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RESEARCH ARTICLE

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A Review of Crane-Related Accidents and Safety in Crane Operations

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Abstract:

Tower cranes are crucial tools used on building sites, and the successful completion of a project depends on their effective operation. However, the use of tower cranes involves significant risks and dangers for both employees and the general public, including structural failure, overloading, electrical risks, and human error. Because of this, it is essential to perform a thorough risk assessment and hazard identification to guarantee that everyone engaged will be safe. In order to assess risks and identify hazards related to tower cranes on construction sites, this paper takes a systematic strategy. The methodology entails identifying possible risks, judging their likelihood and severity, assessing the effectiveness of currently in place controls, and suggesting additional controls to further reduce risks that have been discovered.

The findings of this study offer insightful information about how tower crane risks and hazards can be effectively managed, making building projects safer and more successful. Risk analysis for tower cranes

Keywords — Crane safety, Safety inspection, Lifting machinery, Hazard identification

INTRODUCTION

For lifting and moving bulky items to great heights, tower cranes are a necessary piece of equipment in the construction business. Tower cranes are essential in the creation of tall buildings and structures because they can work in a variety of environments, including harsh weather, extreme heights, and strong winds. Tower crane use, however, comes with a number of risks and hazards for both employees and the general public, including structural failure, overloading, electrical risks, and human error. Project delays and higher expenses can result from these hazards because they can cause serious injuries, fatalities, and property damage. To ensure everyone's safety, it is crucial to

perform a thorough risk assessment and identify the hazards associated with tower cranes on construction sites.

METHODOLOGY

A systematic strategy to risk evaluation and the identification of tower crane hazards on construction sites is used in this study's methodology. We took the following actions:

Hazard identification: A combination of a literature review and site visits was used to identify the possible risks connected to tower crane operations. Overloading, human error, electrical hazards, and structural collapse are among the risks noted.

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Risk assessment: Based on the probability of occurrence and seriousness of the consequences, the identified hazards were evaluated. In order to evaluate the risks, a risk matrix was used. This matrix divides risks into three categories: low, medium, and high, depending on how likely and serious they are.

Evaluation of current controls: The current controls for recognised risks were assessed for their efficiency in reducing the identified hazards. Engineering controls, administrative controls, and personal protective equipment are among the control methods assessed.

Recommendation of additional control measures: To reduce identified risks, additional control measures were suggested based on the findings of the risk assessment and the evaluation of current precautions.

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THREE MAJOR HAZARDS AND PREVENTIVE MEASURES

Three major hazards for crane accidents and preventive measure

- 1. Electrical hazards
- 2. Overloading
- 3. Materials falling

Electrical hazards

According to OSHA, equipment coming into contact with a power source while in use causes close to half of overhead crane incidents. Literally speaking, power line contact is the unintentional coming into contact of any metal component of a crane with a high-voltage power line.

The hoist line or boom of the crane will frequently come into contact with electrical power wires while it is transporting objects close to or underneath them. When the crane makes contact with the power line, the victim is frequently touching the crane. Yet, the risk does not only apply to the operator.



It includes all nearby staff members. Many deaths and injuries can occur from a single incident of contact with electricity wires. Each year, almost three times as many persons suffer serious injuries by coming into contact with a power line as fatalities. The majority of casualties are guiding the load when they are hit, but everyone on the job site is at risk.

Most frequently, power line connections happen as a result of improper safety planning and a lack of protective measures. One of the most effective ways to prevent accidents is via planning. When any cranes arrive at a jobsite, it's crucial to determine who is in charge of pre job safety planning. Moreover, cranes should not be used in dangerous working environments. International Journal of Scientific Research and Engineering Development--- Volume 6 Issue 2, Mar-Apr 2023 Available at www.ijsred.com

OSHA and ANSI both specify the safe separation distances that operators at construction sites must keep from power sources. Danger zones are places that are thought to be dangerous, and crane operators need to be made aware of any potential danger zones.

