An Experimental Study on Strength And Durability Properties of M20, M25, M30 And M35 Grades of Concrete With The Influence of M-Sand And Nanosilica

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Abstract- *Increased use of natural resources and restrictions due to environmental impact have restricted the availability of river sand, and the building materials industry has begun to find suitable alternative fine aggregates. One of them is "manufacturing sand (M-SAND)". The application of m-sand to concrete must achieve the desired quality and ensure a serviceable R.C.C structure. Portland Pozzolana cement provides some improvement in structural durability due to the low heat of hydration. Nanosilica is a Nano material that has a valuable impact on improving the strength and durability of concrete structures. In current work, nanosilica is used by weight as a partial replacement for Portland pozzolana cement. In the current work, the partial replacement of nanosilica with cement by 1.5% and the complete replacement of M sand with natural river sand have had a positive effect on improving strength and durability.*

Keywords- M-Sand, Nanosilica, Nano materials, Portland Pozzolana cement, Durability.

I. INTRODUCTION

Cement is one of the widely used building materials in concrete structures, which consumes almost the entire production of cement. Portland cement is one of the largest products used worldwide. Experimental research and accurate engineering of the complex structure of cement-based materials at the nano level is a new generation with stronger, more durable, desirable stress-strain behavior, and perhaps a newly introduced range. Brings eco-concrete to desire properties, such as Electrical conductivity, temperature, humidity, stress detection ability, etc. The grading of the mixture, which contains particles in the range of 300 μm to 32 mm, determines the mixing properties of the concrete. To obtain least porous material, such Packing can only be done by including particles smaller than 300 μm. Materials available in the industry are limestone and fine silica such as silica fume (SF) and Nano silica (NS). In cement, its main hydrate C–S–H gel is a natural nanostructured material. The mechanical properties and durability of concrete mainly depend on the gradually refining structure of the hardened cement paste and the gradually improving interface between the paste and the aggregate. Micro silica (silica fume) belongs to the category of high pozzolanic materials because it is composed essentially of non-crystalline form of silica, has a high specific surface area and exhibits excellent pozzolantic activity. New pozzolan materials, synthetically produced in the form of water emulsions of ultrafine amorphous colloidal silica (UFACS), are available on the market and are superior to silica fume due to their high amorphous silica content (> 99). There is a possibility. %) And the reduced size of its spherical particles (1-50 nm). The use of NS has improved the durability of concrete and the compressive strength for 28 days. Adding NS to high-strength concrete improves both short-term and long-term strength.

II. OBJECTIVE

The objective of the prevailing work is to study the influence of Nano silica, Fly ash and M sand on Durability of concrete and strength properties like Compressive strength, split tensile strength and flexural strength of concrete at 3,7,28 days of different grades of concrete.

III. EXPERIMENTS CONDUCTED

150x150x150 mm cubes and 150x300mm cylinders and 500x100x100mm cubes are casted and cured for 3,7,28 days and examined for strength and durable properties like RCPT, sorptivity, acid attack, water absorption etc. cubes are used to check compressive strength, Cylinders are used to check split tensile strength and prisms are used to check flexural strength.

IV. OBSERVATIONS

4.1 Durability studies

4.1.1 Acid attack

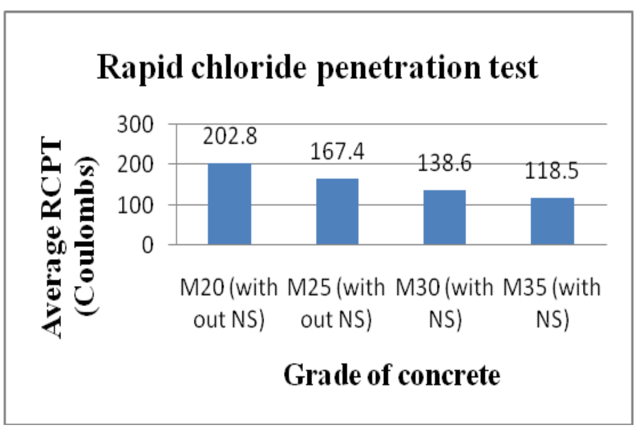
After proper water curing the specimens (cubes, cylinders and beams) were exposed to dilute Sulphuric acid of 0.1% and 0.3% concentrations. The strength of acid was measured at regular intervals and the depleted acid was replenished. For measuring the strength of acid volumetric analysis was used.

