Investigation on the Behaviour of Confined RC Columns

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ABSTRACT

Reinforced concrete columns undergo severe strength degradation when subjected to major earthquake. This phenomenon is observed when there is lack of sufficient lateral reinforcement. In such cases, the reinforced concrete column does not possess the required ductility to dissipate the seismic energy. Typical procedures to compensate for the deficiencies involve external retrofitting of these columns with steel or concrete jacketing. Experiments have established that the additional confinement provided improves seismic performance, especially within the potential plastic hinge zones. An innovative retrofit technique using glass fibre reinforced polymer (GFRP) has emerged as an attractive alternative to conventional upgrading measures. This experimental study deals with the circular columns with various aspect ratio were confined with ferrocement. The load deflection behaviors, load carrying capacity, axial deformation discussed in detail. The results of the load carrying capacity of the confined RC columns are compared with conventional RC column were discussed

KEY WORDS: GFRP, Retrofit, Ferrocement, Buckling, RC.

1. INTRODUCTION

In olden days, the buildings were usually masonry structures, or made with steel or timber based on the requirement and availability of raw materials. But at present, concrete gained so much importance, leading to the present scenario that more than 65% of the present constructions are made with concrete. Similar to other constituent's course aggregate is also one of the important things to be considering while making the better concrete. It has it won influence in the concrete strength. The report will monitor the important and influence in the concrete strength.

Concrete forms the most important component of a structure. According to the strong column weak beam criteria, there is a need to study the behaviour of columns. The load is transferred from the slab to the column through beams, which is then transferred to the ground. The role of engineering materials in the development of modern technology, need to be emphasized. It is the material through which a designer puts forward his ideas in to practice.

Short column: Column is a compression member. A column may be a short column, when the slenderness ratio is less than 12. (i.e lex/D or ley/B about the x and y axes)

Where,

Lex = the effective length in respectively of x-axis

D = the depth in respect of the x-axis

Ley = the effective length in respect of the y-axis

B = the wide in respect of the y-axis

Long column: It shall otherwise be considered as a long or slender column. Slender columns are subjected to buckling and increase secondary moments due to lateral deflection. Therefore, IS code has recommended limits to very slender columns as following

Column with both ends restrained: Unsupported length shall not be greater than 60 times LLD. Where LLD is the least lateral dimension of column section

Column with one end unrestrained: Unsupported length shall not be greater than 100 B^2/D where D is the depth of section measured in the plan under consideration and B is the wide of section

2. MATERIALS USED

Cement: Cement used for the specimen was ordinary Portland cement. OPC grade 53 grade Ultra tech cement was used in this study. The specification gravity of cement was determined as per IS 576-1964(10) and found to be 3.15

Fine aggregate: The fine aggregate used for all the specimens in river sand. The fine aggregate used for casting was sieved through IS 4.75 mm sieve. The specific gravity of fine aggregate used for concrete was determined and found to be 2.65.

Coarse aggregate: The coarse aggregate used in the mixes are hard blue granite stones from quarries around Erode. 20mm size aggregate was stored in separate dust proof containers. The specific gravity of coarse aggregate was determined and found to be 2.7.

Reinforcement steel: The main reinforcement used for the specimen was HYSD (Fe 415) bar of diameter 8 mm. The lateral tie reinforcement was HYSD (Fe 415) bar of diameter 6mm. IS specifications was used to manufacture the test result.

Figure.1. Column reinforcement

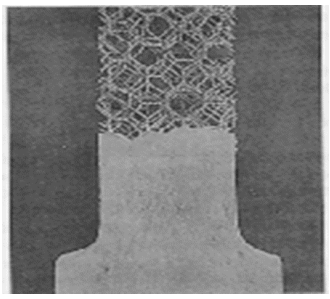

Figure.2. Ferrocement Structure

Concrete: Design mix of M_{20} grade concrete (1: 1.44: 2.68) water cement ratio is 0.50 was used for casting of the column specimens, Six numbers of 8mm diameters were used for main reinforcement of column and 6mm diameter lateral tie 90mm c/c spacing for 160mm specimen.

Ferrocement: Ferrocement is a form of reinforced mortar, in which the cement mortar is applied over closely spaced layers of wire mesh. This wire mesh consists of closely spaced layers of metal or other suitable materials where the diameter of the wire mesh is relatively small. Ferrocement is different from the conventional concrete as well as the prestressed concrete mainly by the arrangement and dispersion of the reinforcing elements

Details of Specimen: Height of the Column was 1200mm, the diameter of column 110mm and 160mm. it namely as Type.1, Type.2, specimens respectively.

3. RESULTS AND DISCUSSIONS

Conventional RC column: The Conventional RC Column specimens were subjected to axial loading. The load was applied by using hydraulic jack. The Columns were gradually increasing the load level up to Ultimate load. The above axial load sequence consists of 20 KN, 40 KN, 60 KN and up to 260 KN. The average axial deformation measured at the load of 260 KN, for 160CC column was 3.76mm, for 110CC column was 3.78mm.

