BEHAVIOR OF REINFORCED CONCRETE BARE FRAME UNDER CYCLIC LOADING (CONTROL FRAME)

Dr.A.ANBUCHEZIAN

Principal & professor , Department of Civil Engineering , AnnaPoorana Engineering College , Sankari Main Road Periya Seeragapadi, Salem, Tamil Nadu 636308

Abstract- *The bare frame cast characteristics using concrete of Mix-1 under cyclic loading had been detailed in this article. The factors such as load with respect to deflection, load carrying capacity, stiffness, ductility factor, and the energy dissipating capacity are discussed for the test specimen RCBF1 cast using are IS 456-2000 detailing subjected to cyclic loading. Similarly, the test specimen RCBF2 cast using IS: 13920–1993 detailing was determined for parameters like load vs deflection, load carrying capacity, stiffness, ductility factor and energy dissipating capacity under cyclic loading.*

Keywords – RCBF beams , Conventional ,load,stiffness,ductility factor investigation .

I.INTRODUCTION

The bare frame was subjected to lateral cyclic loads in a quasi-static pattern simulating seismic action. The ultimate load of 36kN and 44kN were reached in the twelfth and fifteenth cycle of loading for RCBF1and RCBF2. The detailed behavior of specimen RCBF1 is described in the following section. The terms front, center, and back are used to identify the location of columns with respect to the loading end. The term front refers to the member nearest to the loading jack, while the term back refers to the member farthest from the loading end. The detailed behavior of specimen RCBF2 is described in the following section. The terms front, center, and back are used to identify the location of columns with respect to the loading end. The term front refers to the member nearest to the loading jack, while the term back refers to the member farthest from the loading end. Stiffness is defined as the load required to cause unit deflection of the beam-column joints. The initial stiffness of the frame RCBF2 was1.75 kN/mm. In Figure 5.20, the stiffness was found to decrease from 1.75 kN/mm during the second cycle to 0.62 kN/mm during the fifteenth cycle of loading. Ductility is defined as the ability of the structure or its components to sustain large inelastic deformations. Cumulative ductility factor up to any point is the sum of displacement ductility factors attained in each cycle of loading up to the cycle considered. This gives an idea about the overall ductility of the laterally loaded structure.

II.LOADING AND LOAD DEFLECTION BEHAVIOUR

The bare frame was subjected to lateral cyclic loads in a quasi static pattern simulating seismic action. The history of sequence of loading for the bare frame RCBF1and RCBF2 is shown in Figure 1 and 2. The ultimate load of 36kN and 44kN were reached in the twevelth and fifteenth cycle of loading for RCBF1and RCBF2.

