CHAPTER 3

METHODOLOGY

3.1 GENERAL

The objectives, scope and a detailed literature review on the research have been discussed in the previous chapters. In this chapter, the methodology of the research is presented.

3.2 METHODOLOGY IN A NUTSHELL

The methodology followed in this research is represented by a flowchart in Figure 3.1. The entire work has been divided into three stages. In the first stage, GCS has been analyzed for its chemical characteristics, environmental factors and physical properties. These factors are used to find an alternative for the aggregate in the bituminous base.

In the second stage, the mix designs incorporating different combinations of slag along with varied percentage of binder and compaction levels have been performed. In the third stage, the mix properties are optimized using MONL0P technique. Finally, conclusions are drawn based on the test results for effective utilization of the slag.
Figure 3.1 Flow Chart of Methodology
3.3 CHEMICAL AND PHYSICAL ANALYSIS OF SLAG

The mineral compositions of GCS have been studied in detail. The environmental issues such as leaching hazardous material from the mineral composition of the copper slag have been considered in this study. The leaching behavior of copper slag has been studied using Toxicity Characteristics (EPA 2004) Leaching Procedure (TCLP) test prescribed by Environmental Protection Agency (EPA). From the above test, the toxic level of leached material has been compared with the existing regulatory measures governed by various agencies.

The physical properties required for aggregate in bituminous construction are also studied in detail. The gradation of GCS has been analyzed in order to select the exact course of application in bituminous pavements for optimum utilization.

3.4 CSDB MIX DESIGN

In this design stage, an exclusive method of mix design has been tried in order to optimize the GCS in CSDB. The slag concentration in the grading design has been evolved through the method of proportioning the aggregate. The mix properties are obtained for various mix combinations by using standard and modified Marshall compaction methods. The values of mix properties are recorded for further investigations.

3.5 OPTIMIZATION OF GCS IN BITUMINOUS BASE

As GCS is used for aggregate replacement, the optimization of the same has been investigated to utilize it to its maximum quantity. The mix design constraints for CSDB base as FABB have been formulated from the literature review and specifications for FABB. The polynomial regression analysis has been carried out for all the mix properties and MONLOP
technique has been performed in the polynomial regression curves obtained from the values of mix properties. The lower limits and upper limits were derived from the above processes for the respective mix properties by applying the formulated design constraints.

3.6 CONCLUSION

Finally, conclusions are drawn about the suitability of GCS as an aggregate in bituminous mix based on the physical and chemical properties. The optimum utilization of GCS in the FABB mixes is obtained by adopting the MONLOP optimization program. The recommendations are made to use GCS as an aggregate alternative in bituminous bases.