Investigating the Strain of Standard Concrete Specimen with FRP and Nano Silica Fiber Coating

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Abstract

Prevention of the occurrence or reduction of mortality and financial losses due to earthquakes in our country is important given its geologically sensitive location. One of the activities that is carried out today in the advanced countries in this field is the examination of existing buildings to assess the structures and identify their weaknesses, to improve and if they are damaged, they will be strengthened. Screw-up of concrete members with FRP materials is considered as a new method of repairing and retrofitting buildings. Also, the use of nano-silica in concrete increases the compressive strength. In this study, the results of a laboratory study on the performance of a concrete sample of nano silicon with FRP fibers are investigated. For this purpose, 9 samples with nano silica with the proposed mixing rate of the factory and 36 silica-filtrated and rounded screws with 4 series of fiber in the Iranian market, which are laboratory samples including 45 cylindrical samples, are tested. In all models, the strain rate in the compression test was examined. In general, compared to the results, it was found that the nano silica-reinforced specimen was less versatile than nano silica without a nano silica, and the use of nano particulate fibers with nano silica rather than nano silica should be considered by designers in retrofit schemes when using nano silica.

Keywords: Pressure strain, Nano silica, FRP fibers, retrofitting

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Introduction

Due to the increasing consumption of concrete additives such as nano silica and FRP products in individual retrofitting projects by different companies, there is no research reference on the proper functioning of these products and their interaction between these compounds. Therefore, the purpose of this study is to investigate the stress strain performance of fiber reinforced, nano silica-free and non-nano-silica samples, which can be widely used for engineers, designers, engineers, consultants and housing and urbanization, etc. In developed countries, FRP systems have grown as a successor to steel plates. Due to the corrosion of steel plates that lead to the destruction of adhesion between steel and concrete, and also their installation, it is very difficult and need heavy equipment, to solve this problem, they recommended the use of galvanized sheets (steel + zinc alloys), but this alloy was reacted in an acidic medium, and the thread was disconnected between the steel and the various companies, offering different solutions to this problem. Use of electrostatic sprays, powdered compound adhesives, steel-to-oil impregnation, gas pipes, etc., so that the Federal Highway Administration of the United States recommends the use of epoxy steel, and eventually the Marshall-Vega Company, Glass Fiber It was produced and marketed [2]. These products are used to build and strengthen structures, especially concrete structures. For reinforcement with FRP, 4 types of fibers are used (Fabric FRP), which includes carbon fibers, glass, aramid and basalt. FRP can be used to reinforce columns, beams, slabs, fittings, concrete shear walls, brick walls, base and deck bridges, etc. Compared with the use of taps and steel spirals, enclosing using FRP can provide enclosure continuously for the entire cross-section of the column. Also, these materials have high resistance to weight and high resistance to corrosion and electromagnetic neutrality, so that they can be used to retrofit or rebuild concrete members successfully. FRP can be used in concrete beams and concrete slabs to replace the required tensile strength. Also, FRP can be used in concrete fittings and can increase bonding strength. The use of nanotechnology is one of the few things that have had many hopes in recent years to improve various properties in the world. New approaches to concrete technology have been introduced in recent years with the introduction of nanotechnology. One can also improve the knowledge and understanding of the physical and chemical reactions and microstructure of concrete, as well as improving the quality of existing concrete and its related methods using new nanoscale materials, or the same nanoparticles. By definition, nanoparticles are said to be particles that at least one of their dimensions is less than 399 nm. Due to the microstructure of hydrated cement and the presence of cavities in the nanoscale dimensions, the use of nanoparticles can be effective in filling the very fine porosity of cement paste and increasing the strength and, in particular, the durability of concrete. One of the interesting things in this regard is nano silica. Studies have shown that the amount of this material needed to achieve a similar effect of silica is much lower, and this has led to various advantages in the use of nano silica. In the combination of cement with water, Si-O silica bond due to its high binding energy is not easily broken. The first reaction of silica is slower than the first reaction of nano silica. Therefore, nano silicon can accelerate the process of hydration and drainage. Therefore, the presence of nano silica can increase the compressive strength of hardened dough and increase the bond strength of aggregates to the pulp and improve the structure of the transfer region more efficiently than the soot of silica. [3] Considering the effects of using nano silica in concrete, including improving microstructure, reducing permeability, reducing pore size and increasing compressive strength, it can be argued that the use of nano silica in concrete reduces the rate of chloride ion penetration.

