CHAPTER 8

CONCLUSION

Manufacturing comprises of casting, machining, forming, joining, etc. Metal casting carried out in foundries provides huge employment opportunity. India is one of the countries housing majority of foundries meeting global demands. Since the manual work is being dominant in these foundries, they are the major source of occupational health hazards and work-related disorders. To understand the severity and predominance of the hazards, and the associated disorders, a study has been initiated to bring out ergonomically problematic activities in Indian foundries.

The study has been designed with four modules namely (i) preliminary investigation to establish the need for study, (ii) ergonomic investigation to identify the problematic activities in the foundry, (iii) validation of the study results and (iv) improvement proposals for problematic activities.

In the preliminary investigation module, a questionnaire consists of three section had been designed to gather information on ill effects and difficulties from the workers. The collected data has been statistically analyzed and the results indicate that the melting/pouring and the fettling shops have been found to be ergonomically critical. Similar trend is present in other shops as well but less critical than the above mentioned shops. This motivates further research to assess the ergonomical problems among foundry workers.
As the foundry work involves multiple activities demanding different postures, it is necessary to identify and segregate critical activities from remaining. Since the available tools are task specific and are capable of handling single posture at a time, a new questionnaire based tool has been designed for studying foundry activities. The tool has been built based on the physiological approach in ergonomic investigations. A physical effort index has been derived from the above tool considering the job factors and work environment to identify shop floor-wise critical areas. The tool has been validated through face, content, predictive and external validations. The index has been assessed on a scale of zero to one and the range has been divided into four categories i.e. very light (0 – 0.28), some what hard (0.28 – 0.45), very strenuous (0.45 – 0.78), extremely strenuous (0.78 – 1). The effectiveness of proposed tool has been demonstrated with the help of survey conducted among one hundred and ninety two foundry workers. The following inferences are drawn from the results.

i. Activities of each shop floor demand different levels of physical exertion causing varied physical discomfort amongst the workers

ii. Environmental factors highly influence the physical exertion.

iii. Fettling shop floor workers, having a $P_{Avg}$ of 0.491, are experiencing more discomfort compared to other departments

iv. There are 78% of fettling, 64% of melting/pouring and 61% of molding shop floor workers are in the ‘Very Strenuous’ category.

v. Large proportion of workers has reported more than one discomfort.
vi. Majority of the workers being involved in repetitive activities throughout the year, resulting in a sustained physical exertion

Hence it can be concluded that the proposed tool (Physical Risk Assessment) is an effective instrument for assessing risk at workplace. Other advantages of the proposed tool are (i) the tool is simple and easy to use, (ii) the tool is designed in such a way that the user need not be an ergonomist, (iii) the questionnaire used in this method will not interrupt the work as it is observation based and not interactive, (iv) critical activities can also be identified independently and improved by using this tool.

In the third module the proposed tool’s applicability in foundry environment has been assessed through performance evaluation. The results of the proposed tool have been compared with HSI, RULA, heart beat rate and cognitive approaches. For example, HSI value and RULA scores for activities in melting/pouring area, indicate the need of immediate attention, which is coinciding with the recommendations of the present index i.e. very strenuous. This is further substantiated with the results of cognitive analysis (Karasek’s Demands-Control model) which indicates 43% of melting/pouring shops workers suffer with high job strain. Further heart beat rate recorded on workers (experiencing more than 90 beats per minutes) involved in hazardous operations also support the above inferences.

Finally this thesis work attempts to improve some of the very critical activities. CFD based FLUENT software is used to improve the melting activities for ergonomically comfortable environment. Similarly changes in work posture are arrived with the help of CATIA V5 software which is inbuilt with biomechanical analysis on RULA approach. The results indicate that at present the workers are in high thermal distraught zone (350K) during
charging of raw material into furnace. This condition affects human thermoregulation and the worker should be prevented from entering into the zone. By introducing a feeding channel or block the thermal radiation with the help of protective barriers or provide air flow such that the thermal radiations do not affect the worker, a worker can be prevented from entering the zone. With these changes the modified furnace environment analysis shows the working temperatures has been reduced (310K) to acceptable levels. This study suggests that CFD analysis is helpful in designing safe work environment and prevent health hazard.

Postural analysis through RULA approach shows that the present work postures in most of the activities need to be changed. These changes could be achieved by modifying the dimensions of tools/equipments used. Proposals are arrived at for the possible modifications which will improve the present work postures. The improved comfortable postures will help in increasing labor productivity.

8.1 SCOPE FOR FUTURE WORK

- Effectiveness of the proposed tool can be studied in other manufacturing environments like machining, welding, forging, heat treatment areas.
- Environmental influence on productivity can be studied using this tool.
- The tools applicability in area other than manufacturing like mines, construction and garment industries can be studied.
- As the posture occupied by a worker depends on his experience/expertise, the factor can be considered to study the influence of these factors on the performance of the tool.