when M30 (with Nano Silica) grade concrete exposed to 0.3 % of H_2S0_4 acid for 14, 28 the Compressive strength of cube is reduced by 7.06%, 11.52% respectively and there is a gradual reduction of weight in cube.

when M30 (with NS) grade concrete exposed to 0.1 % of H_2S0_4 acid for 14, 28 days the Compressive strength of cube is reduced by 10.49%, 13.92% respectively and there is a gradual reduction of weight in cube.

4.1.2 Chloride Ion Penetration (Rapid Chloride Permeability Test).

In the AASHTO T277 (ASTM C1202) test, a water-saturated, 50-mm thick, 100-mm diameter concrete specimen is subjected to a 60 V applied DC voltage for 6 hours using the apparatus shown in Figure 3. In one reservoir is a 3.0% NaCl solution and in the other reservoir is a 0.3 M NaOH solution. The total charge passed is determined. It is not permeability test, but ionic movement.



The chloride ion penetrability for M20, M25, M30 and M35 fall under very low chloride ion penetration category.

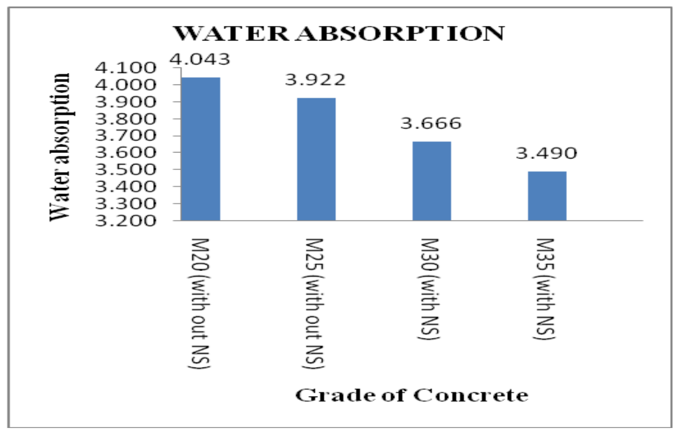
4.1.3 Sorptivity

The Sorptivity test is a simple and rapid test to determine the tendency of concrete to absorb water by capillary suction. The test was developed by Hall (1981) and is based on Darcy's law of unsaturated flow.

It is observed that the Coefficient of Sorptivity is low for M20 and M25 when compared to concrete with M30 and M35 due to nanosilica.

4.1.4 Water absorption

Water absorption characteristic of concrete plays an important role on the durability. The test was performed to evaluate the water absorption characteristics of normal concrete and concrete with nano silica



