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Identification of Occupational Work Place Hazards and Evaluation of Risk for Overhanging Lifting Equipment using Real-World Operations

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Abstract: *The important noticeable objects on any occupational work place sites and a status of upgraded operations, cranes possess the capacity of lifting heavy loads and maneuvering the loads over long spans. When properly located on a site, cranes can strategically lift and lower loads to virtually any desired location on a site. Unfortunately, when large numbers of cranes have been dispatched to an Industrial site, the hazard exposure also increases for workers who work with, around or under these cranes. As the part of this dissertation hazard identification will carried out with the help of checklist and different mathematical methodology with respect to various lifting machines and their control measures will also be given in this work, to reduce the number of Accidents and improved safe work conditions in industry for using this engineering tool this is the objective of this project work. The Second objective of this study was to examine the descriptions of accidents related to Lifting machines and other serious factors and then identify the direct causes and contributing factors of these accidents..*

Keywords: Occupational work Place, Hazard Identification, Risk Evaluation, Lifting operations, Lifting equipment's, Fault Tree Analysis, Mathematical concept, Practical approaches, Hazard and Risk calculation with Check list etc

I. INTRODUCTION

Every Manufacturing organization or Construction companybelieves that there is no task which is more important than workmen's health and safety. In case of any job that represents a potential safety or health threat, every effort should be made to plan a better way to complete the task in asafer manner. Every procedure must be a safe procedure. Shortcuts in safe procedures by management and all the otherassociates should not be tolerated. If a worker observes any unsafe or unprotected exposure, which may pose a potential threat to their safety and health, he or she must inform the management immediately. At any workplace there are physical, chemical, biological, psychosocial, electrical, mechanical and traffic hazards. Then there are common hazards in terms of falls from heights, falls into a depth, slips, trips and falls; manual handling and exposure to hazardous substances [1].

In addition to these, there are identifiable hazards like a body part striking against, being struck by, making harmful contact with an object, caught in, on, by or between objects, slip, trip or fall, abrasion from any object, reaction toany chemicals, strains from pushing, pulling, lifting, bendingor twisting etc.

Fig. 1: Safety Measures and Analysis Module [1]

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Methods Directional Hazard Identification and Analysis

Various methods used in industries for safety of their workersincludes several given parameters [2]

- Job safety management planning tool
- Planning safe execution of work
- Improving work efficiency and effectiveness
- Provision of information communication
- An accident prevention tool
- Identification of inherent hazards associated with aspecific task or group of tasks
- Eliminating or mitigating hazards
- Stipulating controls, precautions and safe-guards
- Defining potential hazards
- Creating a plan – 'Safe System of Work'
- Minimizing risks the workforce will actually face
- Coordinating and controlling potential high riskactivities
- Communication of hazards and controls – to the peopleactually doing the work
- Avoiding injuries and or damage, interruptions toprocess/operation.

Lifting Equipment's in Industries

Lifting equipment includes any equipment and machinery used at work for lifting or lowering loads or people, including accessories and attachments used for anchoring, fixing or supporting the equipment [4]. There is awide range of lifting equipment in the industry. Typicalexamples are:

A hoist: is a device used for lifting or lowering a load bymeans of a drum or lift-wheel around which rope or chainwraps. It may be manually operated, electrically or pneumatically driven and may use chain, fibre or wire rope as its lifting medium.

- A crane: is a type of machine, generally equipped with ahoist, wire ropes or chains, and sheaves, that can be used to lift and lower heavy materials and to move them horizontally.
- A tower crane: is a balance crane that consists of thesame basic parts. Fixed to the ground on a concrete slab, tower cranes offer height and high lifting capacity. The base is then attached to the mast whichgives the crane its height. The mast is attached to theslewing unit (gear and motor) that allows the crane to rotate.
- Telescopic crane: has a boom that consists of a number of tubes fitted one inside the other. A powered mechanism extends or retracts the tubes to increase or decrease the total length of the boom. These types of booms are highly adaptable, are oftentruck mounted and used for short term projects.
- A Portable and Overhanging crane: is a cable- controlled crane mounted on crawlers or rubber- tired carriers or a hydraulic-powered crane with a telescoping boom mounted on truck-type carriers or as self-propelled models. They are designed to easily transport to a site and use with different typesof load and cargo with little or no setup or assembly.
- All terrain cranes: is a Portable and overhanging, truck mounted crane with the necessary equipment to travel at speed on public roads, and on rough terrain at the job site using all-wheel and crab steering.
- A crawler crane: is a crane mounted on an undercarriage with a set of tracks (also called crawlers) that provide stability and mobility. They need little set-up and can travel with a load but are very heavy and cannot easily be moved from one jobsite to another.

