CHAPTER 8

SUMMARY AND CONCLUSION

8.1 SUMMARY

Partial substitution or total replacement of common basic ingredients of any concrete mix undergoing improvisation is subject to trial and error experimentation by treatments and replications. The overall performance an improvised concrete thus obtained warrants a mathematical modeling by first principles or an empirical regression modeling dovetailed to the trial and error experimentation.

8.2 CONCLUSIONS

The experimental findings thus corroborated signifying the permissible limits or ranges of material substitution regarding fine aggregate mantle alone or enumerated as follows

1. A perusal of the observed values of slump indicated a workability regarding the slump depression by 76 mm for MAGFOU compared to 91 mm for the control mix, both the values are well within the IS prescribed range of 50 – 100 mm. A further differential analysis with 15% MRW indicated a slump dip of 80 mm and 35% FSW reported 64 mm
independently. However, these values are also relatively lower than that for the conventional concrete mix.

2. In line with the experimentation, followed by regression, to facilitate interpolation and extrapolation for predicting the strength criteria, it was established that by partial substitution within the fine aggregate mantle, the percentage proportion of FSW shall be limited to 35% and that for MRW not to exceed 15% when substituted independently for fine aggregate in concrete.

3. In this direction in order to optimize the limiting proportions of MRW and FSW as the chief substitution components of improvised MAGFOU concrete mix, the experimental treatments considered the MRW at 10, 15 and 20% whereas the same for FSW was tried at 30, 35 and 40% to get at the reliable maximum strength for MAGFOU, the optimal permissible proportioning of FSW was fixed at 35% and that for MRW at 15% taking into account the compressive strength at 28 days as the only criteria.

4. Even as the experimental analysis was carried out accommodating variations on curing spells and optimal combinational percentages of MAGFOU, it is customary to consider the nominal curing period of 28 days at which nearly 95% of the design strength is expected to be achieved by any concrete mix. By this notion, MAGFOU concrete could exhibit a strength attainment of 34.19 MPa as against the control concrete 29.5 MPa both exceeding the design target strength point of 26.5 MPa for a base M20 mix.

5. For the first approximated proportional combination of MAGFOU with 15% MRW and 35% FSW from the strength point of view, a supporting criterion in the form of the durability was also felt indispensable. From this point of view also the improvised MAGFOU concrete could exhibit durability parameter in a better way than the conventional concrete in terms of water absorption (1.32% for MAGFOU against 1.88% for CM),
permeability (3.45% for MAGFOU against 4.5% for CM), sorptivity (0.021 mm min^{-0.5} as against 0.017 mm min^{-0.5} for CM), acid resistance (MAGFOU had an average weight loss of 4.5% as against 7.56% for CM; by percentage decrease in compressive strength also MAGFOU showed 16.5% as against 17.9% in CM), temperature tolerance (for maximum tolerable temperature exposure at 800°C MAGFOU had a weight loss of 10.5% as against 12.6% for CM; by compressive strength too, MAGFOU exhibited 21.9 MPa against significantly low 12.32 MPA for CM), Accelerated Corrosion Test (MAGFOU experienced CPT of 19.5 hours lapse which was 11.47% considerably higher for 17.5 hours for CM) and RCPT (designated in the low category for CM compared to very low group for MAGFOU as per ASTM C 1202 – 97).

6. Besides a confined cube test for compressive strength an extended flexural strength of reinforced beam form of cured concrete was also felt inevitable. From the flexural strength point of view depicting the vulnerability of the beam towards deflection, MAGFOU proved an edge over the control concrete mix by registering an ultimate load of 5.25 Ton against 5 Ton for control mix. As a result, MAGFOU concrete could tolerate a final deflection of 27.93 mm as against 25.19 mm for control mix before failure. The susceptibility for MAGFOU to become ductile was found to be low at 15.96 compared to a relatively higher value of 16.14 for CM. The same trend also reflected in the final stiffness values of 0.187 t/mm for MAGFOU against a slightly increased value of 0.198 Ton/mm.

7. Apart from the workability, strength and durability parameter at a macro level data analysis ending with regression, a microstructural level SEM analysis also indicated favorable structural orientation within the MAGFOU mass compared to the conventional concrete mass. This further strengthens the experimental findings for adoption with a reasonable microstructural stability too.
8. The present investigation employed the ANN and FL models using MATLAB, from the output of which it could be ascertained that the predicted values of compressive strength were contained well within 10% permissible error or deviation on experimental outputs of the same.

9. Besides verifying the technical feasibility of infusing such foreign bodies as FSW and MRW, for improvising a concrete control matrix, the economic viability analysis (as explained in section 8.3) also indicated the considerable saving in the procurement of conventional river sand as replaced partially by waste materials MRW and FSW.

10. In addition to techno-economic evaluation, the environmental compatibility against pollution and contamination by open exposure of waste materials to the atmosphere and water resources could also be curtailed by means of hiding the same within a structure. However, caution needs to be exercised in restricting the relative proportion of FSW not to exceed 35% and MRW by 15% only.

8.3 ECONOMICS OF MAGFOU CONCRETE

The ultimate aim of partial substitution of MRW and FSW is to produce an improvised concrete mix termed as MAGFOU concrete and to critically evaluate its tangential benefits over the conventional concrete mix concerning cost economics.

In the case of a standard concrete mix, the total cost involved on the part of river sand in producing one cubic meter of the mix is Rs. 1820 when the proportion was optimized as 1: 1.74: 3.35 for cement: river sand: Coarse aggregate using potable water (0.5%) in required quantities. In the case of the improvised MAGFOU concrete mix, by 50% replacement of river sand with MRW and FSW, the cost of river sand used is brought down to Rs. 910
only. However, the cost included in the transforming process of FSW and MRW to replace river sand was worked out as Rs. 250 approximately. Hence, the net gain in using FSW and MRW in place of river sand is reckoned as Rs. 560 per cubic meter of concrete mix. The percentage saving works out to be 30.77%. Hence it is inferred that nearly one-third of the cost involved in producing one cubic meter of concrete can be saved by shifting to the usage of MAGFOU concrete.

8.4 FUTURE SCOPE

From the future perspective point of view, MAGFOU concrete shows a promising dependability and reliability towards sustainability in narrowing down the demand-supply gap of building materials cheaply derived from non-renewable geological resources. However, the social acceptability within the construction arena for a satisfactory adoption, the legal implications of the administrative side and alternative strategies shall also be explored keeping the findings of this investigation at the stepping stone level.