CHAPTER 10

CONCLUSIONS

10.1 GENERAL

The experimental investigation on beams and beam-column joints has been carried out with and without SIFCON laminates. The details of the experimental investigation were discussed in the preceding chapters. Based on the results of the experimental investigation, the following conclusions are drawn.

10.1.1 Research Findings Based on the Tests Conducted on SIFCON Beams

1. Use of SIFCON in the bottom tension zone of the conventional RC beam can enhance the ultimate load carrying capacity significantly.

2. Behavior of RC beams with SIFCON in top and bottom cover concrete and RC beams with SIFCON in bottom cover concrete is identical.

3. In general, the behavior of RC beams with SIFCON in full cross section (full section) and beams with SIFCON only in the tension zone is identical and exhibits significant improvement in ductility and energy absorption capacity as against conventional RC beams.
10.1.2 Research Findings Based on the Test Conducted on SIFCON Laminated Beams

1. The ultimate load carrying capacity was found to have significantly increased for the beams strengthened with SIFCON laminates.

2. Cracking and disintegration of concrete at the tension zone of laminate confined beams was less when compared to conventional concrete beam.

3. In general, all the beams confined with SIFCON laminates exhibit enhanced flexural strength, ductility and energy absorption capacity when compared with that of conventional beams.

10.1.3 Research Findings Based on the Test Conducted on the Beam-Column Joints

1. The use of fibrous concrete in conventional RC beam-column joints results in a significant improvement in first crack loading. This is mainly due to the presence of fibres, which interlock the cracks by bridging the gap.

2. Although the increase in load carrying capacity of RC beam-column joints with SIFCON in fuse location is marginal when compared to FRC beam-column joints, the ductility and energy absorption capacity was found to be reasonably high when compared to FRC beam-column joints.

3. SIFCON beam-column joints and RC beam-column joints with SIFCON in fuse location suffer less damage compared to conventional RC and FRC specimens.
10.1.4 Research Findings Based on the Test Conducted on Strengthening of Beam-Column Joints by SIFCON Laminates

1. The ultimate load carrying capacity of the strengthened RC beam-column joints was found to be 30% more than that of the conventional RC beam-column joints and for the strengthened FRC beam-column joints the value was found to be 20% more than that of the conventional FRC beam-column joints.

2. For strengthened specimens, the cracks have appeared only on the portion of the beam that was not covered by SIFCON laminates and the strengthened portions of the joint suffer less damage.

3. For strengthened beam-column joints, the numerical modeling load deflection curve seems to be close to that experimental result. For the conventional beam-column joints, the load deflection from numerical modeling showed higher stiffness compared to that from experimental results.

4. Failure mechanism of the models in numerical investigation compares well with the observed failure mechanism in the experimental investigation.

5. The ultimate load predicted for the models in numerical investigation is very close to the ultimate load recorded in the experimental investigation.

6. In general, the overall performance and the behavior of conventional beam-column joints improved by means of SIFCON laminate confinement.
10.2 OVERALL SUMMARY AND CONCLUSION

In general, it has been concluded that the use of fibrous concrete in the structural members exhibits more ductility and energy absorption capacity which are essentially needed for earthquake resistant structures. The use of SIFCON in reinforced concrete structural elements yields better results than structural elements with fibre reinforced concrete. It is explicit that the cost of SIFCON is very high and it cannot be used for the construction of full structure. However, under abnormal loading conditions, certain parts of the structure act as the failure zones or hinges and if these failures are checked the failure/collapse of the structure can be prevented. Hence, it is suggested that SIFCON may be used only in the selected fuse locations in order to prevent the collapse of the structure and optimize cost. SIFCON laminates of proposed thickness can be used for the repair and rehabilitation of structures as strengthening techniques. Further, it is also inferred that SIFCON laminate is an ideal construction material for seismic retrofitting of structures.

10.3 SUGGESTIONS FOR FUTURE WORK

1. In the present investigation, mineral admixtures like silica fume and fly ash were used for making the cement slurry. Hence, investigation can be made on other types of mineral admixtures like metakaolin, ground granulated blast furnace slag and rice husk ash etc.

2. Investigations may be carried out to study the effect of fibre orientation on the behavior of SIFCON.

3. Different forms of steel fibres and their combinations could be used instead of crimped fibres.
4. Investigations may be undertaken to study the effect of SIFCON on pre-stressed concrete elements.

5. Investigations may be carried out to study the effect of SIFCON as a strengthening material for RC columns.

6. The effect of SIFCON laminate thickness on strength and ductility may be investigated.

7. The effect of multiple laminate strips (horizontal, vertical, or diagonal) versus one large laminate may be investigated.

8. Nonlinear finite element modelling incorporating the composite properties may be used to evaluate the behavior of SIFCON composite structural members.