9.1 Summary

From the experimental work undertaken in the present research it is observed that the construction and demolition waste when appropriately segregated and processed can be effectively used as recycled aggregates in making second generation concrete. However, replacement of normal aggregates by such recycled aggregates leads to reduction in the compressive strength of concrete. The reduction is mainly on account of the adhered mortar present on the recycled aggregates resulting into 5 to 10 percent higher water absorption than the normal aggregates. A reduction in compressive strength of 15-35 percent at 28 days for M25 grade concrete has been noticed by using recycled aggregates in the proportion of 40 to 60 percent respectively. Recycled aggregates in size of 10 mm when incorporated along with coarse recycled aggregates of size 20 mm in concrete have found to further reduce the compressive strength upto 46 percent.

It is observed that state of art techniques, are available to improve the quality of recycled aggregates by removal of the adhered mortar content. However these techniques need to be efficient, economical and should have a simplified approach so that they can be adopted on site. Thus in the present work, a method is proposed for removing adhered mortar content from the recycled aggregates to treat recycled aggregates obtained from demolished concrete in large quantity. Such recycled aggregates after processing for adhered mortar content are found to behave almost like normal aggregates.

In order to proportion such recycled aggregate concrete to produce M25 grade concrete, DOE method with requisite adjustments based on characteristics of recycled aggregates has been found to provide the desired compressive strength at a lower water cement ratio.
Thus it is inferred that recycled aggregates processed for removal of adhered mortar content, proportioned by adopting the mix design procedure proposed in the present work are able to provide the desired compressive strength at 28 days. However the serviceability criteria of this concrete needs to be evaluated as recycled aggregates on account of higher water absorption may withdraw the water required for hydration from the concrete matrix and thereby such concrete may be subjected to higher strain. From the various durability tests namely water permeability, chloride permeability, modulus of elasticity, drying shrinkage and creep performed on this concrete, it is seen that such recycled aggregate concrete not only gives rise to the desired compressive strength but also satisfies the durability aspects. Laboratory experiments thus demonstrate that it is technically feasible to use recycled aggregates to produce structural concrete of M25 grade which fulfils the performance criteria, thus acknowledging the behaviour of recycled aggregate in concrete.

9.2 Conclusions

1. The method proposed in the present work for removal of adhered mortar content from recycled aggregates consisting of environmental cycles followed by dry rolling has been found to be the most effective for the samples tested and also could be easily adopted on site.

2. Removal of attached mortar reduced water absorption of recycled aggregates and then found to behave at par with normal aggregates.

3. Recycled aggregates processed for removal of adhered mortar content when incorporated in concrete are able to provide M25 grade concrete at a reduced w/c ratio using the designed mix proportions.

4. Recycled aggregate concrete having recycled aggregate sample with lesser water absorption and higher removal of adhered mortar content has been able to provide better
compressive strength in comparison to those with higher water absorption and lesser removal of adhered mortar content.

5. Statistical models are seen to be fairly reliable to predict the compressive strength of recycled aggregate concrete without taking recourse to the laborious experimentation. The regression coefficients obtained in the statistical model reflect the impact of various ingredients on the compressive strength of concrete.

6. Recycled aggregate concrete designed as per the proposed method is found to satisfy the durability aspects as in indicated by resistance to chloride ions, water permeability, higher modulus of elasticity, lower drying shrinkage and lower creep strains.

7. The use of recycled aggregate concrete over normal aggregate concrete leads to a direct saving in cost of concrete. It also minimizes environmental degradation and at the same time can replace normal aggregates to the extent of 60 percent resulting into saving of natural resources.

9.3 Future Scope of Work

The use of recycled aggregates in higher grade concrete can be studied. Mineral and chemical admixtures may be used with care to prepare recycled aggregate concrete of desired higher strength which also satisfies the durability criterion. As the characteristics of recycled aggregates are site specific, various samples from different region can be tested and the performance of such recycled aggregate concrete could be verified. The micrographic and mineralogical study can be carried out to understand the structure and composition of recycled aggregate concrete matrix.