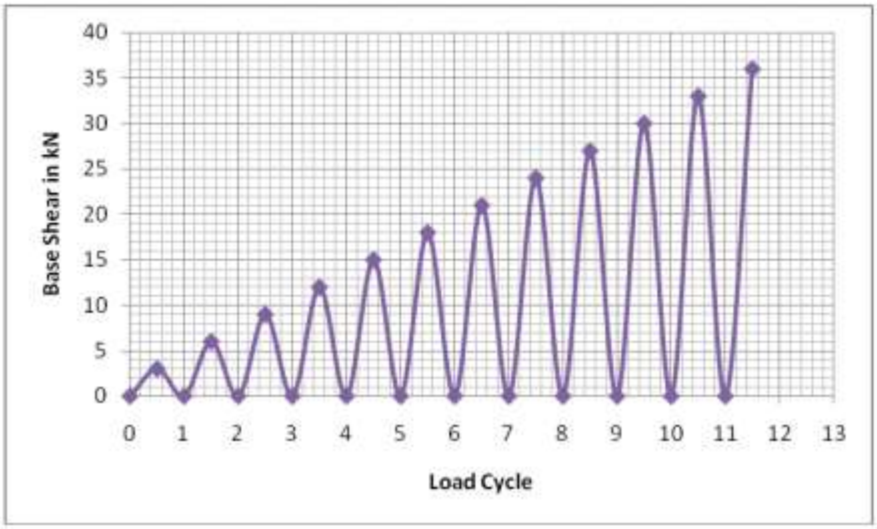

Figure 1 Sequence of Loading for the Frame RCBF 1

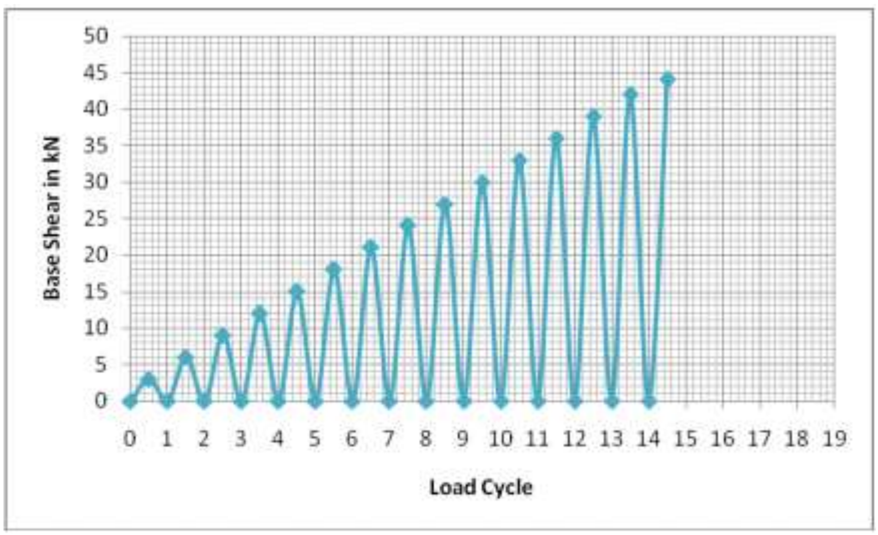

Figure 2 Sequence of Loading for the Frame RCBF 2

3.SPECIMEN BEHAVIOUR AND CRACK PATTERN

3.1 BEHAVIOR AND CRACK PATTERN OF RCBF1

The detailed behavior of specimen RCBF1 is described in the following section. The terms front, center, and back are used to identify the location of columns with respect to the loading end. Figure 3 shows the cracks in the front column. In the control specimen RCBF1, first structural cracks began to form at a base shear of 14 kN. These cracks started from the tension side of the beam-column joint in the front columns of the bottom-story.

Figure 3 Cracks in the front column

At a base shear of 26 kN, the cracks formed in the top and bottom of the column region as flexural hinges and diagonal shear cracks started propagating between them (Figures 4)

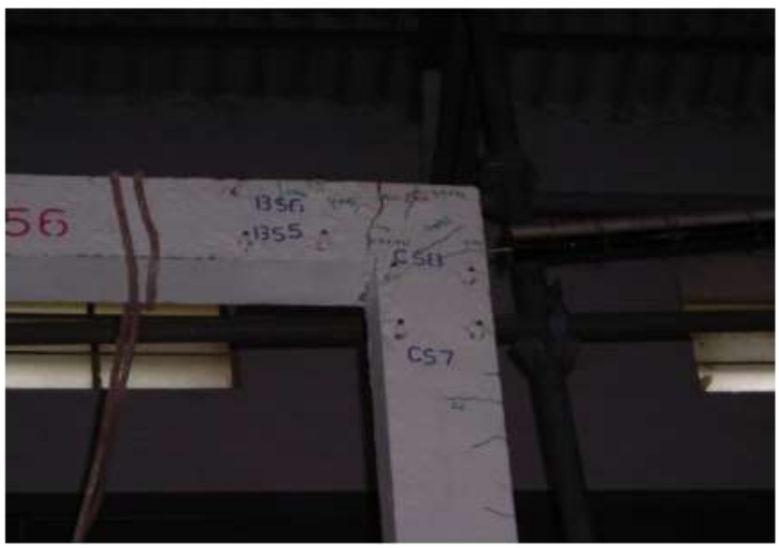

Figure 4 Shear cracks in the front column

Additionally, cracks developed in the back column of bottom-story at the compression end because of diagonal strut action. From the failure pattern, it is observed that the beam-column condition was formed at a base shear of 24 kN initially and it leads to the formation of flexural hinges and shear cracks in the front columns at 34 kN.

3.2 BEHAVIOR AND CRACK PATTERN OF RCBF2

The detailed behavior of specimen RCBF2 is described in the following section. The terms front, center, and back are used to identify the location of columns with respect to the loading end. Figure 4 shows that the specimen RCBF2 reached a maximum lateral displacement of 69.9 mm, which corresponds to a base shear of 44 kN. Additionally, cracks developed in the back column of bottom-storey at the compression end because of diagonal strut action.

IV .STIFFNESS

Stiffness is defined as the load required to cause unit deflection of the beam-column joints. The stiffness was calculated as the amount of base shear required for causing unit deflection at the top-storey level.

