

HAZARDS IDENTIFICATION OF EOT CRANES AND THEIR CONTROL MEASURES

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ABSTRACT

Material handling is a vital component of any manufacturing industry. An Electric Overhead Travelling (EOT) crane is a mechanical material handling device equipped with a rope drum, wire rope and sheaves that are used both to lift and lower materials and to move them horizontally or vertically. EOT cranes are associated with large number of hazards in their operation. So that that it necessary to check the effectiveness of present safety and health program time to time to mitigate the hazards associated with crane a survey is performed in manufacturing industry with the help of questionnaire study and checklist method in questionnaire study the three levels are assigned to take response of them and a survey with the help of checklist method is performed to identified the hazardous condition on three cranes installed in an industry and their control measures are given. Which is help to mitigate the hazards and hazardous conditions, from questionnaire study the response was taken showing with the help of graph which shows the effectiveness of present established safety and health program.

Keyword: EOT crane, Crane Safety, Hazard Identification, Checklist method, Questionnaire method

1. INTRODUCTION

The EOT cranes are mostly used in manufacturing industries in shop floor to transfer the goods for one place to another place; it is repetitive type of work for operators. EOT crane having their horizontal travel and up and down motion which is control by pendent control when needed around the shop floor there are one to three numbers of cranes are moving in around one shop floor installed by different types of manufactures and only 2 or 3 operators are available to operates these crane so there is a chance of mistake is available which further converted into hazard and also lack of operators training, experience and qualification is the main reason of accidents and also various conditions associated with hazards such as physical, operational and maintenance working conditions in which number of hazards are identified in this research work. Depending upon their different types of design and operational features they have their advantages and also various hazards associated with the to eliminate these hazards associated with cranes various techniques are available in safety management with the use of questionnaire study and checklist methods hazards are identified and their control measures is recommended to prevent them and also their low cost preventive measures are provided. Ergonomically and psychologically condition are also be taken into account to avoid these. By questionnaire study positive response of all levels are taken and with the help of graph the effectiveness of present safety and health program is reviewed and also recommendations are given for further improvement in safety and health program.

2. ELECTRIC OVERHEAD TRAVELLING (EOT) CRANE

EOT cranes are commonly used inside factories for a wide range of lifting goods. These have parallel runways, where the gaps are spanned by travelling bridge on which the hoist is mounted. As the name this crane is operated by electrically either through a pendant or an operator cabin. EOT cranes are equipped with the capacity from 2 Ton

4. PROBLEM FORMULATION

Several accidents are occurs inside the industries and the owner of the factory face many problem like loss of the trained worker, loss of production, loss of materials. There are various challenges in the heavy industry. In field of industry every day an accident is occurred due to unawareness, lack training, absence of personal protective equipment etc. The manufacturing industry involves complex and dynamic work environments that present new hazards to workers on a daily, or even hourly, basis. As a result of the complicated and constantly changing nature of lifting operations, the manufacturing industry has very high injury and fatality rates compared to other industries. According to Bureau of Labor Statistics (BLS) the data for 2006, in that year, there were 72 bridges crane-related fatal work- related injuries, down from an average of 78 fatalities per year from 2003 to 2005. These comprise all fatalities where the source of the injury was a crane, the secondary source of the injury was a crane, or where the worker activity was operating a crane.

5. METHODOLOGY

We have applied two methods for hazard identification of EOT crane.

1. Questionnaire study method
2. Checklist method

5.1. Questionnaire study method

Questionnaire study is used to evaluate the safety and health programs are available to follow by organization. To identify the root causes of hazards and evaluate the effectiveness of current established safety and health program a questionnaire study conducted on 03 EOT cranes in steel wire manufacturing industry. To perform questionnaire survey of running safety and health program associated with EOT machinery, employee divided in different levels of group:

1. Top level (Supervisors/shift in charge)
2. Middle level (Operator’s)
3. Lower level (Rigger/Helpers)

To identify the hazards related to EOT crane there are certain criteria are made, by which we find the root causes of particular hazards, for each levels of group 15 questions are prepared which have two choice Yes/No of responder, positive or negative, in which 3 questions are come in each criteria, these criteria’s are as follows:

1. Recordkeeping.
2. Physical conditions.
3. Ergonomically conditions.
4. Questions associated to mental issues.
5. Emergency preparedness.