5.1 Strength Tests

5.1.1 Compressive strength of concrete

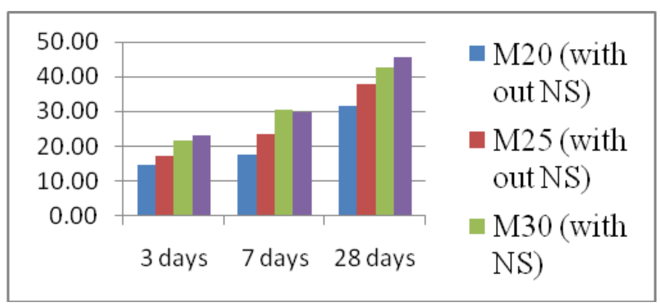


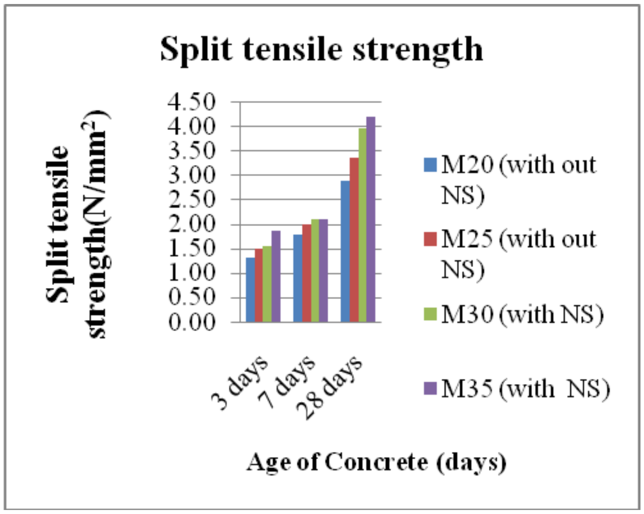
Table 5.1.1 Compressive Strength of concrete (N/mm^2)

GRADE	M20 (without NS)	M25 (without NS)	M30 (with NS)	M35 (with NS)
3 days	14.81	17.33	21.63	23.11
7 days	17.78	23.56	30.37	29.70
28 days	31.56	38.00	42.67	45.53

5.1.2 Split Tensile Strength

Table 5.1.2 Split Tensile Strength of concrete (N/mm^2)

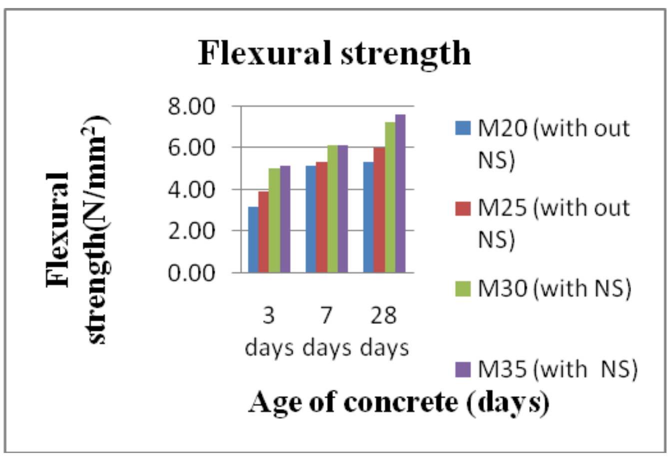
GRADE	M20 (without NS)	M25 (without NS)	M30 (with NS)	M35 (with NS)
3 days	1.30	1.49	1.53	1.86
7 days	1.77	1.98	2.10	2.10
28 days	2.87	3.36	3.96	4.18



5.1.3 Flexural Strength

Table 5.1.3 Flexural Strength of concrete (N/mm^2)

GRADE	M20 (without NS)	M25 (without NS)	M30 (with NS)	M35 (with NS)
3 days	3.19	3.89	4.99	5.12
7 days	5.12	5.31	6.10	6.10
28 days	5.31	6.00	7.22	7.58



VI. CONCLUSION

A study was done on use of 100 % replacement of M-sand to river sand 25% fly ash and 1.5% of Nano silica by weight of cement, tests like Compressive strength, Split tensile strength, Flexural strength, Water absorption, RCPT, Sorptivity, Acid Attack.

Based on the test results, the following conclusions were drawn:

1. As grade of the concrete increases, Compressive strength, Split tensile strength and Flexural strength increases with the increase of age of the concrete.
2. As grade of the concrete increases, Average Water Absorption and void ratio of the concrete decreases with increase in the age of concrete because of dense packing.
3. The average bulk density after immersion of the concrete decreases as the grade increases because lower grades of the concrete displaces less water due to their relatively porous structure when compared to higher grades.
4. The chloride ion penetrability of all the grades fall under the very low chloride penetration category. The penetrability of the chloride ion decreases as the grade of the concrete increases.
5. As the grade of the concrete increases, the points on the curve plotted between the gain in mass per unit area over the density of water and square root of time are coming closer to the slope of the line of best fit. This represents the tendency of concrete to absorb water by capillary suction decreases as the grade of the concrete increases.
6. There is minor weight loss observed due to acid exposure for 14, 28 days for all grades for 0.1% and 0.3 % of H_2SO_4.
7. There is gradual reduction of compressive strength for 14,28 days of acid exposure corresponding 0.1% and 0.3 % of H_2SO_4 exposed for all grades.

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