Research Methodology

In this study, the results of a laboratory study on the performance of a concrete sample of nano silicon with FRP fibers are investigated. For this purpose, 9 samples were prepared with nano silica with the proposed mixing rate of the factory for the ages of 7, 14 and 28 days, and 36 silica wrapped and rounded screws with 4 series of fibers in the Iranian market, which included laboratory samples including 45 cylindrical specimens have been tested. In all models, the strain value in the standard compression test is examined. For persentage of silica used by ctalog that show by company equal 5% of cement.

Figure 1. two sample of standard cylindrical screwed with *glass and carbon FRP after test*

The greases are used to lubricate the molds so that the prepared concrete can easily be placed inside the molds. Then, the mixture of the prepared concrete is poured into the molds in such a way that the concrete is poured into three layers and each layer is hit 25, until all the air bubbles extract and compress concrete. Put the specimens in a corner to dry completely. After 24 hours, they took the specimens completely and molded the specimens into a pond of water until they reached the desired age.

Findings

Discussion and inference on data and impact of FRP fibers

In the study of the strain performance in FRP coating, a compressive strength test of 45 cylindrical specimens was made in the lab that obtained the following results after obtaining laboratory results:

1) The sample A, considered as the control sample, has a strength of 307.05 kg/cm2 and a strain of 0.000367. Then, using interpolation, we obtain the strain value for other samples under resistance of 307.05 kg/cm2. In this case, a comparison can be made between the strains values in samples amplified with different fibers.

Table 1: Strain values in reinforced specimens

Plan	Resistance Kg/cm2	Strain
A	307.0536	0.000367
B	307.0536	0.001
C	307.0536	0.00064
D	307.0536	0.000579
E	307.0536	0.000603

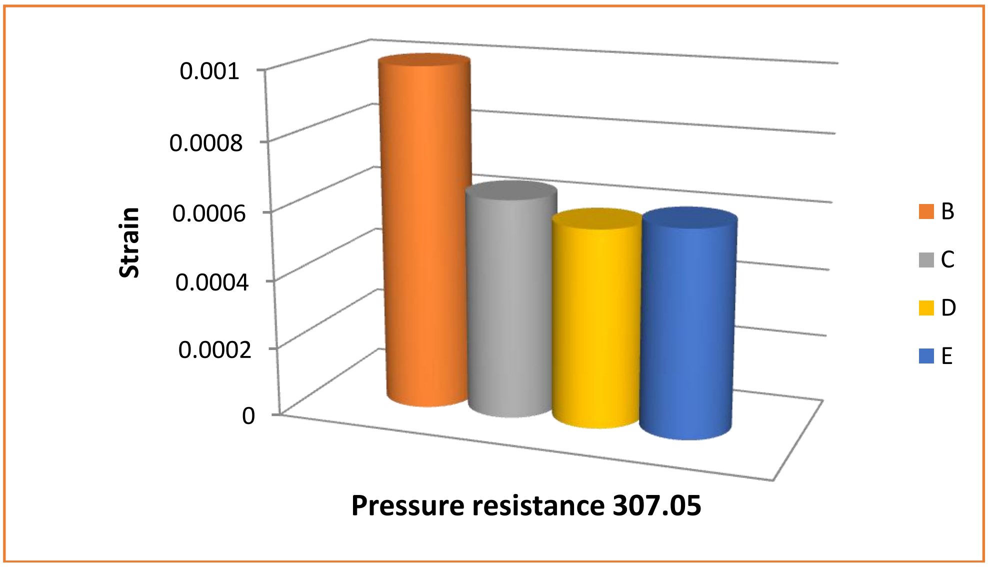

Figure 2: Strain values in reinforced specimens

Based on the interpolation done, sample B has the most strain or indeed the greatest change in length, which is very satisfactory.