Table.1. Results of Conventional RC Column (110CC & 160CC)

Specimen diameter :110 mm height :1200 mm				**Specimen diameter :160 mm height :1200 mm**		
Axial Load (Kn)	**Axial deformation in concrete (mm)**	**Lateral deflection in concrete (mm)**	**Axial deformation in steel (mm)**	**Axial deformation in concrete (mm)**	**Lateral deflection in concrete (mm)**	**Axial deformation in steel (mm)**
	110CC	110CC	110CC	160CC	160CC	160CC
0	0	0	0	0	0	0
20	0.32	0.29	0	0.35	0.16	0
40	0.46	0.80	0	0.62	0.32	0
60	0.72	1.02	0	0.88	0.65	0
80	1.02	1.22	0.01	1.12	0.82	0
100	1.48	1.38	0.02	1.47	1.03	0
120	1.72	1.52	0.03	1.75	1.22	0.01
140	1.98	2.20	0.06	1.92	1.38	0.02
160	2.42	2.32	0.09	2.22	1.52	0.03
180	2.65	2.48	0.12	2.56	1.94	0.04
200	2.86	2.65	0.14	2.86	2.20	0.06
220	3.04	2.84	0.16	3.12	2.32	0.08
240	3.42	3.02	0.19	3.42	2.48	0.11
260	3.78	3.56	0.20	3.76	2.65	0.15

RC Column with Ferrocement: The Conventional RC Column confined with Ferrocement specimens were subjected to axial loading. The Columns were gradually increasing the load level up to Ultimate load. The above axial load sequence consists of 20 KN, 40 KN, 60 KN and up to 260 KN. The average axial deflection measured the load at 260 KN, for (160FC) column was 3.92mm, and for (110FC) column was 3.65mm.

Table.2. Results of Conventional RC Column confined with Ferrocement

Specimen diameter :160 mm height :1200 mm				**Specimen diameter :110 mm height :1200 mm**		
AXIAL LOAD (Kn)	**Axial deformation in concrete (mm)**	**Lateral deflection in concrete(mm)**	**Axial deformation in steel (mm)**	**Axial deformation in concrete (mm)**	**Lateral deflection in concrete(mm)**	**Axial deformation in steel (mm)**
	160FC	160FC	160FC	110FC	110FC	110FC
0	0	0	0	0	0	0
20	0.28	0.16	0	0.28	0.25	0
40	0.49	0.32	0	0.50	0.76	0
60	0.69	0.51	0	0.69	1.01	0
80	0.87	0.73	0	0.98	1.15	0
100	1.29	0.89	0	1.27	1.25	0.01
120	1.67	1.03	0.00	1.53	1.65	0.03
140	1.98	1.14	0.01	1.88	2.35	0.05
160	2.26	1.37	0.02	2.27	2.43	0.06
180	2.52	1.54	0.03	2.53	2.85	0.07
200	2.89	1.86	0.04	2.78	3.19	0.09
220	3.12	2.05	0.05	2.93	3.65	0.11
240	3.49	2.26	0.08	3.37	3.98	0.13
260	3.92	2.35	0.10	3.65	4.19	0.17

Load Carrying Capacity: The average ultimate load carrying capacity of the Conventional RC Column confined with Ferrocement for (110FC) was 260KN, and for (160FC) was 390KN.

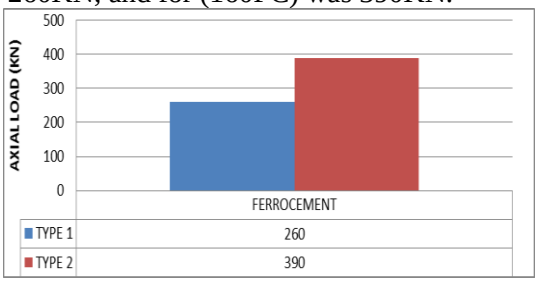

Figure.3. Comparison of load carrying capacity of ferrocement column

4. CONCLUSIONS

Research Findings based on 110mm Diameter Columns: The RC column confined with Ferrocement, the load carrying capacity increased by 17% and the cost increased by 72% than conventional RC column**.**

- The axial deformation in steel is almost same for all types of columns.

Research Findings based on 160mm Diameter Columns: The RC column confined with Ferrocement, the load carrying capacity increased by 17% and the cost increased by 73% than conventional RC column.

Future work: In economical, load carrying capacity & ductility point of view the external wire winding techniques is suitable

- Anti-corrosive coating may be gives on the under surface of column to proven rusting of wires
- Thin fiber wire can be used for a external wire winding
- PVC & GFRP materials can be used for confinement of columns
- External striupps may gives more confinement effect
- Verification of analytical model with experimental values.

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