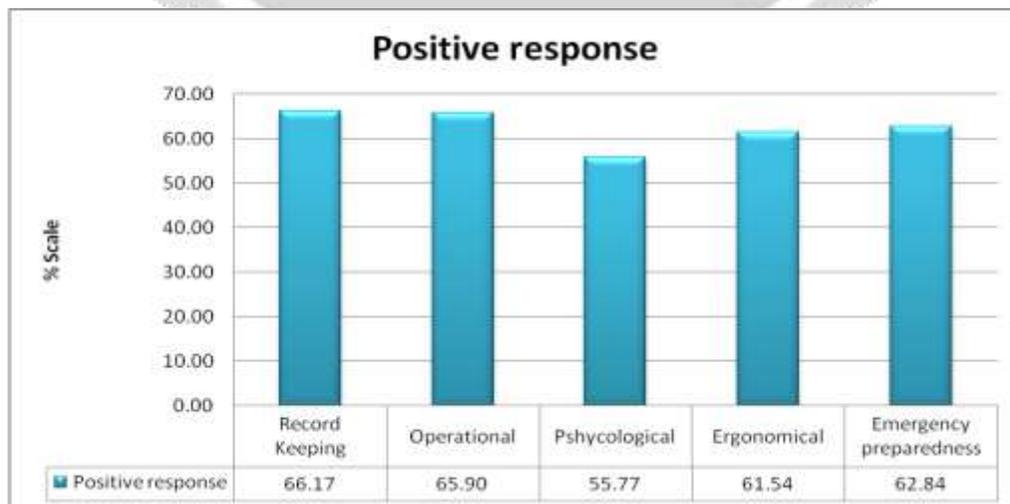


Fig. 3: Bar graph of Average of all Responses

5.2. Checklist method

In steel wire manufacturing industry there are 03 no's of EOT cranes are installed in which all are operated by pendent control. The survey is performed on 03 EOT cranes based upon the checkpoints this methodology is used to take physical interaction with EOT cranes in which condition, operation, maintenance and other general observation are taken into account by one by one, and then find the hazards which can be present in lifting machinery. Results are note down from following term that is Satisfactory/Not satisfactory Working/Provided, provided but not working, not provided /not working. From the checklist inspection we collect the data of 03 EOT cranes related important checkpoints. Natures of results is obtained by this survey, which is depend upon condition and availability satisfactory/not satisfactory, provided not provided, working/ not working and also some other physical conditions also be noted down in the format to take appropriate action, observations are summarized with the help of table as follow.

| Checklist | | Satisfactory | Not satisfactory | Provided/ Working | Provided but Not working | Not provided/ Not working | Remarks |
|-----------|---|--------------|------------------|-------------------|--------------------------|---------------------------|---------|
| A | HOOK BLOCKS | | | | | | |
| 1 | Identification Mark | 3 | | | | | |
| 2 | Capacity of Hook (Marked) | 3 | | | | | |
| 3 | Condition of Hook | 2 | 1 | | | | |
| 4 | Condition of Swivel | 2 | 1 | | | | |
| 5 | Throat Opening | 2 | 1 | | | | |
| 6 | Shank Dia. (Marked) | 2 | 1 | | | | |
| 7 | Condition of Hook Block | 1 | 2 | | | | |
| 8 | Condition of Centre Pin | 1 | 2 | | | | |
| 9 | Safety Latches | | | 1 | 2 | | |
| 10 | Oil greasing | 3 | | | | | |
| B | HOIST | | | | | | |
| 1 | Wire Rope Diameter | 3 | | | | | |
| 2 | Construction Of Wire Rope | 3 | | | | | |
| 3 | Original Test Certificate | | 3 | | | | |
| 4 | Nut and bolt condition | 3 | | | | | |
| 5 | Condition Of Wire Rope | 2 | 1 | | | | |
| 6 | Wire Rope Drum Condition | 2 | 1 | | | | |
| 7 | Groove Condition | 3 | | | | | |
| 8 | Wire Rope End Fitting | 3 | | | | | |
| 9 | Riving of wire ropes | 3 | | | | | |
| 10 | Pulley Condition | 2 | 1 | | | | |
| 11 | Outer Pulley Cover | 1 | 2 | | | | |
| C | LIMIT SWITCH | | | | | | |
| 1 | Transverse Travel Limit switch | | | 1 | 1 | 1 | |
| 2 | Long Travel Limit Switch | | | 1 | 1 | 1 | |
| 3 | Upper Travel Limit Switch | | | 1 | 1 | 1 | |
| 4 | Lower Travel Limit Switch | | | 1 | 1 | 1 | |
| 5 | Gravity Limit Switch | | | 2 | 1 | | |
| 6 | Anti Collision limit switch (If applicable) | | | 2 | 1 | | |
| D | CONTROL LEVER / PENDENT | | | | | | |
| 1 | Emergency Stop | | | 2 | 1 | | |
| 2 | Auto Off Released System | | | | | 3 | |

