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EXPERIMENTAL RESEARCH ON ENHANCING THE DUCTILITY PROPERTY OF PARTIAL REPLACEMENT OF FLY ASHED NANO CONCRETE

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ABSTRACT

Nano silica and Nano fibers, used to increase material properties and durability of cementations materials. Service life can be doubled through the use of Nano-additives. The workability of concrete acquire increased by Nano particles. in current times, Nano particles have been gaining increasing attention and have been applied in many fields to fabricate innovative materials with novel functions due to their incomparable physical and chemical properties. In this paper the influence of Nano silica particles on the material properties and durability of concrete has been studied through measurement of compressive and tensile strength, water absorption, and the depth of chloride penetration. The investigational results show that the material properties conscious, and the durability of the concrete mixed with the Nano particles were improved than that of a plain concrete, also the SEM study of the microstructures showed that the nano particles filled the cement paste pores and, by reacting with calcium hydroxide crystals from calcium silicate hydration, decreased the size and quantity of these crystals. Therefore the results shows that nano scale silica behaves not only as a filler to develop microstructure, but also as an activator to promote pozzolanic reaction (Balaguru, P, etal.,).

In a recent research project a new nano-silica is produced from olivine. This nS, as well as commercially available nS, will be applied and tested. In addition, a mix design tool used for self-compacting concrete (SCC) will be modified to take into account particles in the size range of 10 to 50 nm. This paper aims to present the state of the art of nS application in concrete, focusing on the nS properties to render it suitable to be applicable in concrete. It includes the nS production process, their addition effect and their application in Concrete. Also an overview of the experimental setup and further research is presented.

I. INTRODUCTION

The behavior of reinforced concrete moment resist frame structures in recent earthquakes all over the world has painted the consequences of deprived performance of beam-column joints, which are considerable in the reinforced concrete frame structures. Beam column joints in a reinforced concrete moment resisting frame are vital zones for transfer of loads effectively among the connecting elements (i.e. beams and columns) in the structure. So it is very much essential to reduce the weakness of Beam-Column joint towards the Seismic loading. In this experimental investigation, Nano-SiO_2 can behave as a nucleus to strongly bond with cement hydrates. The stable gel structures can be formed and the properties of hardened cement paste can be improved when a smaller amount of nS is added. Nano-SiO2 can perk up the pressure-sensitive properties of cement mortar. Fly ash concrete with nano-SiO2 has the higher density and potency. Lofty strength concrete with nS has higher flexural strength *(Bartos, Peter J.M, elal,).* In this paper, an attempt has been made to study the behavior of reinforced concrete (RC) beam-column joints with internal concrete confinement by nS and Fly ash, called Nano Concrete, which improves the seismic behavior. Seven exterior RC beam-column joint specimens (control) were cast, cured for 28 days and experienced to failure. Three were only with Fly ash (20%, 40% and 60%) and the further three were with nS (2.5%) and Fly ash (20%, 40% and 60%). An axial load was applied on the column. Seismic load (Push and pull load) was applied at the free end of the cantilever beam till failure. The performance of reinforced Nano concrete Beam Column joints and the Fly ash supplementary RC Beam Column joints were compared with one another and then with the control specimen and the test results are presented.

II. EARTHQUAKE BEHAVIOR OF JOINTS

Under earthquake quaking, the beams adjacent a joint are subjected to moments in the same (clockwise or counterclockwise) track. Under these moments, the top bars in the beam-column joint are pulled in one direction and the bottom ones in the reverse direction. These forces are impartial by bond stress developed between concrete and steel in the joint area. If the column is not broad enough or if the strength of concrete in the joint is low, there is inadequate grip of concrete on the steel bars. In such situation, the bar slips inside the joint region, and beams lose their capacity to carry load. Further, under the action of the above pull-push forces at top and bottom ends, joints undergo geometric deformation; one diagonal length of the joint elongates and the other compresses. If the column cross-sectional size is inadequate, the concrete in the joint develops diagonal cracks.

III. NANOTECHNOLOGY CHANGES THE BEAM COLUMN JOINT BEHAVIOUR

Concrete is used in structure and in buildings. It is composed of granular materials of different sizes and the size range of the collected solid mix covers wide intervals. The overall grading of the mix, contain particles from 300 nm to 32 mm determines the mix properties of the concrete. The properties in fresh state (flow properties and workability) are for instance govern by the particle size distribution (PSD), but also the properties of the concrete in hardened condition, such as strength and durability, are exaggerated by the mix grading and resulting particle packing. The majority of current nanotechnology research in construction has focused on the structure of cement-based materials and their fracture mechanisms. New advanced equipment makes it possible to observe a structure at its atomic level. So to improve the packing we have to increase the solid size range, e.g. by including particles with sizes below 300 nm. Possible materials which are presently available are limestone and silica fines likes silica flavor (Sf), silica fume (SF) and nano silica (nS).