Hazards of Using Lifting Equipment's

The Hazards: associated with the use of lifting equipment in various industries are:

- Hazards related to the loads, e.g. crushing due to impact of moving objects or loads falling from vehicles becausethey are not slinged properly or the wrong type of slingswere used

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- Hazards from moving vehicles, i.e. cranes falling over because of improper fixation or strong wind, unsafe loads, loads exceeding the safe weight limits, trapping/crushing risk in the use of MEWPs while working at height, falling from height , limbs or bodies caught in machinery
- Falling from lifting platforms or being crushed when theplatform moves
- Hazards related to force exertions, poor workingpostures and/or repetitive work
- Hazards related to poor environment that may interfere with communication between workers or concentration needed for the task (noise) or cause sweaty, slippery objects (heat, poor ventilation)
- Contact with overhead electrical cables.

II. LITERATURE REVIEW

Vinay Dubey el.al [15] lifting machineries are widely used inmanufacturing 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 thatis bridge cranes, semi gantry cranes, gantry cranes. Devdatt PPurohit et.al [16] in industrial arena, if any industry to be successful, it has to be safe, reliable, and sustainable in its operations. M. C. Carlos et.al [17] The aim of the present study was to investigate human health risks on the job tasks of heavy equipment operators and determine a significant relationship between age, work experience and average daily working hours on the frequency of reported musculoskeletal injuries of the operators. P. Eraiyanbu et.al [18] HazardIdentification and Risk Assessment (HIRA) is a safety tool used in most automotive industries to identify the hazards andassess the risks in the plant. Vishwas H S et.al [19] the construction industry has the largest number of injuries compared to other industries. Thus, reducing accidents and determining construction risks are extremely important.

III. SYSTEM DOMAIN

The industry look out and, started the services from the year in 2020, and have since then established massive goodwill and reputation in the market by regularly supplying products of international quality to our numerous respected clients [26].

Fig. 2: Industries look out. [26]

Constantly molding ourselves according to the changing service environment, and have cemented the service in the market as a prominent installation, Supplier and Exporter of a wide range of product.

The Industries India Limited's Annual General Meeting (AGM) was last held periodically and as per records from Ministry of Corporate Affairs (MCA).

IV. SYSTEM DOMAIN

The term "accident" can be defined as an unplanned event that interrupts the completion of an activity, and that may (or maynot) include injury or property damage. An incident usually refers to an unexpected event that did not cause injury or damage this time but had the potential. "Near miss" or "dangerous occurrences" are also terms for an event that could have caused harm but did not. Reasons for workplace accident investigation are [28]:

- most importantly to find out the cause of accidents andto prevent similar accidents in the future

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- to fulfill the legal requirement
- to determine the cost of an accident
- to determine compliance with applicable safety regulations
- to process workers' compensation claims

In industry various types of lifting operations are performed so that they contained special Lifting machinery for the special types of lifting operations in which these are the most widely used lifting equipment, to accomplish a goalof management.

- Electric Overhead Travelling Crane or Heavy LiftingCrane
- Gantry Cranes
- Semi Gantry Cranes
- Portable and Overhanging Hydra Crane
- Fork Lifts.

Fig. 3: Electric Overhead Travelling Crane or Heavy LiftingCrane [30]

V. PROBLEM IDENTIFICATIONS

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 complexand dynamic work environments that present new hazards toworkers on a daily, or even hourly, basis. As a result of the complicated and constantly changing nature of liftingoperations, the manufacturing industry has very high injury and fatality rates compared to other industries.

Cause	Incidents	Deaths	Injuries
Crane collapses	26	22	54
Overhead power line contacts	10	8	8
Struck by incidents	18*	12	13
Highway incidents	3	0	3
Caught in/between	3	2	2
Falls	2	0	3
Struck by lightning	1	0	3
Total	**63**	**44**	**87**

Table 1: Parametric Analysis of Crane Accident and theireffects [40]

A. Major Hazards and Risk Related to Cranes

The following are the major hazards are present in craneswhich are used in the system [41].