1) Between samples B and C, both of which are single-sided glass, sample B has a greater strain with a thickness greater than the C sample.
2) The specimens of the D and E planes, both of which are single-sided carbon, have an E-strain with a lower strain than the D sample.
3) Considering that the stiffness of the strain is decisive in determining the thickness of the fiber, the higher the thickness of the fiber, the more strain it can tolerate, the glass fiber of this theory is acceptable, but in the case of carbon fibers the results of

the experiments are indicated contrary to this theory.

4) At 28 days in the lab, the design B has a resistance of 400.7 and a final thickness of 0.001, which is more tolerant than other designs.
5) According to the rules, the best method for enclosing the samples is to twist them in the direction of the fiber, and the more layers are larger, the greater the amount of resistance and strain.
6) In this study, four types of carbon and fiber were used, the glass fibers have the highest strain.

2) Discussion and deduction of data and impact on particles

Now, considering that we want to investigate the effect of nanoparticles in parallel with reinforcement by FRP method, the strains of concrete specimens reinforced with FRP materials at the age of 7, 14 and 28 days without using nanoparticles, which are from previous studies of "accuracy The measurement of FRP fibers was extracted in a compressive strength test [33] (in terms of grading and starting experiments, for the purpose of analogy, the granularity of the granules included in the thesis was on the agenda) with the results of the experiments obtained by age Examples are shown in the tables below.

Table 2: Comparison of samples at 7 days of age

Row	Description	Length Change	Resistance	Strain	The strain obtained from testing nanosized specimens
		mm	Kg/cm2		0.00059
1	A	0.16	208.92	0.00053	0.00074
2	B	0.2	309.9	0.00067	0.00098
3	C	0.28	338.4	0.00093	0.00098
4	D	0.27	306.9	0.00090	0.0011
5	E	0.29	296.3	0.00097	0.00059

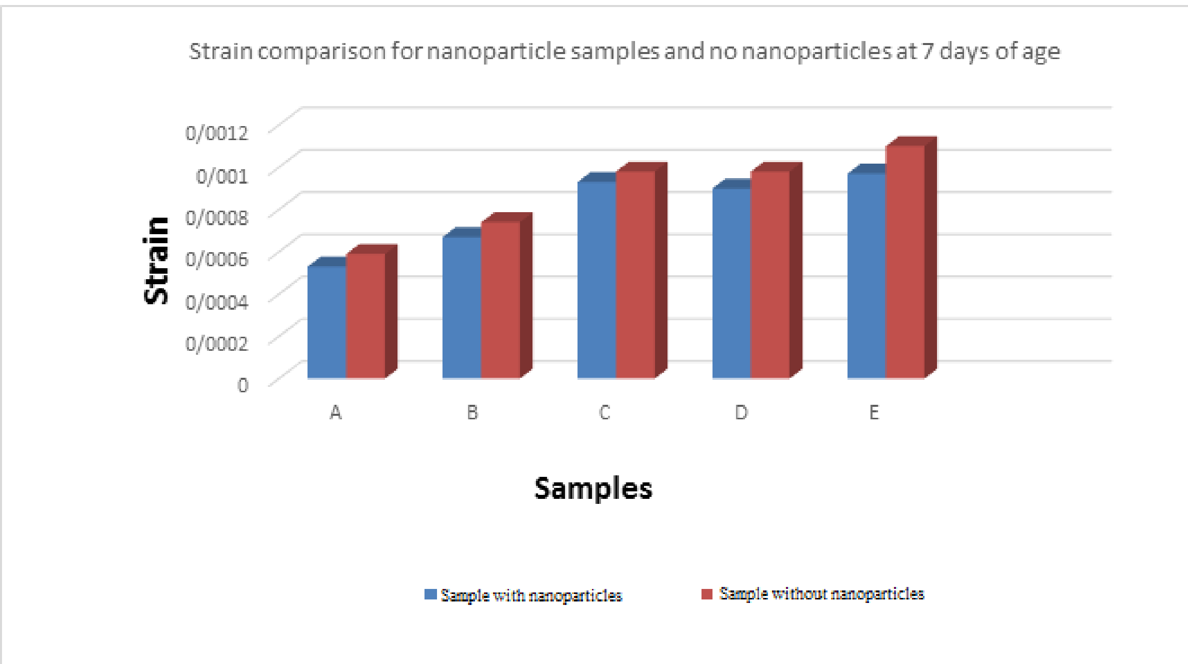

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Table 3: Comparison of samples at 14 days of age