4.1STIFFNESS BEHAVIOR OF RCBF1

The initial stiffness of the frame RCBF1 was 1.17 kN/mm. In Figure 5.19, the stiffness was found to decrease from1.17 kN/mm during the second cycle to 0.44 kN/mm during the twelveth cycle of loading. In addition, it is observed that the stiffness of the frame condition during the sixth cycle at a base shear of 18 kN, the frame exhibited a sudden stiffness degradation resulting in critical shear failure of bottom-storey columns due to the restriction of lateral displacement. The function of the stiffness curve for load cycles (x-values) ranging from 1 to 12 is given by,

$$y = -0.077x + 1.155$$
$$R^2 = 0.1027 \qquad (5.9)$$

4.2 STIFFNESS BEHAVIOR OF RCBF2

The initial stiffness of the frame RCBF2 was1.75 kN/mm. In Figure 5.20, the stiffness was found to decrease from 1.75 kN/mm during the second cycle to 0.62 kN/mm during the fifteenth cycle of loading. In addition, it is observed that the stiffness of the frame condition during the eleventh cycle at a base shear of 33 kN, the frame exhibited a sudden stiffness degradation resulting in critical shear failure of bottom-storey columns due to the restriction of lateral displacement. The stiffness of test specimens RCBF2 at each load cycle was shown Figure 6.

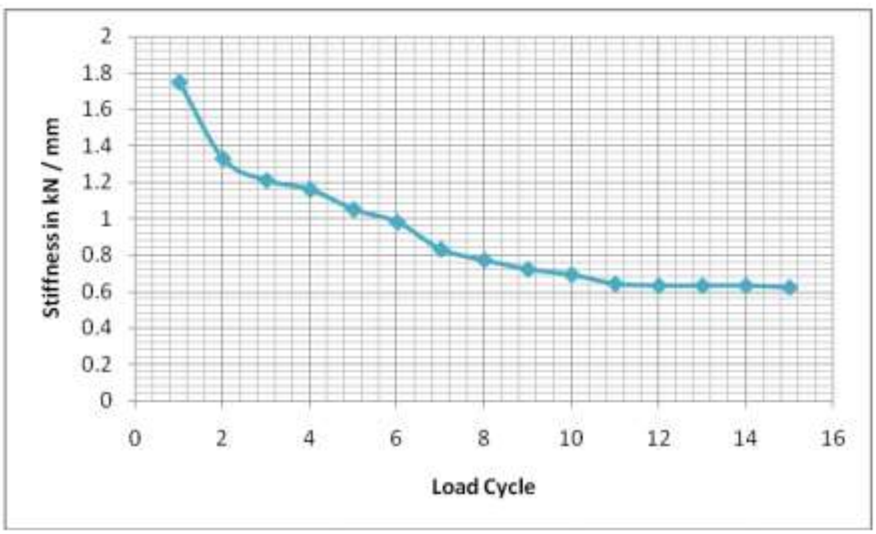

Figure 6 Stiffness of Test Specimen RCBF2

V. DUCTILITY FACTOR

Ductility is defined as the ability of the structure or its components to sustain large inelastic deformations. In this study, displacement ductility factor at each cycle of loading was calculated as the ratio of peak displacement during the corresponding cycle to yield displacement. In the analysis of nonlinear structures, the force-displacement relationship most frequently adopted is the ‘bilinear model’. This model is typically used for structures or structural elements with a linear force-displacement relationship in both the elastic and the inelastic range.

3.3 DUCTILITY FACTOR OF RCBF1

The displacement ductility factor at the ultimate cycle for the frame RCBF1 was found to be 3.55. Figure 7 Shows the ductility factor for Frame RCBF1. Cumulative ductility factor up to any point is the sum of displacement ductility factors attained in each cycle of loading up to the cycle considered. The cumulative ductility factor at the ultimate cycle for the frame RCBF1 was found to be 18.4.

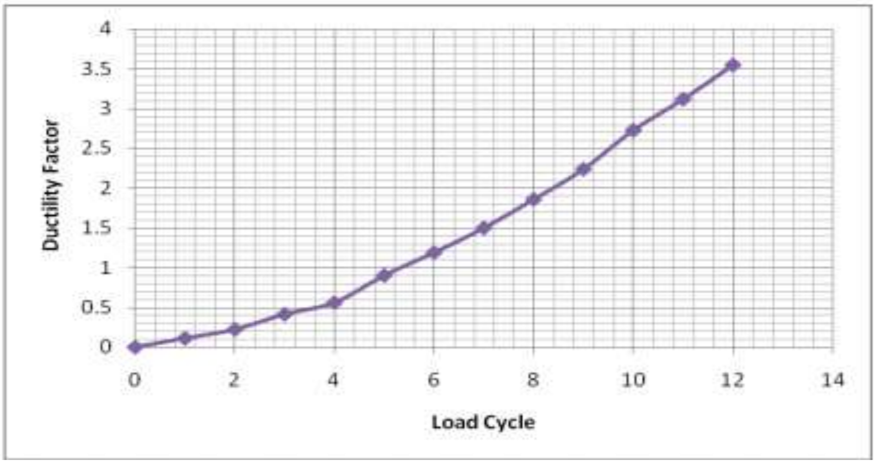

Figure 7 Ductility Factors for Frame RCBF1

3.4 DUCTILITY FACTOR OF RCBF2

The displacement ductility factor at the ultimate cycle for the frame RCBF2 was found to be 3.83. Figure 8 shows the displacement ductility factor for Frame RCBF2. The cumulative ductility factor at the ultimate cycle for the frame RCBF2 was found to be 27.46.