1. Insufficient knowledge of the crane could lead to damageor serious injury.

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2. Sudden discharge of loads.
3. Contact with pinch points
4. Use of defective tools and tackles.
5. Incorrect operation of control levers could lead to harmor serious injury.
6. Broken or defected signage can lead to the non-observance of warning signs.
7. Poor visibility or adverse climate conditions.
8. Electrocution and fire from overhead conductors.
9. Poor communication could result in damage or seriousinjury to personnel or plant.
10. Fire from oil, electrical, material and overheating.
11. Spillage's due to poor housekeeping.
12. Fall from height man or material.
13. Unintentional damage or injury from overloads.
14. Miss-operation of the safe load indicator, leading todamage or injury.
15. Collision, damage or injury due to unclear working zone,or with other crane on the same route.
16. Boom deflections, which increase the radius and can, lead to overload or tipping resulting in damage or injury.
17. Fatigue or injury resulting from poor ergonomics.
18. Collision or damage resulting from a swinging load.
19. Injury or damage resulting from exceeding the safe working parameters.
20. Disablement of safety devices or excessive load on the configuration being used could result in injury, tipping orrolling.
21. Damage or injury resulting from dropping the load, unstable load or overloading the plant.
22. Collisions and crushing with people under the load whilstwinching or slewing.
23. Damage or entanglement of rope during operations.
24. Power failure or brake failure of lifting machines couldresult in damage or injury.
25. Danger of crushing or collision when travelling.
26. Collision or damage with other objects.
27. Lack of training and education of operators.
28. Ergonomically condition and psychological conditions are the main causes of hazards in any organization.
29. Severe injuries may be caused by shearing, cropping, trimming and guillotine machines, unless the dangerous parts are securely guarded

VI. METHODOLOGY ADOPTED

The Company evaluation says that with the help of Preliminary Hazard Analysis so many problems observed in various companies. In these analysis observed that maximum accidents are occur due to wrong Rigging, wrong lifting operations, Lack of knowledge about Lifting Tools and Tackles and less communication between each other's. In Companies Lifting failures can occur with the use of cranes and similar lifting machines many failures arise as a result ofincorrect methods or use of slinging equipment which include:

- Slinging operatives not trained or competent
- Slings and other lifting tackle not maintained andtherefore not fit for purpose
- Lifting equipment misused or incorrectly used
- Poor knowledge of the load characteristics

A. Analysis of Various Accidental Data

- Webbing sling snapped and load fell down on the controlpanel of rolling machine causing property damage: -
- Improper rigging practice for shifting plate: -
- Slipping of Horizontal lifting Clamp: -

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Observe the following precautions when operating a Portableand Overhanging Cranes crane: -

- Do not leave a crane unattended even for a short time, unless all loads have been removed, lowered to the ground or the engine shut down and brakes applied.
- Do not operate a crane beyond 35 KMPH wind speed that may put the load or personnel at risk. Always use the cranes load rating charts for guidance, these have wind and weather factors built into them.
- Faulty slings shall be tagged for destruction with an "Outof Service" Tag and returned to store as scrap material.
- Discard any wire rope used on a crane, when the visiblenumber of broken wires in any length of rope diameter exceeds 5% of the total number of wires in the wire rope.
- Check that there are no loose objects on a load that couldfall during lifting.
- All Portable and Overhanging cranes fitted with outriggers shall have the outriggers during lifting operation.
- No slewing of these cranes is to take place unless outriggers are fully extended and in place.
- Do not use the crane to drag the load along the ground; this may result in severe overloading.
- The work area, equivalent to that of the extended jib, should be barricaded to ensure un-authorized personnel do not enter the area.
- A signalman shall walk alongside a load using tag lines attached to the load, slung from a crane while the load isbeing transported form one area to another.
- Use tag lines to prevent loads from turning or swaying while the crane is in motion of lifting a load.
- Avoid sudden braking and fast hoisting, bluffing and slewing
- Do not under any circumstances, use a crane to lift a load over personnel, or allow anyone to ride the load.
- Keep personnel well clear of the suspended loads.
- The crane shall only be operated minimum 6 M away from live electrical lines or away from safe arching zone whichever is higher

VII. CALCULATION AND MONITOR

The facilities will maintain a register of all the lifting equipment on the facility. Each item must be given a site identification number and the description should include the following information:

1. Location
2. Area
3. Unique identification number
4. SWL or WLL
5. Test certificate details
6. Dates of last and next thorough examination
7. Quarantine / defect report number

Operator:	Mr. XYZ		
Comp.	XYZ India LTD.		
Crane type:	Portable and Overhanging Crane		
Model:	145E68RHG:1689045:OC		
Location:	India		
Unit no.:	Base Unit - I		
Date:	xx/xx/xxxx		
Shift:	Shift - I		
	I – PRE START-UP WALK-AROUND	OK	NO
1.	Cab–glass/doors/2ndexit	□	□
2.	Steps/ladder – secure/clean	□	□
3.	Wheels & tires – rims/lug nuts/tire condition/ inflation	□	□
4.	Boom – angle indicator/jib/condition	□	□
	Main/auxiliary hoist(s) –		