| | | | | | | | |
|----------|---------------------------------------|---|---|---|--|---|--|
| 3 | Key for On/Off and Mode selection | | | 3 | | | |
| 4 | Direction Marking of motion | 2 | 1 | | | | |
| E | TROLLEY, RAIL AND BEAM | | | | | | |
| 1 | Beam Condition | | | | | | |
| 2 | a. Structure | 3 | | | | | |
| 3 | b. Weld Joints Beams/Angles | 3 | | | | | |
| 4 | Rail Condition | 3 | | | | | |
| 5 | Alignment of LT & CT rail | 3 | | | | | |
| 6 | Corrosion on component | 1 | 2 | | | | |
| 7 | Cross Trolley Platform and Trolley | 2 | 1 | | | | |
| 8 | Long Travel End Truck and Truck | 2 | 1 | | | | |
| F | POWER TRANSMISSION | | | | | | |
| 1 | Gear Box Condition | 3 | | | | | |
| 2 | Axle & coupling alignment | 3 | | | | | |
| G | WALKWAY/FLOORS | | | | | | |
| 1 | Ladder to Walk way | | | | | 3 | |
| 2 | Railing on Ladder | | | | | 3 | |
| 3 | Splinters or sharp edges on ladder | | | | | 3 | |
| 4 | Walk Way on The Crane | | | | | 3 | |
| 5 | Railing on Walk Way | | | | | 3 | |
| 6 | Toe Guard on all platforms | | | | | 3 | |
| 7 | Walkway cleanness | | | | | 3 | |
| 8 | Walkway condition | | | | | 3 | |
| 9 | Height of risers | 3 | | | | | |
| H | ELECTRICALS | | | | | | |
| 1 | Motor Condition | 3 | | | | | |
| 2 | Earthing to All Electrical equipments | 3 | | | | | |
| 3 | Main Switch Condition | 3 | | | | | |
| 4 | Emergency Stop | 3 | | | | | |
| 5 | Weather protection | | | | | 3 | |
| 6 | Condition of switch boxes | 3 | | | | | |
| 7 | Cable trays condition | | | | | 3 | |
| 8 | Corner Switches | 3 | | | | | |
| 9 | Rubber Mats Near Control panel | 3 | | | | | |
| 10 | Crane warning lights | | | 2 | | 1 | |
| 11 | Canopy on all motors | | | 1 | | 2 | |
| 12 | Condition of wires and cables | 3 | | | | | |
| 13 | Electrical Cable Handling trolley | | | 1 | | 2 | |
| I | OPERATIONAL | | | | | | |
| 1 | Long Travel Motion | 3 | | | | | |
| 2 | Cross Travel Motion | 3 | | | | | |
| 3 | Noise or Unusual sounds | 2 | 1 | | | | |
| 4 | Vibration | 3 | | | | | |
| 5 | Siren | 3 | | | | | |
| 6 | Visibility condition | 3 | | | | | |
| 7 | Brake Condition | 3 | | | | | |
| 8 | Emergency stop | 3 | | | | | |
| 9 | Rail Alignment | 3 | | | | | |
| 10 | Buffers condition | | 1 | 2 | | | |
| 11 | Mechanical Stopper | 1 | 2 | | | | |
| 12 | Stopping distances with stopper | 3 | | | | | |
| 13 | Rail track clearance | 3 | | | | | |