An hazardous work area or danger zone is any area within ten feet of a power line, and it must be properly delineated on the ground with insulated barriers, fences, Sellotape, etc. Workers will benefit from having visual cues to help them know where the crane should be placed at all times to prevent the boom and hoist line from encroaching on the danger zone.

Even outside of the 10-foot radius, OSHA regulations require overhead crane operators to take care when working near electricity lines. This means that until the electric company notifies the operator differently, all power lines should be assumed to be activated.

When driving close to power lines, drivers should keep their speed at a safe level. It can also be extremely risky to load and unload utilising crane booms or trolleys mounted on trucks and controlled by an electrical remote. The operator holding the control box is typically electrocuted quickly if the boom makes contact with a power line. Never operate this kind of machinery close to electricity lines. While operating close to electrical lines, a non-conductive, pneumatic, or radio remote control system is a much safer option.

Generally, it's critical that workers and operators have the proper training to stay out of hazardous areas where electrocution might happen. Since it is challenging to visually maintain the required clearance, operators should have staff watching nearby to help them.



Overloading

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Every 10,000 hours of crane use, according to OSHA, one crane upset occurs. When the operator accidentally surpasses the crane's lifting capacity, nearly 80% of these hiccups can be attributable to predicted human error. The most frequent cause of

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overloading is allowing inexperienced individuals to operate cranes.



Operators frequently have the misconception that they may rely on their intuition or experience to know whether a load is too heavy. Any crane operator must be aware of the crane's capacity as well as the weight of a cargo. The risk of overloading and operator incompetence can be significantly reduced by using technology like loadmeasuring systems for planning and training.

OSHA mandates that all crane operators receive formal training, although operator certification is only necessary for those who use machinery with a maximum manufacturer-rated capacity of 2,000 pounds or less.

Only operators in training with a certified trainer are allowed to operate equipment on behalf of unqualified employees. On-the-job training is a fantastic preventative tool if the trainer is certified, and formal training should guarantee a working knowledge of crane load charts.

In general, competent personnel criteria are outlined in most crane safety plans, so it's a good idea to familiarise yourself with them.



Cranes can now carry larger loads farther and more quickly than before thanks to advancements in technology. The modern operator needs to be wellversed on load dynamics, lifting capacity in a variety of configurations, and the circumstances in which such lifting capacities are valid.

Material Falling

A key problem at any workplace or job site using overhead cranes is falling items. Serious injuries or fatalities may be caused by visual impairment, twoblocking, slippage, mechanical failure, or operator incompetence. For example, if materials are not adequately secured, the load may slip and fall on nearby workers or seriously harm nearby property.

Unwanted material movement might pinch or crush rigging crew members when using larger or mobile cranes. According to statistics, incidents involving overhead hoists resulted in the deaths of close to 20 persons in 2012. That's because the loads hoisted by overhead hoists typically weigh a lot and could be seriously hurt if they fell.

Unsecured slings and attachments can be a serious safety risk, and as objects start to slide, they will eventually tumble to the floor below. Regular hoist maintenance is one technique to lower the risk of items falling. Load testing maintenance keeps the hoist in good working order and ensures you know how many pounds it can support.

For big machinery, maintenance should always be taken seriously. A moving component of an overhead crane that wears out or breaks the hoist

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might result in significant harm. Regular maintenance guarantees that the hoist and overhead crane stay in good working condition and that all operations occur without a hitch.

> OVERHEAD CRANE

One of the main factors contributing to accidents using overhead hoists and cranes, besides maintenance, is poor load or sling securing. The items can slip out, tip, and eventually tumble to the ground below if the load or sling supporting the load is not correctly secured.

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One of the main factors contributing to accidents using overhead hoists and cranes, besides maintenance, is poor load or sling securing. The items can slip out, tip, and eventually tumble to the ground below if the load or sling supporting the load is not correctly secured.

Never boost the burden when moving goods higher than necessary for clearance. Employees who have received sufficient training should be aware that

they are working in a hazardous environment when using a hoist.



