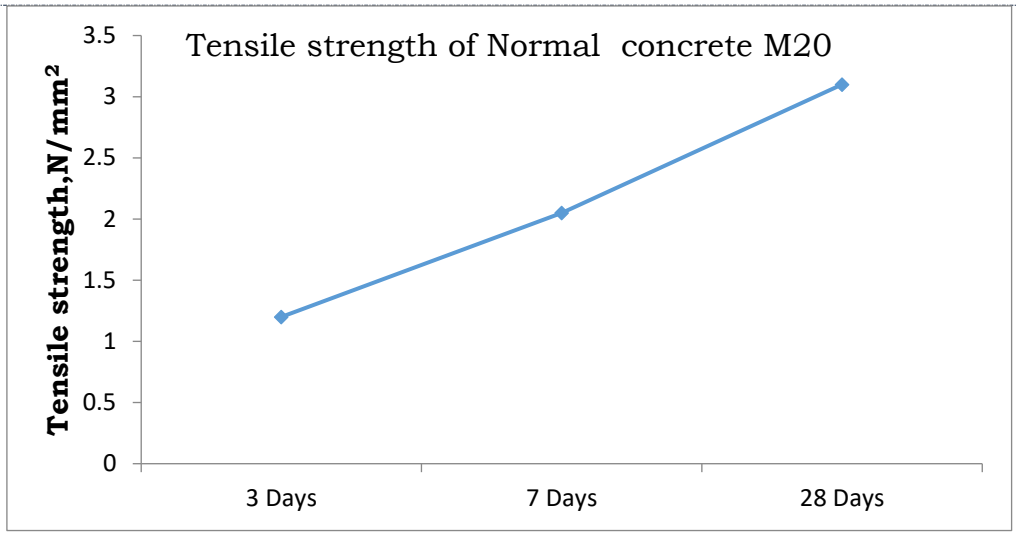
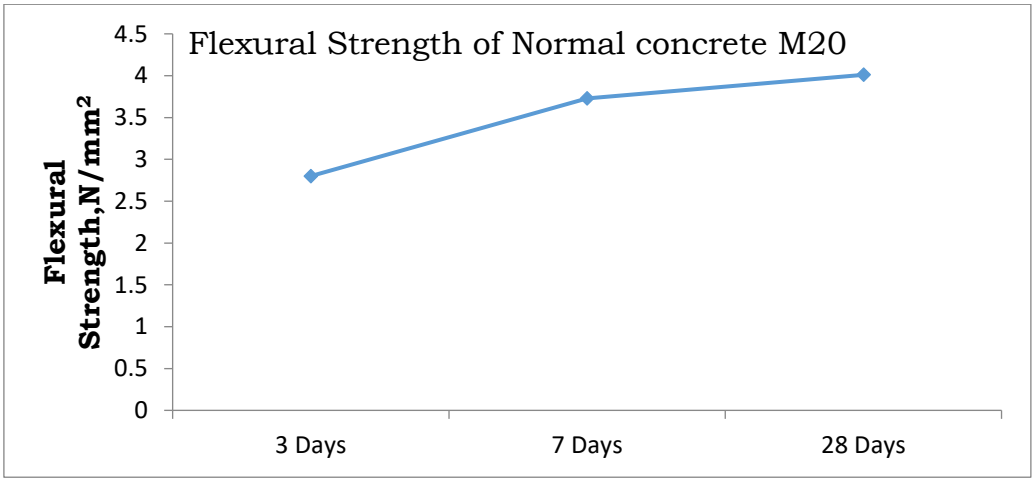


Graph2: Tensile strength of normal concrete



Graph3: Flexural strength of normal concrete

TRIAL MIXES OF NORMAL CONCRETE WITH SILICA FUME:
Cement was replaced with the silica fume in different proportions such as 5, 10, 15 & 20 percent.
Quantities of materials for Normal concrete with silica fume:

Table 7: Quantities of materials per m^3

Silica Fume Proportion	Cement (kg)	Silica fume (kg)	Water (lt)	Fine Aggregate (kg)	Coarse Aggregate (kg)
5%	380	20	180	580	1120
10%	360	40	180	580	1120
15%	340	60	180	580	1120
20%	320	80	180	580	1120