| J FIRST AID, FIRE AND EMERGENCY PREPAREDNESS | | | | | | | |
|---|---------------------------------|---|---|---|---|---|--|
| 1 | First-Aid kit | | | 2 | | 1 | |
| 2 | Emergency phone numbers chart | 2 | | | | 1 | |
| 3 | Condition of Emergency Exists | 2 | 1 | | | | |
| 4 | Fire Extinguisher at vulnerable | 3 | | | | | |
| K OTHER GENERAL CONDITIONS | | | | | | | |
| 1 | Housekeeping nearby crane | 3 | | | | | |
| 2 | Guards to all moving equipments | 3 | | | | | |
| 3 | Operator's Personal protective | 3 | | | | | |
| 4 | Rated Capacity marked | | | 3 | | | |
| 5 | Safe load indicator | | | 2 | 1 | | |
| 6 | Warning and safety levels | | | 2 | | 1 | |

6. RECOMMENDATION

On the basis of the results and discussions, a number of very low-cost, easily implementable, Ergonomics solutions of the existing problems were recommended to the factory management for implementation to improve the working conditions, work methods, efficiency, productivity, occupational safety and health of the crane operators. Hazards identification of lifting machinery have been performed with the help of questionnaire study and checklist inspection and control measure on the basis of these two methodology have been given. Hazard cannot be completely eliminated until we are not able to take continuously review the work environment and work practices to control or prevent workplace hazards. Below table describe the hazardous condition of EOT crane, their potential hazard and their control measures.

| Sr. no. | HAZARDOUS CONDITON | POTENTIAL HAZARD | CONTROL MEASURES |
|---------|--|--|---|
| 1 | Lack of ID. Plate with SWL. | Overloading may occur which leads to fall of material, crane failure may occur. | ID plate to be provided with following details Safe working load, identification number, date of inspection. |
| 2 | Wear, tear and throat opening more than permissible limit of hook. | Hook can be broken, lifting gear may come out from jaw and load can fall floor. | Periodically inspection of hook and proper maintenance to be performed. |
| 3 | Lack of safety latch/ Safety latch is not working | Lifting gear can came out from hook jaw, larger effort is needed to attach or remove lifting gears so riggers helpers are expose to back injury, holding, pushing and frustration. | Safety latch to be provided in working condition , periodic inspection to be performed, training to be given to personal of manual lifting. |
| 4 | Reduction in wire rope diameter/crushing/kink/corrosions/ Elongation in length/broken wires. | Deduction in wire rope diameter ,kinking, crushing, from which hook block and load can fall from height which results to fatal accident, body part injury. | Preventive maintenance of wire rope. Periodically inspection of wire rope. Wear all work related PPE's. |
| 5 | Damaged pulley | Broken wires can cut the body parts of riggers/operators. | Proper clearance of rope to pulley Periodically inspection, preventive maintenance. |
| 6 | End fitting of wire rope | Wire rope end fittings are not proper or loose which can results to fall of hook block, property damage | End fitting should be according to standard and at proper distance should be periodically inspected, |

