

# Hazard Identification of cranes and their control measures

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**Abstract** - lifting machineries are widely used in manufacturing industry and also associated with large number of hazards in their operation. Depending upon their nature of work it can further divided on their type of use that is bridge cranes, semi gantry cranes, gantry cranes. 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 46 cranes installed n 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.

**Index Terms** - Crane safety, Safety examination, Hazard identification, Questionnaire Study, Checklist method.

## INTRODUCTION

The cranes are mostly used in manufacturing industries in assembly shop to transfer the job for one place to another, it is repetitive type of work for operators, there are number o cranes are installed in which electric overhead travelling, semi gantry and gantry crane are taken in this project work for identify their inherent hazards. Bridge crane having their cross travel, long travel and up and down motion which is control by pendent control or operators cabin installed when needed around the shop floor there are one to 5 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 paper 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 cast 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.

## LITERATURE SUREVEY

Tor-Olav Nvestad Richard (2007) this paper gives an account of two typical ways of thinking drawn on by process operators and crane operators on a Norwegian offshore platform in the North Sea as they interpret, negotiate and define situations as hazardous. The discretion required for definitions of situations as dangerous is also discussed. It is concluded that the completely different work processes of the work groups seem to generate different hazard metaphors, ways of thinking and ideas to reduce hazards. (2001) He gives a evaluation of crane safety in industry in this paper reviews available information on crane-related injuries, currently safety devices, and commonly used crane safety procedures. Recommendations for improved crane injury prevention and future crane safety research are given. One of the first ideas for the ergonomic consideration of crane cabin design came from the original & 'common sense' recommendations made by Bramley (1953). He observed that in most cranes, controls varied widely in design, function and manipulation, leading to a large number of hazardous problems. Das & Sen (1999) conduct Ergonomics studies, on the machine control and the resultant movements of the cabins and the hooks in 51 electric overhead travelling cranes in a heavy engineering factory, showed that control-movement compatibility is absent in most of the cranes and also a number of low-cost ergonomics solutions have been recommended to minimize these problems.

## ANALYSIS AND METHODOLOGY

Methodology

1. Questionnaire study (based on lifting machinery)
2. Hazard identification with checklist method

There are numbers of employee involved in lifting machinery operation in manufacturing industry so that questionnaire survey performed to take appropriate respond regarding the safety issues and the analytical data of people collected by this study this help

to identify the hazards related to category. 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 conduct in manufacturing industry 44 bridge crane that is EOT, Semi Gantry and Gantry cranes. Employee are divided into three levels and questions are so design as if the response of employee is positive then we can say that the effectiveness of present safety and health program is better and effective.

Following are the criteria recordkeeping, operational, psychological, ergonomically and emergency preparedness in which three questions are asked in each level. Levels are lower level in which riggers, middle level in which operators and top level in which supervisors are came and the response of each question is taken and then the average response of all level based upon all criteria is shown with the help of graph.