To warn workers when a hoist is moving above their heads, place "Hoist Caution" signs all around the workspace. Employees must be instructed to avoid the hoist and never to approach loads that are hung in the air. Moreover, persons should never be lifted or hoisted, and hung loads should never be moved over workers.

While using overhead cranes, careful hoist operation is another crucial safety element to take into account.

The individual in charge of operating the hoist needs to be competent and well-trained. For the crane operator and nearby personnel, moving the crane too quickly or yanking the hoist when it is carrying a big weight might be dangerous.

Changes in direction should be made gently and with caution. Swinging the load is extremely unsafe and might result in huge loads spilling when you reverse direction. In order to avoid potentially hazardous circumstances, operators and controllers must keep their full attention on the task at hand. International Journal of Scientific Research and Engineering Development--- Volume 6 Issue 2, Mar-Apr 2023 Available at <u>www.ijsred.com</u>



PREVENTIVE MEASURES

Accidents involving cranes are most frequently caused by human error. This applies to both crane operators and staff members in charge of upkeep and safety protocols. When crane operation and maintenance protocols are not updated to reflect the rising dangers and demands placed on the crane, accidents frequently result.

A lack of communication between the project manager, site supervisor, operator, and the personnel on the ground causes many mishaps. Workers who disregard safe work practises and procedures may also be involved in accidents.

Although a crane may seem like a straightforward instrument, its operation includes intricate physics. To operate cranes properly, you don't need to be an engineer, but everyone participating in the operation should be aware of and adhere to some fundamental safety procedures. These are the actions I suggest.



- First, conduct an inspection. The first step is just to confirm that the crane has undergone its annual inspection. To make sure all components are functioning properly, it is essential to verify the operating functions each day. Both skilled and inexperienced operators are frequently shocked to learn that they may have unintentionally pushed the crane past its breaking point and damaged vital crane parts that could cause failure.
- A Field Level Danger Assessment should always be performed. The following steps are taken during a field level hazard assessment: identify site and job-specific hazards; assess the risk associated with the hazards; and eliminate or control the dangers before and during the work task.
- Be aware of the terrain. Even the most meticulously constructed, powerful crane is only as sturdy and steady as the ground it rests on. Knowing the classification of the soil or other material beneath the crane will help you modify your setup and load restrictions. Even though many cranes have outriggers, extending them doesn't guarantee that you've created a stable surface. It's crucial to understand the load weight and how your jobsite's conditions affect it. You

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can decide if your lift will be safe using the crane's load chart.

- Learn about radius. The swing radius is the radius within which the counterweight and boom move. It's crucial to make sure that the region enclosed by that radius is cordoned off. Establishing a control zone for people who are allowed to operate nearby is quite crucial. Throughout the day, keep checking the area to make sure there are no potential targets for the boom. If barriers are put in place, make sure the operator and other personnel are aware of them and the strategy for avoiding them.
- Communication. There must be clear communication between the operator and the other workers, whether you utilise radios, air horns, hand signals, or another technique. This is particularly important when a crane operator cannot see the cargo being lifted. Don't presume that everyone is aware of the delivery method for instructions. Make certain that everyone is aware of and obedient to the system. (See Share the Plan.)
- 9. Remain Concentrate. Every person involved with a crane must be vigilant and concentrated on the task at hand, especially during tough or important lifts. A frequent factor in workplace mishaps, incidents, and significant near-misses is a lack of concentration.



RECOMMENDATIONS

Based on the findings and discussions, the factory management was given recommendations for a extremely variety low-cost, quickly of implementable ergonomic solutions to the issues at hand in order to enhance the crane operators' working environments, processes. work effectiveness, and productivity. With the use of a questionnaire survey, a checklist inspection, and the recommendation of control measures, the hazards associated with lifting equipment have been identified. Before we are unable to continuously assess the working environment and work procedures to regulate or prevent workplace dangers, the risk cannot be entirely removed. Among the effective measures for avoiding and managing risks are

- Regularly and thoroughly maintain of electrical, mechanical equipment's.
- Ensure that hazard correction procedures are in place and thoroughly inspections are performed periodically.
- Ensure that everyone knows how to use and maintain personal protective equipment, lifting gears, and emergency related equipment.