HARDENED PROPORTIES

Table 8: Hardened Properties of Normal Concrete with Silica fume

% of Silica Fume	Compressive strength in N/mm²			Tensile strength in N/mm²		
	3days	7days	28days	3days	7days	28 days

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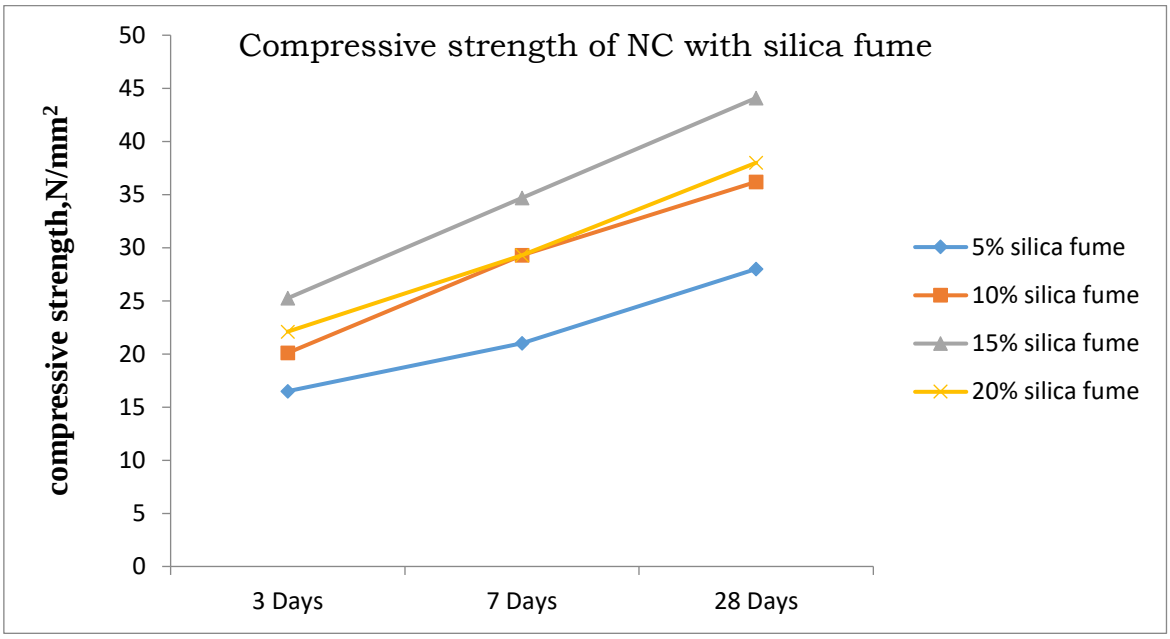
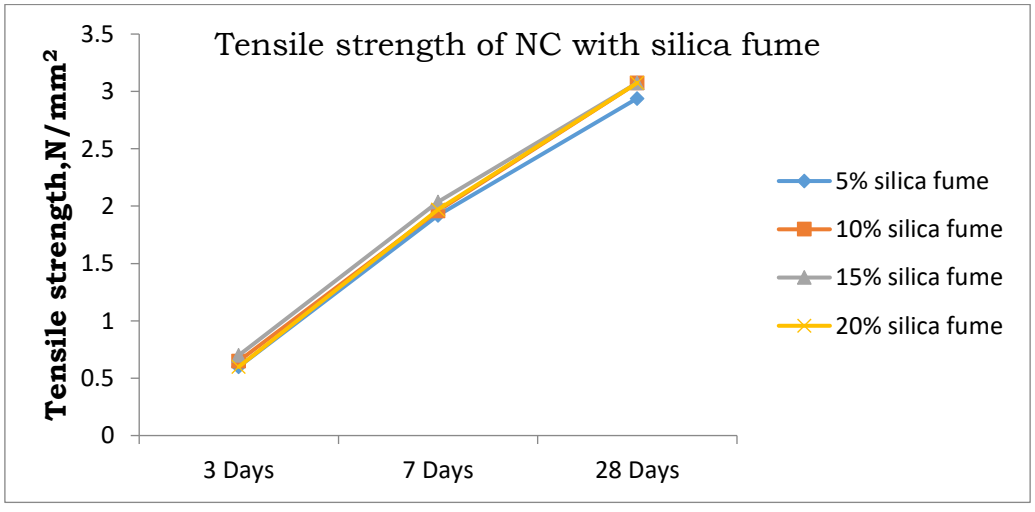
5%	16.5	21	28	0.6	1.92	2.94
10%	20.1	29.3	36.2	0.65	1.96	3.0748
15%	25.25	34.7	44.1	0.7	2.0374	3.0748
20%	22.1	29.3	38	0.6	1.97	3.0748