| | | | |
|----|--|---|--|
| 7 | Failure of limit switch/lack of limit switch | Failure of any type of limit switch can cause to fall of material, crane component failure, property damage, fatal accident, injury. | Operator should be trained Daily inspection of crane operation Preventive maintenance EOT cranes, brake should be in operative condition, buffers stopper to be installed |
| 8 | Damage or tight on/off mode selection key/ Damage push button or control lever | Damage or tight push button can causes electric shock, static charge, burn injury and pain in figures. | Insure all push button shall be in operative and good condition to, Fire extinguisher, rubber mats to be provided in operator's cabin |
| 9 | Emergency stop not working or not available | If emergency stops are not working crane collide with another crane can be occur, material can fall, property damage, fatal injury can be occur. | Daily checklist inspection shall be performed by operator, operators should be trained, and brakes are effective, preventive devices. |
| 10 | Alignment is not proper of rail track | Poor rail track condition that is alignment, poor housekeeping, obstacles on track leads to sudden failure, fall of person, fall of material, property damage. | Rail alignment should be proper Periodically inspections, housekeeping to be improved, Proper maintenance of rail track |
| 11 | Toe guard not provided on all opening areas, Lack of walkway to crane and lack of walkway on crane | Lack or improper condition of toe guard, hand railing and walkway can causes, slip, trips, fall of object, personal from height results to fatal accident or death injury | Toe guard and hand railing to be provided housekeeping to be provided on walkway and walkway to be free from obstacles |
| 12 | Electrical condition such as 1. Ear thing not provided 2. Open wires or cable 3. Lack of rubber mats near control panel 4. Weather protection of electric components 5. Canopy of all motors are not satisfactory | Electrically poor conditions such as naked wires, poor earthing, lack of rubber mats can causes fire or burn injury, electric shock, arc etc. | Periodically inspection of electrical components to be performed, proper ear thing to be provided, fire extinguisher to be provided near control panel, PPE to be provided to workers. |
| 13 | Crane warning lights and siren do not work properly. | Not working or not availability of electrical safety components like Crane warning lights, siren leads to crane collide, property damage, poor visibility, eye deficiency, frustration of operator's. | Preventive maintenance of electrical components should be done. Periodically / daily checklist inspections to be performed and operational testing of warning devices. |
| 14 | Heavy noise or unusual sound | Heavy noise or unusual sound can cause hearing losses, communication error between operator's and riggers. | Periodically inspection and maintenance to be performed PPE should be worn by operator's Proper communication device to be provided in noisy areas. |
| 15 | Vibration of lifting machinery components | Vibration of EOT crane components leads to crane failure, fall of material, machinery damage can causes dangerous accidents | Loose nut bolt should be tight and proper oiling greasing to be done at the time of maintenance, through inspection and testing to be performed. |

| | | | |
|----|---|--|--|
| 16 | Any type of Fire | Electrically unsafe condition can leads to fire hazard which is related to dangerous fire, explosion | Fire extinguisher to be provided, Effective emergency action plan should be prepared and training should be provided to workers, housekeeping to be maintained near electrical components |
| 17 | Lack of guarding in moving components | Absence guard of rotating parts can cause body part injury such as cut, hit hurt, stuck with object. | Proper machine guards to be provided to all rotating machinery Proper inspection to be performed. |
| 18 | Repetitive motions | Shifting of operator's, repetitive motions, environmental condition leads to body stress, leg, hand pain, fatigue, boredom, frustration and others ergonomically and psychological hazards | Proper seating to be provided to operator's, should encourage workers about safety ,worker should be train, shifting of operator's to be avoided as much as possible, should not give more workload to workers |
| 19 | Lack of qualification, training, and experience | Lack of training, qualification, and experience related to lifting machinery can results into dangerous accidents , injury or death | Training programs must be run time to time, ensure that all workers, Ensure that all workers have the ability to read and write, experience person should be assign as a operator |

CONCLUSION

The questionnaire study is the best way to take the response of personals in any organization regarding any type of condition by which it is easy to assess the present influence of the particular program. It is the only way to eliminate the accidents is Identify the Hazards to assess the associated controls with the cranes and to bring the hazard to tolerable level. Lifting activity because of the very nature of the operation, complexity of the systems, procedures and methods always involves some amount of hazards. Hazard identification is carried out with the help of checklist methodology it is the point to point throughout survey of particular task which is design first and then performed easily by any non experienced person of the for identification of undesirable events that can leads to a hazard, the analysis of hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects. It is widely accepted within industry in general that the various techniques of Hazard Identification contribute greatly toward improvements in the safety of complex operations and EOT cranes.

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