CHAPTER 7

CONCLUSIONS AND SCOPE FOR FURTHER WORK

This chapter embodies the conclusions, which emerged on the basis of the entire research work. Using the results of computer simulation, foundry tooling and prototype castings were made. NDT, and mechanical tests as well as metallographic examinations of the heat treated IS1030 and IS2644 alloy steel castings were carried out. Results of these investigations revealed a satisfactory quality of the new range of castings, consistent with Indian Foundry Standards. Based on this study, the following conclusions can be drawn.

1. The alloy steel sand casting industry is one of foremost suppliers of castings to the automobile industry. The manufacturer of alloy steel castings should meet quality requirements set forth by automotive industry, failing which defective castings attract a financial burden on manufacturer due to rejections. Hence, this research proposes an effective methodology for validating the simulation, as a means to minimizing defects and improving casting yield.

2. There have been, very few publications whose results can be directly applied in mass production because the results of the studies have not been confirmed with tests in manufacturing scale. In view of this, the project is taken up to propose effective utilization of simulation in an alloy steel casting industry, towards minimizing defects and improving casting yield.
3. The ProCAST software, based on the Finite element Method, is considered in this research because it is rather faster, accurate than the Finite Difference Method and easier to use as it would not produce meshing gaps. The user interface is easy to understand and user friendly.

4. Two case studies were conducted to validate the utility of ProCAST in an alloy steel casting environment. The first case study belonged to a plate casting and the second case study belonged to a connector casting. These case studies revealed that alteration of gating system design, by simulation, can effectively reduce residual stresses and resulting distortion, and other defects like hot tears and shrinkage porosity. Further, it observed that casting yield could be improved by simulation.

5. An effective gating system has been proposed by modifying the position of in-gates, in the normal gating system followed in an industry, for a flanged bar casting employing CO$_2$ sand as mould material and IS1030 and IS2644 as cast materials.

6. The effect of pouring metal temperature on the casting phenomenon has been determined by simulation using the straight bar and flanged bar castings employing CO$_2$ sand and Silica sand as mould materials. With increase in temperature, the stresses induced in the straight bar casting after solidification were found to be high. Similar trend is observed in case of flanged bar casting, also. Stresses were found to be more on the straight portion in the flanged bar
casting. The reason for this may be attributed to hindered contraction in the case of flanged bar. When large flanges are present at the end of the straight bar, it is prone to hindrance while contracting during solidification and this may lead to hot tears.

7. By varying the mould material from CO₂ sand to silica sand in straight bar casting, it was found that the type of mould material used does not show much influence on the type of defects observed in casting, but solidification rate was more in the case of green sand mould.

8. Simulation trials were carried out on both the straight and flanged bar castings using blow-up instead of risers so as to observe its effect on the solidification phenomenon, determine the riser position, and maximize the yield. The simulation results revealed defects in both the castings, and this may be due to improper feeding of cast metal.

9. Simulation trials were carried out on both the straight and flanged bar castings using risers instead of blow-ups so as to observe its effect on the solidification phenomenon. The simulation results obtained in the castings revealed defects in both the cases. This may be due to improper feeding of cast metal. But reduced yield is noticed in both the cases.
10. The yield of the casting was improved, maintaining the same cast quality in both straight and flanged bar castings by using an exothermic sleeves with risers.

11. Corresponding to the two geometries of experimental samples considered in simulation, actual alloy steel castings were produced and they are examined by NDT technique and metallographic testing. Based on a comparison, it is found that simulation results are in good agreement with those shown by NDT techniques. Further, effective utilization of this simulation resulted in micro structural development acceptable to Indian foundry standards.
SCOPE FOR FURTHER WORK

The same methodology can be used to improve the quality of casting by using other feeding aids like Filters, padding, chills, and it is possible to optimize the other design parameter (position and dimension) for feeding aids. Also, it is possible to analyze the effectiveness of runner and riser, by optimizing the dimensions and position of runner and riser for different materials. The same methodology can be used in other casting processes like die casting, centrifugal casting, vacuum casting, and investment casting for minimizing the distortion as well as to improve the quality of casting, and Optimization of the process to get desirable microstructure.