Graph 4: Compressive Strength of NC with Silica fume



Graph 5: Tensile Strength of NC with Silica fume

TRIAL MIXES OF NORMAL CONCRETE WITH GGBS:
Cement was replaced with the GGBS in different proportions such as 5, 10, 15 & 20 percent.
Quantities of materials for Normal concrete with GGBS:

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Table 9: Quantities of materials per m³

GGBS Proportion	Cement (kg)	GGBS (kg)	Water (lt)	Fine Aggregate (kg)	Coarse Aggregate (kg)
5%	380	20	180	580	1120
10%	360	40	180	580	1120
15%	340	60	180	580	1120
20%	320	80	180	580	1120

HARDENED PROPORTIES:

Table 10: Hardened Properties of Normal Concrete with GGBS

% of GGBS	Compressive Strength (N/mm²)			Tensile strength (N/mm²)		
	3days	7days	28days	3days	7days	28 days
5%	14.4	17.2	28.5	0.5187	1.815	2.7935
10%	15.3	20.9	31.5	0.5187	1.815	2.834
15%	17.2	23	36.5	0.5187	1.8518	2.845
20%	22.2	27.6	42.3	0.778	1.9374	2.967

NORMAL CONCRETE WITH ROBO SAND:
Sand was replaced with the Robo Sand in different proportions such as 25, 50, 75 & 100 percent.

Quantities of materials for Normal concrete with GGBS:

Table 11: Quantities of materials per m³

Robo Sand Proportion	Cement (kg)	Water (lt)	Fine Aggregate (kg)	Robo Sand (kg)	Coarse Aggregate (kg)
25%	400	180	435	145	1120
50%	400	180	290	290	1120
75%	400	180	145	435	1120
100%	400	180	0	580	1120

HARDENED PROPORTIES:

Table 12: Hardened Properties of Normal concrete with Robo sand

% of Robo sand	Compressive Strength (N/mm²)			Tensile strength (N/mm²)			Flexural strength (N/mm²)		
	3days	7days	28days	3days	7days	28days	3days	7days	28days
25%	16	22	29.5	0.5187	1.78	2.85	2.9	3.5	3.9
50%	19.5	27.6	32.5	1.0374	1.83	2.896	3.01	3.75	4.05
75%	23.5	30.6	39.3	1.29	2.07	3.17	3.15	3.89	4.15
100%	18	25	32	0.778	2.07	2.9	3.25	4.01	4.30

OPTIMIZED MIX OF SILICA FUME:
From the results obtained silica fume optimization is done. 15% of silica fume is considered as optimum mix.
Quantities of materials of optimized silica fume Mix:

Table 13: Quantities of materials per m³

Silica Fume Proportion	Cement (kg)	Silica fume (kg)	Water (lt)	Fine Aggregate (kg)	Coarse Aggregate (kg)
15%	340	60	180	580	1120

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HARDENED PROPERTIES:

Table 14: Hardened Properties of Optimized Silica fume mix

No of days	Compressive strength (N/mm^2)	Tensile strength (N/mm^2)	Flexural strength (N/mm^2)
3 days	25.25	1.12	4
7 days	34.7	2.03	4.82
28 days	44.1	3.07	5.12

OPTIMIZED MIX OF GGBS:

From the results obtained, the optimized value obtained is 20% of GGBS is convenient.
Quantities of materials of optimized GGBS Mix:

Table 15: Quantities of materials per m^3

GGBS Proportion	Cement (kg)	GGBS (kg)	Water (lt)	Fine Aggregate (kg)	Coarse Aggregate (kg)
20%	320	80	180	580	1120

HARDENED PROPERTIES:

Table 16: Hardened Properties of Optimized GGBS Mix

No of days	Compressive strength (N/mm^2)	Tensile strength (N/mm^2)	Flexural strength (N/mm^2)
3 days	22.2	1.2	2.8
7 days	27.66	2.05	3.73
28 days	42.3	3.1	4.01

NORMAL CONCRETE WITH OPTIMIZED SILICA FUME AND ROBO SAND:

Optimized value of Silica fume is mixed with the different proportions of the Robo Sand.
Quantities of materials for Normal concrete with Optimized Silica fume and Robo sand:

Table 17: Quantities of materials per m^3

Robo Sand Proportion	Cement (kg)	Water (lt)	Fine Aggregate (kg)	Robo Sand (kg)	Coarse Aggregate (kg)	Optimized Silica fume (kg)
25%	340	180	435	145	1120	60
50%	340	180	290	290	1120	60
75%	340	180	145	435	1120	60
100%	340	180	0	580	1120	60

HARDENED PROPORTIES:

Table 18: Hardened Properties of NC with Optimized SF and Robo Sand

% of Robo sand	Compressive strength (N/mm^2)			Tensile strength (N/mm^2)			Flexural strength (N/mm^2)		
	3days	7days	28days	3days	7days	28days	3days	7days	28days
25%	23	28.9	31	1.988	2.0374	3.0748	3.89	4.01	4.53
50%	26.8	32.5	39.8	1.988	2.0374	3.14	3.29	3.89	4.86
75%	30.25	37	48.2	1.55	2.26	3.215	3.28	3.80	4.9

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100%	28.3	32.1	43.4	1.64	2.17	3.21	3.16	3.79	4.14

NORMAL CONCRETE WITH OPTIMIZED GGBS AND ROBO SAND:

Optimized value of GGBS is mixed with the different proportions of the Robo Sand

Quantities of materials for Normal concrete with Optimized Silica fume and Robo sand:

Table 19: Quantities of materials per m³

Robo Sand Proportion	Cement (Kg)	Water (lt)	Fine Aggregate (kg)	Robo Sand (kg)	Coarse Aggregate (kg)	Optimized GGBS (kg)
25%	320	180	435	145	1120	80
50%	320	180	290	290	1120	80
75%	320	180	145	435	1120	80
100%	320	180	0	580	1120	80

HARDENED PROPORTIES:

Table 20: Hardened Properties of NC with Optimized GGBS & Robo Sand

% of Robo sand	Compressive strength (N/mm^2)			Tensile strength (N/mm^2)			Flexural strength (N/mm^2)		
	3days	7days	28days	3days	7days	28days	3days	7days	28days
25%	18.2	22.3	30.1	0.778	1.987	3.012	2.56	3.05	3.95
50%	21.8	26.2	39.8	0.785	2.05	3.125	2.57	3.14	3.85
75%	24	29.8	45.1	0.82	2.16	3.125	2.72	3.38	4.07
100%	22.4	27.6	40.5	0.88	2.1	3.01	2.68	3.17	3.75

CONCLUSIONS

The following conclusions drawn from this work are

- The Optimum percentage replacement level of Silica fume in ordinary Portland cement based on the maximum compressive strength and water/cement ratio of 0.45 was 15%.
- The optimum percentage replacement level of GGBS in ordinary Portland cement based on the concrete maximum compressive strength and water/cement ratio of 0.45 was 20%.
- The addition of silica fume provides high compressive strength development, compared to normal concrete. The 28 days strength increase with 15% silica fume specimen was higher by 24.5%.
- The addition of GGBS provides high compressive strength development compared to normal concrete. The 28 days strength increase with 20% GGBS specimen was increased by 16.67%.
- The admixture concrete has shown improvement in workability with GGBS, decrease in workability with silica fume.
- Hence, observed that a mineral admixture varies the workability and strength up to certain limit.
- Addition of Robo sand shows improvement in workability and strengths.
- Concrete modified with robo sand perform comparatively better than normal concrete with and without admixtures like GGBS & Silica fume.
- It is observed that percentage weight loss and strength loss is less in admixture concrete with robo sand as compare to normal concrete. This shows that admixture concrete with robo sand compared to normal concrete has better resistance against acidic solutions.

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