CHAPTER 5: SUMMARY AND CONCLUSIONS

5.1 Summary

In this present research work, silica fume and ground granulated blast furnace slag has been used as a source material to produce a geopolymer concrete. The compressive strength and durability characteristic such as sorptivity and porosity test has been conducted to produce an ecofriendly concrete. Basic material properties has been studied and concrete mix design was done using IS method. For the present study several parametric studies has been done with some of the parameters which affects the compressive strength of concrete. This include % replacement of silica fume as 60, 70 and 80%, ratio of alkaline liquid to source material as 0.25, 0.30 and 0.35, concentration of sodium hydroxide solution as 8, 14 and 16 M, ratio of silicate to hydroxide as 0.5, 1.5 and 2.5, age of GPC as 3, 7, 28 and 56 days and effect of thermal curing as 60, 80 and 100°C. Experiments were done by using digital compression testing machine of capacity 3000 kN and flexural behavior of SF based GPC beam and GGBFS based GPC beams were tested in loading frame. The first crack load, ultimate load, failure load are noted and corresponding deflections are also measured by using dial gauges of least count 0.01mm. The load deflection curve was plotted and crack patterns was also studied.

5.2 Conclusions

Based on the detailed experimental studies performed on SF and GGBFS based GPC the following broad conclusions were arrived.

- Production of GPC using industrial wastes such as SF and GGBFS was made possible without compromising compressive strength.
- Increase of thermal curing from 60°C to 80°C increased the compressive strength and further increase of curing temperature to 100°C yielded a reverse trend on certain mixes. Similarly increase of AL/GBFS from 0.25 to 0.30 increased the compressive strength.

- Rate of gain in compressive strength at the earlier ages of 3 and 7 days was found to be faster due to effective geopolymerization process and continues similar trend even till the age of 28 days.

- Hence it was inferred that curing temperature of 80°C, AL/GBFS ratio of 0.30 and SiO₃ to OH ratio of 1.5 for concentration of NaOH = 8M were found to be optimum values to produce better performance of ground granulated blast furnace slag based geopolymer concrete.

- In the case of SF based GPC, the optimum values were 60°C with AL/SF ratio of 0.35 and SiO₃/OH ratio of 2.5 for concentration of NaOH = 14M.

- Durability characteristics of mineral admixtures based GPC against sorption and porosity was found to be better than the control concrete.

- From the statistical analysis, it was understood that the quality of concrete produced was very good. Cost analysis also justifies the GGBFS based GPC made with AL/GBFS ratio of 0.30 and SiO₃ to OH ratio of 1.5 as optimum mix by giving better economy index.

- Sizable percentage of carbon foot print could be achieved if cement is replaced when mineral admixtures used as substitute in specific for producing geopolymer concrete.

- The ultimate load carrying capacity of GGBFS and SF based GPC beams were found to be more than control beams. Hence it is possible to use GGBFS and SF based GPC in precast structures.
5.3 Scope for future work

- Performance characteristics of SF and GGBFS based GPC was studied in the present research work and can be extended further for other mineral admixtures such as rice husk ash and metakaolin.
- Structural behavior of GPC beams was studied under static loading conditions and can be tried further for dynamic loading conditions.
- Structural behavior of GPC columns can also be tried for future research.