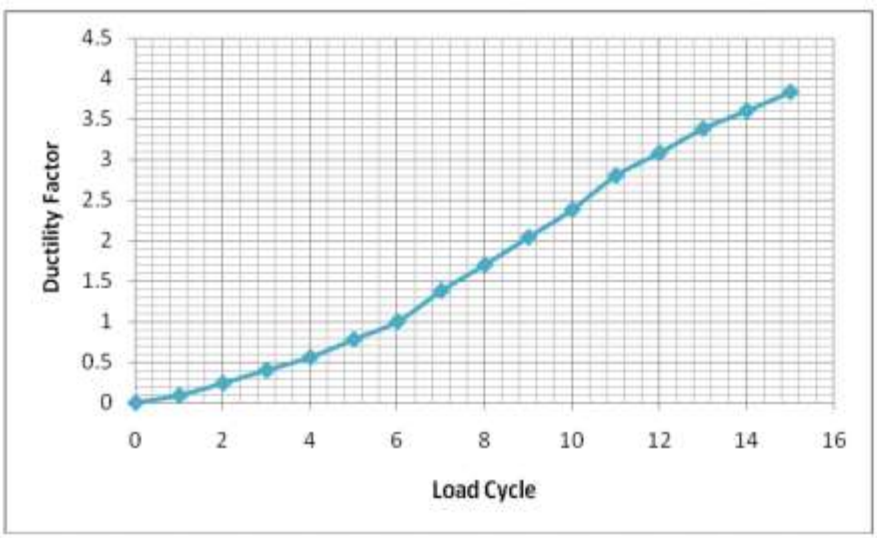

Figure 8 Ductility Factors for Frame RCBF2

VI CONCLUSION

This chapter presented the experimental investigations carried out on single-bay, two-storey Reinforced Concrete Bare Frame (RCBF). The frame designated as RCBF1 and RCBF2 were subjected to quasi-static cyclic loads simulating seismic action. The load-displacement response, specimen behavior, crack pattern, and mode of failure of both the frames RCBF1 and RCBF2 were observed. Other parameters like ultimate capacity, lateral deflection, stiffness, ductility, and energy dissipation capacity were calculated to study the behavior of the bare frame and to make a comparison with fibrous bare frame specimens. The initial crack formation on specimen RCBF1 was 14KN and 20KN for RCBF2. The ultimate load-carrying capacity of RCBF2 has increased to 22.22% and lateral deflection is reduced to 16.16% when compared to RCBF1. The Stiffness and Ductility factor of the specimen RCBF1 and RCBF2 was found to be 1.17kN/mm &1.75kN/mm and 3.55 & 3.83 respectively.

REFERENCES

1. Kara, Mehmet Emin, and Sinan Altin. "Behavior of reinforced concrete frames with reinforced concrete partial infills." *ACI structural journal* 103.5 (2006): 701.
2. Chrysostomou, Christis Zenon, et al. "Pseudo-dynamic tests on a full-scale four-storey reinforced concrete frame seismically retrofitted with reinforced concrete infilling." *Structural Engineering International* 23.2 (2013): 159-166.
3. Strepelias, Elias, et al. "Experimental investigation of concrete frames infilled with RC for seismic rehabilitation." *Journal of Structural Engineering* 140.1 (2013): 04013033.
4. Basha, Syed Humayun, and Hemant B. Kaushik. "Behavior and failure mechanisms of masonry-infilled RC frames (in low-rise buildings) subject to lateral loading." *Engineering Structures* 111 (2016): 233-245.
5. Moretti, Marina L. "Seismic design of masonry and reinforced concrete infilled frames: a comprehensive overview." *American Journal of Engineering and Applied Sciences* 8.4 (2015): 748.
6. Anil, Özgür, and Sinan Altin. "An experimental study on reinforced concrete partially infilled frames." *Engineering Structures* 29.3 (2007): 449-460.
7. Kose, Mehmet Metin. "Parameters affecting the fundamental period of RC buildings with infill walls." *Engineering Structures* 31.1 (2009): 93-102.
8. Karayannis, Ch G., D. J. Kakaletsis, and M. J. Favvata. "Behavior of bare and masonry infilled R/C frames under cyclic loading: Experiments and analysis." *WIT Transactions on The Built Environment* 81 (2005).
9. Kakaletsis, Demetrios J., and Christos G. Karayannis. "Experimental Investigation of Infilled Reinforced Concrete Frames with Openings." *ACI Structural Journal* 106.2 (2009).