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STRENGTHENING OF COMPRESSION COLUMNS WITH GLASS COMPOSITE REINFORCEMENTS

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A R T I C L E I N F O.

Key words: *bearing structure, composite materials, reinforcement methods, technology, reinforced concrete columns, and external composite rods.*

Abstract

The column is the most important structural element transmitting floor loads to the foundation, and its proper strength is of paramount importance. Failure of a column can lead to the collapse of the entire frame structure. The purpose of this study is to test the effectiveness of the column strengthening method.

Introduction. Reinforcement is used in a structural system to increase its seismic resistance by increasing strength or ductility. There are many methods of reinforcement. Currently, the most commonly used methods include the application of ferrocement, external reinforcement, and the central core technique. Reconstruction of a weak building is not a reasonable approach and can create a huge burden on the national economy. Many existing reinforced concrete (reinforced concrete) structures need to be reinforced due to increased demand, corrosion of steel rods, insufficient maintenance, changes in structural functions, changes in the rulebook and the impact of adverse circumstances such as earthquakes and explosions. Reinforcement of the column may also be required due to an increase in the number of floors, the difference in the strength of concrete in the field, the discrepancy between the percentage and type of reinforcement to the requirements of standards, the slope of the column and the draft. the foundation exceeds the permissible design limits. If proper attention is not paid to strengthening the building, it will lead to huge losses in terms of lives and wealth. Strengthening a building or its components is the best alternative approach to improving its seismic characteristics [1] [8].

2. Methods. In this study, two square columns were constructed, one control column and one reinforced column, as shown in Figure 1. Both the control and reinforced columns were subjected to the same axial load setting to test the effectiveness of the reinforcement method. The columns were reinforced with external composite rods attached to the existing main rods. They were designed for a minimum area of steel (4pcs Ø6AIII). Concrete with a strength of B20 was used. All samples were tested under axial loading. The dimensions of the columns are shown in Table 1.

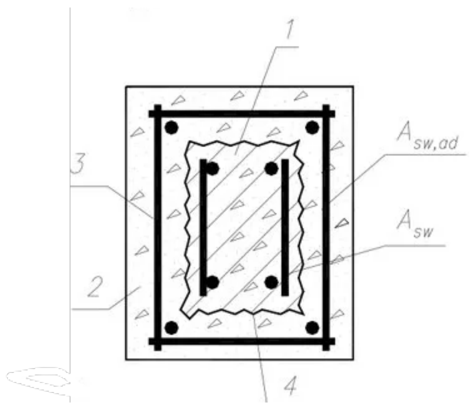

Figure 1. Visual representation of a reinforced column

1-reinforced structure, 2-monolithic concrete, 3-additional composite reinforcement, 4- surface notch

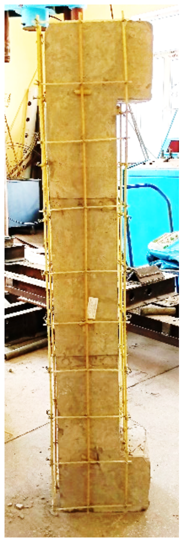

Figure 2.

The process of strengthening columns

The dimensions of the columns.

Table 1.

Reinforced square column	
Cross section	200x200mm
Height	1500mm
Reinforcement. Main rods 4pcs Ø6AIII	

In order to strengthen, the transparent cover was first removed from the column. The outer rods were used for reinforcement and then attached to the existing main rods, as shown in Figure 2. To protect the outer rods, concrete was poured again to provide a transparent coating, which led to a slight increase in the diameter of the column. After applying the transparent coating, it was cured for 28 days. Load cells were connected to the column to measure displacement and load, respectively. Grout concrete was designed to strengthen the bond between old and new concrete [2] [7].

3. The results and their discussion. The results are shown in Table 2 and graphically shown in Figure 3. The column of the control square has been tested and the behavior of the column is shown in the graph. The control column failed with an applied load of 209 kN, as well as with some cracks in the middle of the column, which corresponds to the line of the deformation graph 0.04–0.07, as shown in Figure 5. The maximum lateral deformation is approximately 2.03 mm, which is very small in magnitude, and the load is within the core section [9] [10].

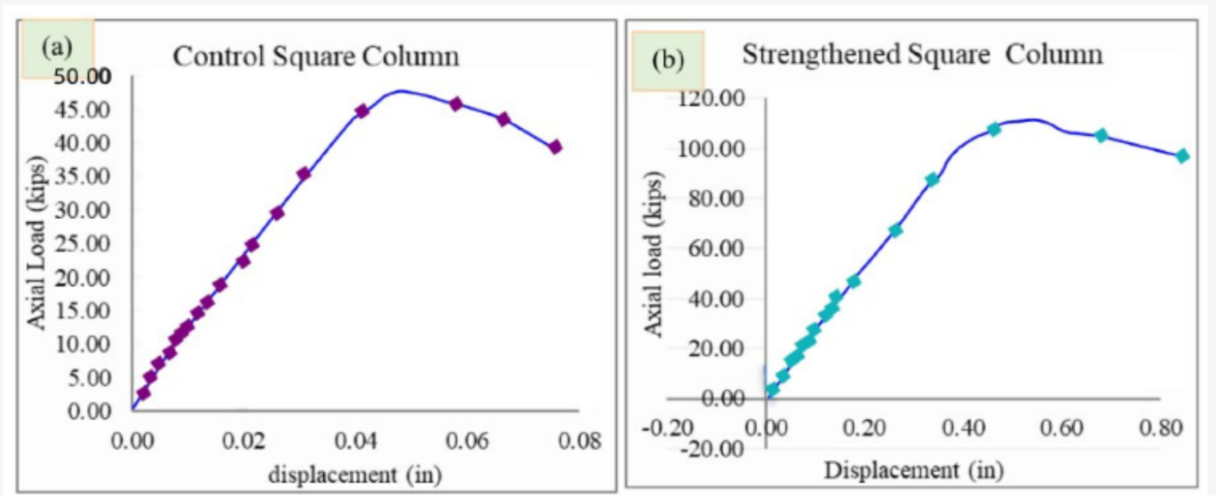

Figure 3. Graphs of the dependence of axial load on deformation for the control SC (a) and reinforced SC (b).

Figure 4. Reinforced square column.

Test results

Table 2.

Power	Design pressure (kN)	Test value(kN)
Control sample	254	209
Reinforced sample	421	501

The reinforced square column collapsed right in the middle in the form of buckling at an applied load of 501 kN. This strength is almost 2 times higher than the calculated strength of the steering column [12]. The column shows some deformation at the beginning of 0.51mm without load, and then the deformation returns to zero with increasing load, which is due to surface irregularities and self-adjustment for proper adhesion. Columns are destroyed due to shear (crumpling), due to which the lateral deformation suddenly increases without increasing the load. The maximum lateral deformation is approximately 2.29 mm, which is very small in magnitude and is located within the core of the section [3] [11].

Conclusions. The load-bearing capacity of reinforced square columns increases by 58%, respectively, compared with control columns. This method can be effectively used to strengthen columns, as it leads to a significant increase in the bearing capacity and plasticity of structural elements. The calculated load is slightly less than the test load due to the use of rational reduction coefficients. The deformation capacity of reinforced square columns has been improved by 20%, respectively.

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