Row	Description	Length Change	Resistance	Strain	The strain obtained from testing nanosized specimens
		mm	Kg/cm2		0.00059
1	A	0.14	291.39	0.00047	0.00051
2	B	0.21	334.4	0.0007	0.00081
3	C	0.27	316.5	0.0009	0.00099
4	D	0.29	325.4	0.00097	0.0012
5	E	0.24	330.1	0.0008	0.0093

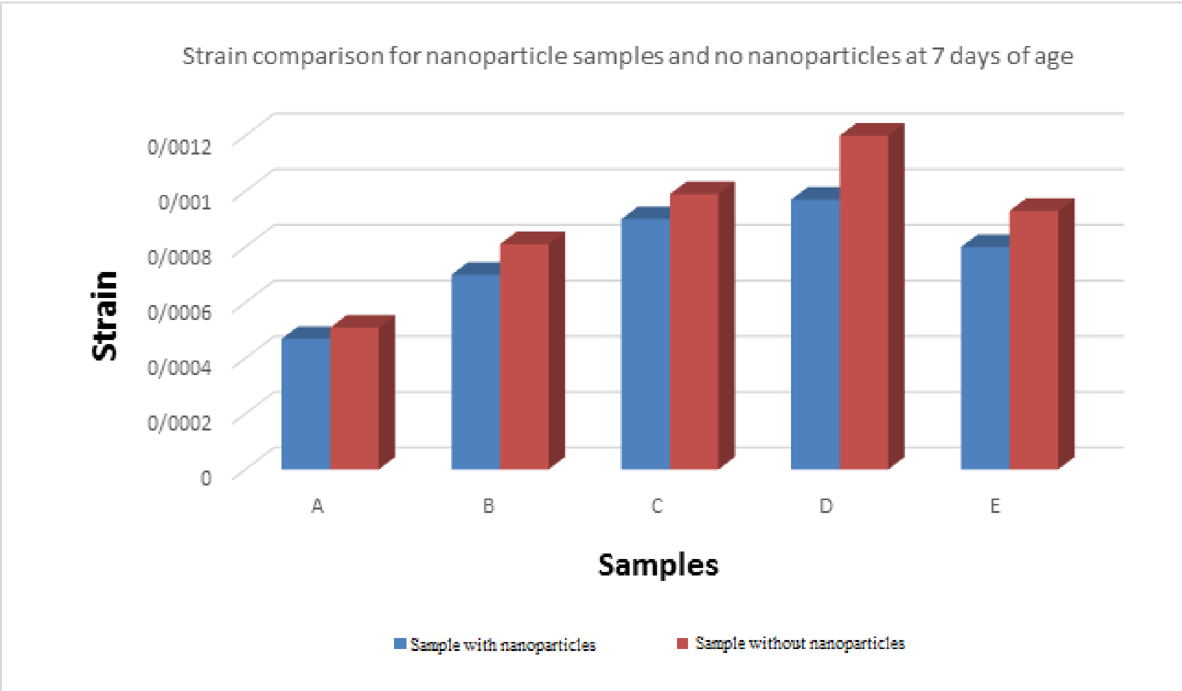
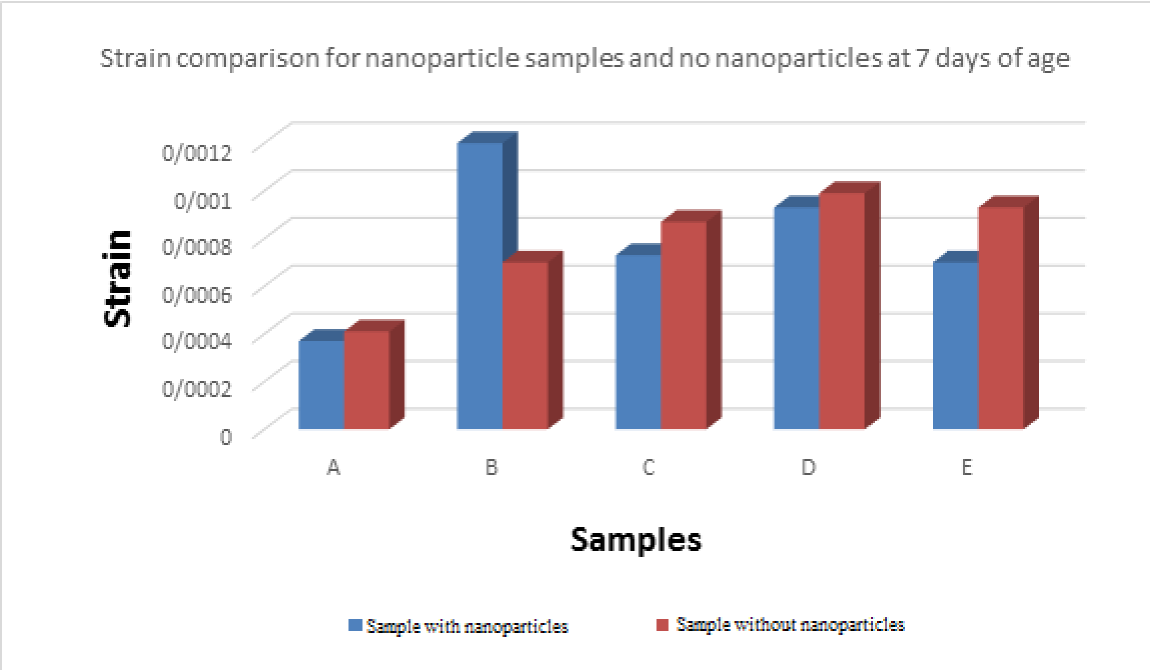


