CONCLUSIONS
6.1 CONCLUSIONS:

The research objectives stated in chapter 2 was to improve the understanding of the behaviour of HSC, HSSFRC concrete beams and beams with SFRC in critical regions failing in shear.

To understand the shear transfer mechanism of HSC and HSSFRC beams with and without web reinforcement was carefully illustrated in this thesis in phase wise manner and different approaches to shear design were introduced sequentially in the same order. Moreover, the main differences in shear strength between high-strength concrete beams with and without shear reinforcement were highlighted. The difference in shear strength of HSC beams with fiber throughout the beam and fiber only in shear predominant regions is emphasized. To fully understand the behaviour of high-strength concrete beams with and without shear reinforcement failing in shear, fifty six beam specimens were tested.

Fourteen analytical models were created using ANSYS (FEM software) to compare the experimental results and predict the shear strength of HSC beams with and without shear reinforcement.

Finally, new simplified equations are proposed for high-strength reinforced concrete beams with and without web reinforcement were presented in Chapter 8. The specific conclusions drawn from the research are summarized as follows:

1. All the beams tested in this investigation failed in shear. Beams without fibers failed in a brittle manner. Non fibrous beams showed deep cracking compared the fibrous concrete beams.
Fiber addition showed a noticeable improvement in ductility.

2. The shear capacity of the HSSFRC beams with and without shear reinforcement increased with increase in fiber content.

3. The percentage increase in shear capacity capacity of specimens with and without shear reinforcement and with fiber in critical regions was in variation of 10% of the results of beams provided with fiber all through the length of the beam.

4. It was observed that the cracking shear resistance decreased with increasing a/d ratio.

5. The fibers appeared to be effective in delaying the formation of cracks and in arresting initial growth of the crack.

6. The increase in shear capacity is remarkable up to 0.8% dosage of fibers but decreased slightly at 1.2% dosage of fibers. This decrease in shear capacity for 1.2% fiber content may be due to less workability observed during casting.

7. The area under the load deflection curve which is a measure of energy absorbed by the test specimen is found to be higher for fibrous beams compared to non fibrous beams.

8. Higher energy absorption capacity for lower a/d ratios (one and two) may be attributed to the strut action in the beam. In strut action, failure of the beam is governed by the compressive strength of concrete present in the strut. For higher a/d ratios (three and four), beam action prevails and the load carrying capacity is governed by the diagonal tensile strength of concrete the energy absorption capacity of the beams reduced.
9. The addition of fiber enhanced the post ultimate ductility of the members.

10. The non fibrous beams, failed suddenly along a single potential shear crack. As the steel fiber volume increased to 0.4%, 0.8% and 1.2% the failure mode was observed with numerous cracks.

11. With the addition of shear reinforcement the failure of beams was observed to be of ductile in nature compared to specimens without shear reinforcement. The addition of fibers still enhanced the ductility of the specimens.

12. The experimental results revealed that the spacing between shear cracks for the specimens with larger shear span to depth ratio \((a/d = 3.0 \text{ and } 4.0)\) is greater than the spacing between shear cracks in the case of specimens with smaller shear span to depth ratio \((a/d = 1.0 \text{ and } 2.0)\).

13. At lower \(a/d\) ratios the shear capacity is very higher due to strut action and lower at higher \(a/d\) ratio due to the beam action.

14. The shear capacities of beams with fiber in critical regions are convincing with results of beams provided with fiber throughout the beams at all \(a/d\) ratios and all dosages of fibers. This indicates that use of steel fibers in the critical regions is better than using the steel fiber throughout the length of the beam.

15. The ANSYS (Finite Element Method based software) modeled specimens predicted the shear behaviour very closer to the experimental results. The results were convincing at all \(a/d\) ratios, different dosages of fibers for the beams with and
without web reinforcement.

16. Two simplified equations proposed to predict the shear capacity of HSC and HSSFRC specimens with and without shear reinforcement fairly estimates the shear capacity of the members. The shear equations evaluated from this research have yielded better results.

6.2 SCOPE FOR FURTHER RESEARCH:

- The shear resistance of fiber reinforced PSC members can be studied.
- Shear resistance of reinforced masonry members can be studied.