

CHAPTER 6

CONCLUSIONS

6.1 Summary

- An attempt has been made to carry out an experimental and Ansys modeling to understand the behavior of beam-column joints under static and load reversal cases.
- Two hundred and sixteen beam-column joint specimens have been cast and tested.
- One hundred and eight specimens were tested under static load.
- One hundred and eight specimens were tested under load reversal case.
- An experimental investigation has been carried out to understand the effectiveness of GFRP, AFRP, CFRP and Sisal fibers in improving the performance of beam-column joints.
- Experimental investigation has also been carried out to find out the best combination of hybrid wrapping. GFRP-CFRP, GFRP-AFRP, AFRP- CFRP, AFRP- GFRP, CFRP- GFRP and CFRP- AFRP combinations have been tried during the present study.
- A detailed cost analysis has been carried out to find out the cost effectiveness of various fiber reinforced polymer sheets.
- An Ansys model has been developed to understand the behavior of beam-column joint specimens subjected to static load.
- Ansys analysis has also been carried out to understand the effect of grade of concrete on the load carrying capacity and energy absorption capacity of beam-column joint specimens.

6.2 Conclusions

- The beam-column joint specimens detailed as per code 13920:1993 subjected to static load were found to have 4.30 % to 12.30 % more load carrying capacity and 4.67 % to 14.10 % more energy absorption capacity than the specimens detailed as per code IS 456:2000 subjected to static load.
- The beam-column joint specimens detailed as per code 13920:1993 subjected to reversal load were found to have 14.50 % to 18.30 % more load carrying capacity and 16.40 % to 23.10 % more energy absorption capacity than the specimens detailed as per code IS 456:2000 subjected to reversal load.

- It is found that specimens detailed as per code IS 456:2000 retrofitted with GFRP sheets subjected to static load were found to have 12.30 % to 17 % more load carrying capacity and 17.20 % to 20.53 % more energy absorption capacity than the specimens detailed as per code IS 456:2000 subjected to static load.
- It is found that specimens detailed as per code IS 456:2000 retrofitted with GFRP sheets subjected to reversal load were found to have 19.40 % to 27.20 % more load carrying capacity and 22.20 % to 29.60 % more energy absorption capacity than the specimens detailed as per code IS 456:2000 subjected to reversal load.
- It is found that specimens detailed as per code IS 456:2000 retrofitted with AFRP sheets subjected to static load were found to have 14.30 % to 21.50 % more load carrying capacity and 20.40 % to 26.54 % more energy absorption capacity than the specimens detailed as per code IS 456:2000 subjected to static load.
- It is found that specimens detailed as per code IS 456:2000 retrofitted with AFRP sheets subjected to reversal load were found to have 24.30 % to 30.70 % to more load carrying capacity and 27.20 % to 32.40 % more energy absorption capacity than the specimens detailed as per code IS 456:2000 subjected to reversal load.
- It is found that specimens detailed as per code IS 456:2000 retrofitted with CFRP sheets subjected to static load were found to have 20.50 % to 26.50 % more load carrying capacity and 25.10 % to 31.83 % more energy absorption capacity than the specimens detailed as per code IS 456:2000 subjected to static load.
- It is found that specimens detailed as per code IS 456:2000 retrofitted with CFRP sheets subjected to reversal load were found to have 30.70 % to 37.30 % to more load carrying capacity and 32.10 % to 42.30 % more energy absorption capacity than the specimens detailed as per code IS 456:2000 subjected to reversal load.
- It is found that retrofitting with carbon fiber reinforced polymer sheets resulted in maximum increase in load carrying capacity and energy absorption capacity. However the cost of carbon fiber reinforced polymer sheets is found to be the highest.
- It is found that retrofitting with glass fiber reinforced polymer sheets resulted in least increase in the load carrying capacity and energy absorption capacity. It is also found that cost of glass fiber reinforced polymer sheets is the least.

- In case of hybrid wrapping, it is found that wrapping with one layer of carbon fiber reinforced polymer sheet along with any other fiber reinforced polymer sheets resulted in maximum increase in load carrying capacity and energy absorption capacity.
- Based on percentage increase in the energy absorption capacity per unit cost, it is found that glass fiber reinforced polymer sheet wrapping is found to be the best in terms of cost effectiveness.
- The results of Ansys modeling has been compared with the results of the experimental investigations. The percentage deviation between the Ansys results and the experimental results is found to be in the range 1.33 % to 9.10 %.
- Based on Ansys modeling, it is found that as the grade of concrete increases, the load carrying capacity and energy absorption capacity of the beam-column joint increases. However the increase in the load carrying capacity and energy absorption capacity were found to be insignificant beyond M35 grade of concrete.

6.3 Scope for Future Studies

- Experimental investigation may be carried out for cyclic load
- Investigation may be carried out to find the effectiveness of the Basalt fiber reinforced polymer sheets.
- Natural fibers like Bannana, Vakka etc. can be tried to find out their suitability for retrofitting.