

Ergonomic Study of Cabin of Tower Crane

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ABSTRACT:The study, carried out at the construction site of a private project at Indore (M.P), concerns ergonomic study and evaluation of a manually-operated Electrical Overhead Travelling (EOT) crane cabin. The crane cabin is a complex work system consisting of the crane operator and twelve specific machine components embedded in a closed workspace. A crane operator has to perform various activities, such as loading and unloading of steel rods, setting and removal of huge pipes, and routine maintenance work. Initially, an operator had to work in standing posture with bent back most of the time. Ergonomically poor design of the chair and the controls, awkward work postures, vibrations and insufficient vision angle resulting in musculoskeletal disorders (MSDs) are some of the critical problems observed.

KEYWORDS:Crane Cabin, sitting posture, visibility, vibrations, ventilation.

I. INTRODUCTION

Ergonomics is “that branch of science that is concerned with the achievement of optimal relationships between workers and their work environment”. It deals with the assessment of the human’s capabilities and limitations (biomechanics and anthropometry), work and environment stresses (work physiology and industrial psychology), static and dynamic forces on the human body structure (bio mechanics), vigilance (industrial psychology), design simulation and training, and design of workstations and tools (anthropometry and engineering), therefore ergonomics draws heavily from many areas of science and engineering [1].

The term “Ergonomics”, which was used for the first time by Wojciech Jastrzebowski in 1857, is literally derived from the Greek ergo (meaning work) and nomos (meaning law). While it has its roots in several branches of study such as work physiology, biomechanics, and workstation design, its close synonym, Human Factors has its origin in experimental psychology with the focus in human performance and system design [2]

Ergonomics is defined in various ways, few of them are written below-

“Ergonomics is the relation between man and his occupation, equipment, and the environment in widest sense, including work, play, leisure, home, and travel situations” [3].

“Ergonomics attempts to optimize the fit between people and their environment” [4].

“Ergonomics is Person- Machine system design” [5].

“Ergonomics is designing for human use” [6].

The work in this paper is broadly divided into two parts. 1) Problem identification 2) Recommendation. Problem identification is the process in which we attempt to find problem in current workplace, for this basically we have Traditional method, in which look until you find something that is wrong. This hit-or-miss approach is simply not very effective. Unless one has extensive experience. Checklist of some type can be valuable in this method. By using a checklist many questions were asked to the crane operator of different shifts and then by analysing their answers, the

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problem which they are facing are identified. Once the problems are known, some basic and creative measures are suggested to overcome the known problems.

Paper is organized as follow. Section 3 describes the details of problem that operators are facing and also the adverse effects of the problems and in Section 4 suggestions to overcome these problems are given. Section 5 presents conclusion.

II. RELATED WORK

India is a developing country, as we all are moving towards development, focusing on new technologies and methods. But, in all this we somewhere forgot to take care of our labours and machine operators. The work that I did totally emphasis on the condition of workers and operators. I choose the overhead crane operator as it is much difficult for operator to work there for continuously 5 to 6 hours where he have to work with full concentration, if he cause any mistake then it can lead to a major accident on ground level.

The main work done in this study was the asking questions to the operators deeply and making them comfortable to answer the truth irrespective of any fear of higher authorities. The question where mainly based on the changes in their life style, their health, their mental conditions after starting this work of operating a overhead crane at the height of around 80-90 feet.

III. PROBLEMS

As the questions are asked many problems that the operators were facing came into light, some of the problems were important to get rid of. Following are the problems that operators face are:-

1. **Sitting Posture-** The sitting posture of operators is very complicated while he is working, in one shift of his work he stands up and seat again, this cause a great back pain and awkward postures for long periods can put unwanted pressure on the Lumbar vertebrae region of the back when proper areas are not supported. Most discomforts arise in the lower back and the neck-shoulder regions, because of a constant and continuous load while the operator is working.
2. **Visibility-** Another problem that operator faces are visibility, they have to shift here and there while working to see the ground side where they are putting loads. The operators always wants unrestricted and reliable view of the ground situation and working surroundings. The repercussions of a poor field of visibility include inadequate utilization of the cabin functions, increased health risks to the operator due to the awkward postures assumed to avoid obstructions to visibility of the task from within the cabin. An unclear view can also result in possible dangers to the operator himself and the crew working on the ground.
3. **Vibration-** next one is vibrations, operators while working in crane are exposed to whole body vibrations. This vibration is transmitted to the operator in axes of 3 translations (x,y,z) at 3 different interfaces with 3 rotations at the hip. The Whole Body Vibration is distributed to the operator via the closest and largest point of contact that being the Seat and a small amount through the control/joystick and the pedals/footrest within the cabin. Long-term exposure to Whole Body Vibrations especially whilst seated and working in awkward postures consequently resulted in the operator developing either lower back pain (LBP), sciatic problems or degenerative changes in the spinal system or any combination of these conditions.
4. **Ventilation-** This is an another problem that operator faces, operators are working at a height, the cabin operator is exposed to various environmental conditions such as Blast, Heat and cold, Radiation, Incoming light, Dust, gases, pollution some of these can be hazardous to health and cause many diseases. Operator have work at such height irrespective of the weather outside either it is too much cold or its summer and temperature being 45-50 degree Celsius.

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IV. SUGGESTIONS

After too many questions were asked to different operators, I got to know the above problems and the condition in which these labour work to live their life, with the reference to the problems I come up with few basic but important suggestion to decrease the effects of the above problems that are as follows:-

1. Discomfort of sitting postures can be minimized by following
 - Designing cabin seats with armrest supports allowing a proportion weight to be transferred onto supports relieving significant back strain.
 - The required height adjustment of the seat should be about 5 inches to fit both a tall 95th percentile male and a 1st percentile female (which is the difference in the lower limb).
 - The use of a tilting forward seat would allow the operator to maintain more of an upright posture with minimum a back inclination angle, relieving strain from the neck and shoulders when lifting is close to the crane tower.
2. For visibility following can be useful
 - The guideline states that the operator should not have to turn their more than 30° to either side and that head should not tilt more than 5° up and 25° down maintain comfort.
 - Occasional head movements of 50° to the sides and 40° up and 50° down are acceptable.
 - Seats, windows and cabin features should be designed with these guidelines in perspective.
3. The problem related to ventilation can be overcome by following
 - Limited opening of windows, so that fresh air is allowed to circulate around the cabin.
 - Vents need to be built into the cabin structure to allow the flow of air into and out of the cabin.

V. CONCLUSION

I have used some basic questionnaires of ergonomics to find the problems that the operator of overhead crane facing, and with the help of literature and innovative ideas I suggested some of solutions that might be helpful for them.

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