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5.	hook/attachment/block/sheaves/ wire rope	□	□
6.	Hydraulics –cylinders/hosing/pins/fittings/fluid level	□	□
7.	Turntable – ring & pinion condition	□	□
8.	Engine – fluids/belts/hoses/leaks/debris	□	□
9.	Battery/batteries – secure/electrolyte level/ connections clean & tight	□	□
10.	Counterweight–secure/condition	□	□
11.	Drum(s) – condition/line spooled properly	□	□
12.	Air(brake)tanks –condition/waterdrained/ petcock closed	□	□
13.	Outriggers/stabilizers – condition/leaks	□	□
14.	Lights/strobes – condition	□	□
15.	Warning decals – in place/ condition/ legible	□	□
2 – INTERIOR CAB CHECKS		OK	NO
1.	Housekeeping	□	□
2.	Fire extinguisher	□	□
3.	Manufacturer's operating manual	□	□
4.	Log book	□	□
5.	Inspection Certificate	□	□
6.	External Certification	□	□
7.	Load charts/range diagrams	□	□
8.	Level indicator	□	□
9.	Seat belt	□	□
3 – START-UP		OK	NO
1.	Instrumentation – warning	□	□
2.	Oil Pressure	□	□
3.	Air (brake) pressure	□	□
4.	Coolant temperature	□	□
5.	Battery charge rate/level	□	□
6.	Fuel level	□	□
7.	Noises – engine sounds normal	□	□
8.	Lights	□	□
9.	Horn	□	□
10.	Accessories – wipers/heater/fan/radio	□	□
11.	LMI – functions/calibrated properly	□	□
12.	House lock-pin – disengaged (asapplicable)	□	□
13.	Other:		
4 - FUNCTION CHECKS			
1.	Boom – lift/lower/extend/retract	□	□
2.	Hoist(s) – raise/lower	□	□
3.	Turntable swing	□	□
4.	Outriggers/stabilizers	□	□
5.	Steering	□	□
6.	Transmission – gear & direction	□	□
7.	Selector	□	□
8.	Other:		

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9.	Comments		
10.	Operator Name & Sign:		

Table 2: Portable and Overhanging Crane Daily Check List (HAZID)

VIII. CONCLUSION

In industries where the Overhanging cranes are installed hazards related to them can only be eliminated or prevented by the proper safety management in which techniques are available to identify hazards related to lifting machinery and its operation which we used in this project work that is questionnaire study and checklist methodology by checklist method we go through inspection depending upon the checkpoints and questionnaire study by which we can evaluate the effectiveness of present safety and health related program.

Identification of hazardous condition (which results fatal injury or incidents results to death of workers) and their control measure is given by these methodology. There are lots of hazard are present in any organization in which workers are surroundings, safety and health programs are must be emphasis on the prevention and elimination of hazards. Hazards Prevention and evaluation work related accidents and diseases must be goal of management of organization, there are many types of hazard present in workplace or regarding the particular machinery such as physical, electrical, ergonomically, psychological, fire etc. due to lack of training, maintenance and ineffective safety management programmers and negligence of safety rules by workers work-related injury and fatal accidents continue to be serious problems in all over the world, HAZID, checklist method Table 7.2 and questionnaire study used in industry to overcome these problem.

By these techniques we can easily identify the hazards in any organization, there analysis and performed evaluation of safety and health program and their preventive measures also be taken.

Checklist inspection is one of the most useful techniques in safety management to identify the hazards related to particular job or machinery in which we can thoroughly inspected the physical conditions regarding workplace or machinery with the help of data which we obtained by checklist method recommendations can be given to eliminate the hazard.

From checklist survey we find the observations and physical condition which may leads to hazardous condition of Overhanging crane because checklist had following advantages: -

1) It easy to apply the overall principle of this method is simple it's used to compare and identify list wise condition whether it's safe or unsafe.

2) It also can be performed by inexperienced person.

3) It is a point to point survey so that no data can be remaining to check.

4) This is the qualitative method, but observations are also used for quantitative assessment.

5) It is also be used for determine underlying causes of hazards. The outcome of effective training program and questionnaire study also will impact the workers nature by which we can improved the workers efficiency and mental thinking condition related to work place.

Hazards identification of lifting machinery have been done with the help of questionnaire study and checklist inspection and control measure on the basis of these two methodology have been given.

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