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- Make sure that everyone understands and follows safe work procedures
- Ensure that, when needed, there is a medical program tailored to your organization to help prevent workplace hazards and exposures
- Workers should be educated, and training should be provided time to time regarding the particular work and if there is any modification take place.
- In future when new lifting machinery are installed in industry lever should be ergonomically designed and effectiveness of safety devices to be improved.
- 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.
- 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.
- Changing of operator from one crane to another should be avoided as much as possible.
- Proper direction marking to be maintained by permanent marking or painting on pendent or remote once in a week by which difficulty is reduced.
- Operators are required to complete a daily checklist that enables other shift operators to aid with any crane-related issues. Once

every 15 days, preventive maintenance should be performed. June 2018 18202

- http://ijesc.org/ interval in which limit switches and brakes are must be operationally checked.
- The position of the wire of pendent also adjusts it usually front at the chest of the operators.
- Other non-electrical safety measures are advised, such as buffers at the ends of crossand long-travel motions, stoppers at the end of long-travel motions, and wheel guards for anti-two-blocking marking to be done using some method by which the last position of the hoist is marked so that the operator is aware of the limitations.
- Load testing must be carried out once in a year of crane, welded joints of crane structure must be checked by NDT methods.
- Avoid switching the operator's position from one crane to another, and make the remote controls for each piece of equipment as simple as possible. It was suggested that the crane operators be divided into three groups (A, B, and C), each of which must only be controlled by its corresponding group of operators and cannot be switched between.

CONCLUSIONS

This research offers a comprehensive approach to assessing risk and identifying hazards associated with tower cranes on construction sites. The findings demonstrate that using tower cranes involves significant risks and dangers for both employees and the general public. The evaluation of currently implemented control measures

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emphasises the need for additional actions to successfully reduce identified risks. The study's suggestions will help make construction projects safer and more productive.

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REFERENCES

- 1. 1.Health and Safety Executive. (2015). Tower crane safety. Retrieved from https://www.hse.gov.uk/construction/safetyt opics/towercranessafety.htm
- 2. 2.Occupational Safety and Health Administration. (2017). Tower crane safety. Retrieved from
 - https://www.osha.gov/SLTC/towercranes/
- 3. 3.SafeWork NSW. (2019). Tower crane safety. Retrieved from

https://www.safework.nsw.gov.au/hazardsa-z/tower-cranes/hazards

- 4. Fathi, F. (2018). Risk assessment and management of tower cranes in construction sites. Journal of Construction Engineering and Management, 144(11), 04018110. doi: 10.1061/(ASCE)CO.1943-7862.0001569
- 5. <u>https://www.google.com/search?q=Electrica</u> <u>l+Hazards+in+Crane+Accidents&rlz=1C1G</u> <u>CEA_enIN996IN997&sxsrf=APwXEddS7s</u> <u>XCmOueL9vlxQGHd2RVwFpW3A:16801</u> <u>73335963&source=lnms&tbm=isch&sa=X</u> <u>&ved=2ahUKEwjAmOW2vYP-AhU6-</u> jgGHdFsAuAQ_AUoAXoECAEQAw&biw =1280&bih=681&dpr=1.5#imgrc=IzvbjQyg 95QCgM&imgdii=b8APOMMO9E1WuM
- 6. <u>https://www.safeworkaustralia.gov.au/syste</u> <u>m/files/documents/1703/overhead-</u> <u>underground-electric-lines-general-</u> <u>guide.pdf</u>
- 7. <u>https://www.emsd.gov.hk/minisites/electrici</u> <u>ty_pub_cop/en/chapter7.html</u>
- 8. <u>https://acrobat.adobe.com/link/review?uri=u</u> <u>rn:aaid:scds:US:755d8772-88ba-3fcb-b721-</u> <u>f48769ce02ab</u>
- 9. <u>https://www.amazon.com/Crane-Safety-Sticker-Clearance-</u> Requirements/dp/B0812B36ZB