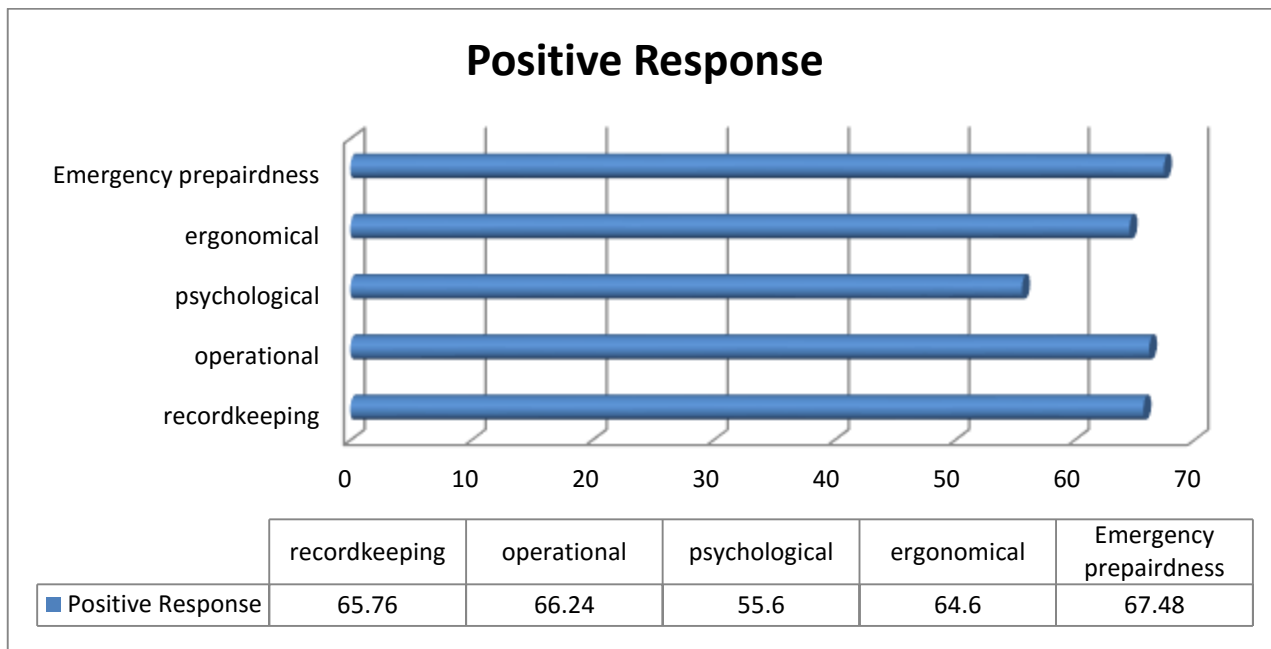


Fig. 1 Average positive response of all levels in each criteria.

**Hazard identification with checklist method**

In manufacturing industry where the industrial training was done there are 46 no's of lifting machinery are installed in which (28 crane are control lever operated and 18 operated by pendent control) electric overhead traveler cranes, semi gantry and gantry cranes are present. The survey is performed on 46 lifting machinery based upon following checkpoints this methodology is used to take physical interaction with lifting machinery 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.

**Table1:- Hazard Identification Checklist**

Check points	Satisfactory	Not satisfactory	Provided/ Working	Provided but Not working	Not provided/ Not working	Remarks
<b>HOOK BLOCKS</b>						
1.1 Identification Mark	18	14			14	
1.2 Capacity of Hook (Marked)	22	11			13	
1.3 Condition of Hook	31	15				
1.4 Condition of Swivel	35	11				
1.5 Throat Opening	38	8				
1.6 Shank Dia.	44	2				
1.7 Condition of Hook Block	32	14				
1.8 Condition of Centre Pin	37	9				
1.9 Safety Latches			25	8	16	
1.10 Oil greasing	29	17				

<b>2.0 HOIST</b>						
2.1 Wire Rope Diameter	26	20				
2.2 Construction Of Wire Rope	28	18				
2.3 Original Test Certificate of	41	5				
2.4 Nut and bolt condition	29	17				
2.5 Condition Of Wire Rope	38	8				
2.6 Wire Rope Drum Condition	44	2				
2.7 Groove Condition	36	10				
2.8 Wire Rope End Fitting	29	17				
2.9 Riving of wire ropes	43	3				
2.10 Pulley Condition	37	9				
2.11 Outer Pulley Cover	29	10			7	
<b>3.0 LIMIT SWITCH</b>						
3.1 Transverse Travel Limit Switch			22	11	13	
3.2 Long Travel Limit Switch			27	9	10	
3.3 Upper Travel Limit Switch			32	6	8	
3.4 Lower Travel Limit Switch			21	14	11	
3.5 Gravity Limit Switch			13	23	10	
3.6 Anti Collision Limit Switch (If Applicable)			19	5	4	
<b>4.0 CONTROL LEVER / PENDENT</b>						
4.1 Emergency Stop			23	16	7	
4.2 Auto Off Released System			22	6	18	
4.3 Key for On/Off and Mode Selection			24	7	15	
4.4 Direction Marking Of Motion	26	12			8	
<b>5.0 TROLLEY , RAIL AND BEAM</b>						
5.1 Beam Condition						
a) Structure	39	7				
b) Weld Joints Beams/Angles	41	5				
5.2 Rail Condition	29	17				
5.3 Alignment of LT & CT Rail	38	8				
5.4 Corrosion on component	35	11				
5.5 Cross Trolley Platform and Trolley Wheel Condition	28	18				
5.6 Long Travel End Truck and Truck Wheel Condition	30	16				
5.7 Buffers Of the End Truck	7		26	8	5	
5.8 Condition of Gantry Crane Leg	36	10				
<b>6.0 POWER TRANSMISSION</b>						
6.1 Gear Box Condition	35	11				
6.2 Axle & Coupling Alignment	38	8				
<b>7.0 WALKWAY/FLOORS</b>						
7.1 Ladder to Walk way	18	10	12		6	
7.2 Railing on Ladder		8	26		12	
7.3 Splinters or sharp edges on ladders			29		17	
7.4 Walk Way on The Crane			37		9	
7.5 Railing on Walk Way		8	31		7	
7.6 Toe Guard on all platforms		13	24		9	
7.7 Walkway cleanness	26	20				
7.8 Walkway condition	22	24				
7.9 Height of risers	30	16				
<b>8.0 ELECTRICALS</b>						
8.1 Motor Condition	25	21				
8.2 Ear thing to All Electrical Equipments			37		9	
8.3 Main Switch Condition	41	5				