Moreover, the strength, hardness and other basic properties of microscopic and nanoscopic phases of materials can be measured. Atomic force microscopy (AFM) has been applied to the investigation of the amorphous C-S-H gel structure. This has lead to the discovery that this product has a extremely ordered structure at the nano scale. Understanding of nano scale structure helps to influence important processes related to production and use of construction materials, including strength development, fracture, and corrosion and tailoring of desired properties.

The scope of this investigation includes

1) To study the RC beam-column joints were made by partially replace cement with fly ash.
2) Different proportions of replacing of cement with fly ash for studies are 0%, 20%, 40% and 60%.
3) Same proportions of replace of cement with fly ash with addition of nano silica were done and their results are studied.
4) To study the durability of concrete is increased with the use of nano silica.
5) To study on ductile properties of the specimens.
6) To study about the beam column joint behavior under push pull load.
7) To study about the strength improvement in beam column joint failure.

IV. AREAS OF CONCENTRATION

This experimental program consists of casting and testing of 7 numbers of beam column joints. The number of specimen casted, their id, descriptions and their curing stage are summarized below.

Table. No:1: Specimen Details of Beam Column Joint

Si. No	Identification	Description	Curing period
1	C	Control mix	28 days
2	F1	20% fly ash	28 days
3	F2	40% fly ash	28 days
4	F3	60% fly ash	28 days
5	F1N	20% fly ash with nano silica	28 days
6	F2N	40% fly ash with nano silica	28 days
7	F3N	60% fly ash with nano silica	28 days

V. BEAM COLUMN JOINT – DUCTILTIY BEHAVIOR

Ductility is an significant factor for any structural element or structure itself particularly in the seismic regions. A ductile material is one that can endure large strains while resisting loads. When applied to RC members, the word ductility implies the ability to sustain significant inelastic deformation prior to collapse. Ductility is also best expressed as an index or a factor, through relationship at some decisive stages in the performance Characteristics of a structural element. In this study, the displacement ductility was investigated. The displacement ductility index can give an estimation of the lack of ductility of these specimens.

Table. No:2: Specimen Details of Beam Column Joint

Specimen description	Yield displacement (mm)	Ultimate displacement (mm)	Ductility index
C	1.66	8.51	5.1
CN	5.2	28.5	5.48
F20	2.12	10.81	4.8
F40	3.48	14.62	4.2
F60	2.24	8.99	4.0
F20N	3.42	18.81	5.5.
F40N	6.21	36.64	5.9
F60N	1.93	10.44	5.4

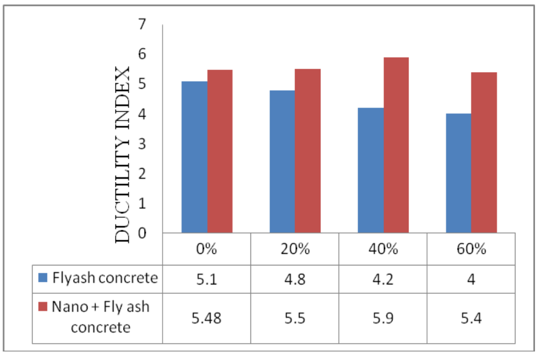

Figure – 1 Ductility Index Comparison for Beam Column Joint Subjected to Cyclic Loading.

The figure above enumerates that the fly ash replaced specimen such F20, F40, F60 having sequent less ductility index comparing to the control specimen. While correlating with the fly ash replaced specimen and Nano concreted specimen such as F20N, F40N, F60N we found that the Nano concrete specimen having more ductile behaviour at all constraints.

So we safely concluded that the Nano added concrete possess some significant higher ductile behaviour than ordinary fly ash replaced concrete.

VI. CONCLUSION

Based on the experiments, we safely conclude the following points

1. Based on the ductility index factor the specimens are ranked as follow on behalf of their results F40N, CN, F20N, F60N, F20, C, F40, and F60.
2. The above comparison indicates that 60% of cement replacement can be possible in the Nano silica concrete.
3. The Nano concreted specimen regards more ductile specimen when compare to remaining specimen, this indicate no case the spalling of concrete and exposure of reinforcement to outer was found till its failure.

But in control specimen and ordinary fly ash replaced specimen the above factors are comparatively not acceptable values while specimen attain seismic effect.

4. At all the constraints we have found that the F40N specimen having more ductile behavior while comparing to others. Thus the F40N specimen surely fulfills the needs of seismic effects and withstands the vulnerability as much as extent. But when comparing to the control specimen the fly ash replaced specimen possess some significant less ductility behavior.
5. Especially the F40N specimen having optimum and sustained strength increment than all other specimens.

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