Table 4: Comparison of samples at 28 days of age

Row	Description	Length Change	Resistance	Strain	The strain obtained from testing nanosized specimens
		mm	kg/cm2		
1	A	0.11	307.05	0.00037	0.00051

2	B	0.36	400.7	0.0012	0.00081
3	C	0.22	395.4	0.00073	0.00099
4	D	0.28	368	0.00093	0.0012
5	E	0.21	346.3	0.0007	0.0093



As can be seen, the effect of nanoparticles in parallel with FRP materials has a decreasing effect on the strain. In Table 3 and 2, in samples of age 7 and 14, this was completely apparent, and in the 28-day specimens except for sample B, the strain was reduced in all specimens by adding nanoparticles. The reason for the difference in sample B with the results of strain results in Table 4, for the 28-day example, is that the error is too high to be answered by the following factors:

1) Homogeneous, non-glued on the sample
2) Inaccuracy in laying FRP sheets on the sample

The results of the experiments, regardless of sample B, at 28 days of age are very interesting and expanding in the future. In more complete terms, with FRP materials, the resistance of the samples has increased, the surface below the strain pressure (energy absorption and movement to formability) has increased and will have the simultaneous effect of strain reduction nanoparticles.

Results

FRP fabric fibers due to its outstanding properties, including high strength, low weight and corrosion resistance, easy to install, consistent with structural architecture, lower overall cost than steel sheets, strong reinforcement when using a highly structured structure. [7]. In this study, using the results and outputs, it was observed that reinforcement with FRP reinforces the compressive strength and due to the linear relationship $\varepsilon = E\ \sigma$ to the same ratio causes to increase strain rate. In general, compared to the results, it was found that the nano silica-reinforced specimen, contrary to the assumption, was less ductile than nano silica without a nano silica, and the use of synthetic fibers with nano silica was more versatile than nano silica It should be considered by designers in retrofit schemes if using nano silica.

Suggestions

1) It is suggested that samples should be made in real sizes and reinforced with fabric fibers and checked for shear strength.

2) It is recommended that samples be made in real sizes and reinforced with fabric fibers and tested for flexural strength.
3) Cylindrical specimens can be reinforced using FRP spindles and their function is examined and the results are compared with the results of this dissertation.
4) The use of cube samples is recommended.
5) It is suggested that the same laboratory work with the model software.
6) The percentage of nanoparticles used in this thesis is 3% according to the catalogs of the manufacturing companies.

It is suggested that different percentages of nanoparticles be tested.

1) It is recommended that other methods of bonding FRP sheets other than screw-in, such as bonding, be tested in the same direction.
2) It is suggested that the nanoparticles in the Iranian market are tested and the information provided by the manufacturer is checked.

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