8.4 Emergency Stop			11	19	16	
8.5 Weather protection	11	11	24			
8.6 Condition of switch boxes	29	17				
8.7 Cable trays condition	21	12			13	
8.8 Corner Switches			27	11	8	
8.9 Rubber Mats Near Control panel		9	13		24	
8.10 Crane warning lights			14	13	19	
8.11 Crane Under Bridge Lights			10	32	4	
8.12 Canopy of all motors.	28	18				
8.13 Condition of wires and cables	29	17				
8.14 Electrical Cable Handling Trolley			19	22	5	
8.15 Festoon Cable Handling Trolley			18	12		
<b>9.0 OPERATOR'S CABIN</b>						
9.1 Operator's cabin Condition	21	7				
9.2 Sitting arrangement	13	15				
9.3 Access Walkway to cabin		5	23			
9.4 Condition of window Glass	18	10				
9.5 Fan condition			7	13	8	
9.6 Visibility from cabin to shop floor from glass	19	9				
<b>10.0 OPERATIONAL</b>						
10.1 Long Travel Motion	29	17				
10.2 Cross Travel Motion	37	9				
10.3 Noise or Unusual sounds	25	21				
10.4 Vibration	13	33				
10.5 Siren			22	11	15	
10.6 Visibility condition	26	20				
10.7 Brake Condition			12	26	8	
10.8 Emergency stop						
10.9 Rail Alignment	27	19				
10.10 Buffers condition		15	11	9	11	
10.11 Mechanical Stopper	12	27			7	
10.12 Stopping distances with stopper.	29	17				
10.13 Rail track clearance	39	7				
<b>11.0 FIRST AID, FIRE AND EMERGENCY PREPAREDNESS</b>						
11.1 First aid kit		7	14		25	
11.2 Emergency phone numbers chart		32	5		9	
11.3 Condition of Emergency Exits	29	17				
11.4 Fire Extinguisher at vulnerable location			23	12	11	
<b>12.0 OTHER GENERAL CONDITIONS</b>						
12.1 Housekeeping nearby crane	11	35				
12.2 Guards to all moving equipments	8	22			16	
12.3 Operator's Personal protective equipment	36	4		6		
12.4 Rated Capacity marked			27		19	
12.5 Safe load indicator			13	7	8	
12.6 Warning and safety levels			24		22	
<b>Name of Surveyor :</b>						
<b>Signature :</b>						

## RECOMMENDATIONS

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.

Some efficient ways to prevent and control hazards are

1. Regularly and thoroughly maintain of electrical, mechanical equipments.
2. Ensure that hazard correction procedures are in place and thoroughly inspections are performed periodically
3. Ensure that everyone knows how to use and maintain personal protective equipment, lifting gears, and emergency related equipments.
4. Make sure that everyone understands and follows safe work procedures
5. Ensure that, when needed, there is a medical program tailored to your organization to help prevent workplace hazards and exposures
6. Workers should be educated, and training should be provided time to time regarding the particular work and if there is any modification take place.
7. In future when new lifting machinery are installed in industry lever should be ergonomically designed and effectiveness of safety devices to be improved.
8. One more consideration also taken in to account that is the length of the pendent wire should be appropriate level of height of the operator which helps to improve the ergonomically conditions.
9. Periodically inspection as well as the load testing must be carried out of lifting machinery to check the stability and physical conditions of lifting machinery.
10. Changing of operator from one crane to another should be avoided as much as possible.
11. Proper direction marking to be maintained by permanent marking or painting on pendent or remote once in a week by which difficulty is reduced.
12. Daily checklist to be filled by operator's which helps to other shift operator's to assist the crane problem if any. Preventive maintenance to be carried out once in 15 days interval in which limit switches and brakes are must be operationally checked.
13. The position of the wire of pendent also adjusts it usually front at the chest of the operator's.
14. Other means of safety devices which are not electrical are recommended likes buffer and stoppers at the end of the Cross Travel and Long Travel motion and wheel guards for anti two blocking marking to be done by some means by which the last position of hoist is marked so that the operator's knows about the limitations.
15. Load testing must be carried out once in a year of crane, welded joints of crane structure must be checked by NDT methods.
16. Change the position of operator's from one crane to another must be avoided, simplify control buttons of remotes related to another by which the machinery is easily operate To overcome this, it was recommended that the crane operators should be placed into Three different groups (A, B, C ) must always be operated by the associated group of operators and they must not be interchanged.

## 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 cranes.

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