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Analysis of Safety Management for Truck Cranes on Construction Sites

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Abstract: *At present, with the rapid development of the national economy, the construction industry still accounts for a large part of the national economy. However, in recent years, the safety management situation of mobile cranes is still grim, and the level of safety supervision still needs to be improved. This paper analyzes the difficult problems in the application of Mobile crane in the construction site project department, obtains the problems in four aspects of people, materials, environment and management, and takes a project headquarters as an example to propose targeted measures suitable for the safety management of mobile crane in the construction site, in order to provide reference and basis for similar projects.*

Keywords: *Truck Crane; Safety Management; Factors; Measure*

1. Introduction

In recent years, with the commencement of housing construction and infrastructure projects, China's urbanization speed has been continuously accelerating. As an important way to reduce labor force and improve production efficiency on construction sites, construction lifting machinery and equipment have become increasingly widely used and frequently operated, thus becoming increasingly important. Especially for mobile automotive lifting machinery, it is highly favored by construction sites due to its simple operation and ease of movement. However, based on recent data, there are still significant weaknesses in the safety management of truck cranes. According to the Notice of the State Administration for Market Regulation on the Safety Status of National Special Equipment in 2022, there will be 108 special equipment accidents and related accidents in 2022, with 101 deaths. Among them, there will be 25 crane accidents, with 23 deaths. The number of accidents is 23%, and the number of deaths accounts for 22.8%[1]. It can be seen that the safety management situation of mobile cranes is still severe, and the level of safety supervision still needs to be improved.

Due to certain safety issues that may occur during the lifting process, such as improper operation and lack of management, it may lead to lifting safety accidents. Therefore, the main purpose of this survey is to enhance the safety management ability of large machinery and equipment, improve the overall level of lifting operations, reduce safety accidents during the lifting process of large lifting machinery, timely identify safety hazards during the lifting process, develop the best handling measures for safety risks and hazards, and avoid casualties and economic losses caused by safety accidents.

2. Current situation and problems

2.1 Personnel management

Through literature review and analysis of crane accident reports, it can be seen that some enterprises in China have reduced their organizational structure, compressed their staffing, and neglected mechanical equipment management during the restructuring process, resulting in incomplete mechanical equipment management teams and even the cancellation of equipment management organizations and personnel[2]. This has led to a sharp decrease in professional technical personnel, weak management capabilities, and inability to exercise management functions normally, resulting in management disconnection. Ultimately, it resulted in the inability to efficiently manage large mechanical equipment. In addition, although some enterprises have established corresponding management systems, they are not entirely scientific and reasonable, do not have strict management processes, and do not pay attention to management work. In

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addition, the implementation process is too flexible and cannot achieve great results, ultimately leading to the inability to ensure the safe operation of large mechanical equipment.

2.2 Equipment defects

Mainly manifested in two aspects: firstly, there are defects in the lifting machinery equipment when leaving the factory. There are a large number of manufacturers producing construction lifting machinery and equipment in China. Although these manufacturers all have production qualifications, the quality of construction lifting machinery and equipment on the market is currently uneven due to their own production level. Especially in recent years, due to the impact of the large economic environment, many small-scale production enterprises have achieved the goal of reducing costs and selling prices by reducing product performance, in order to gain market competitiveness[3]. At the same time, construction enterprises or equipment leasing companies often choose low priced construction and lifting machinery equipment to reduce capital investment or reduce business risks, This has also led to many construction site lifting machinery and equipment having low safety performance at the beginning, and some even have safety hazards. The second is the safety hazards generated during use. The construction lifting machinery and equipment themselves do not belong to construction enterprises, and their enthusiasm for equipment maintenance and upkeep will be greatly reduced. Most construction enterprises completely rely on equipment rental enterprises for equipment maintenance and upkeep, and even do not have specialized departments or personnel. However, equipment rental enterprises cannot pay real-time attention to equipment usage and only provide regular on-site maintenance and upkeep, Therefore, it is not possible to detect safety hazards of the equipment in a timely manner; At the same time, due to the high cost of purchasing equipment for equipment rental enterprises, there may be situations where they are aware that the equipment has many serious problems and are unwilling to eliminate them in advance. Some even conceal the rental even after the equipment has reached its service life. The continued service of these old and even expired equipment is actually a serious safety hazard.

2.3 Environmental factor

Mainly reflected in the environmental impact of the use of lifting machinery and equipment. Especially for sections with poor road conditions such as muddy roads, unstable roadbed, and external power overhead lines, failure to timely place steel plates and sleepers during lifting operations can easily cause overturning of lifting equipment; At the same time, due to limited space, when the crane legs cannot be fully opened, there are also situations of illegal overloading, causing the lifting equipment to roll over[4].

2.4 Management deficiencies

Mainly manifested in three aspects: first, the pre and post management of large mechanical equipment[5]. It mainly refers to the selection of equipment, the compilation and review of plans, and the management of equipment entry and exit. Some enterprises unilaterally consider economic benefits and neglect the basic conditions for large mechanical equipment configuration to meet project construction needs and safe operation; The lack of professional and technical personnel has led to a mere formality in the preparation and review of equipment foundation plans and installation and dismantling plans, resulting in problems where the plans themselves do not meet the conditions for safe use or do not follow the plans based on experience during implementation, laying hidden dangers for the safe operation of large mechanical equipment; Lack of effective management of equipment entry and exit, and failure to timely organize relevant technical personnel for safety acceptance before entry and acceptance during use; Secondly, there is a lack of professional management personnel and special operations personnel, and some of their qualities are not high. In recent years, the level of technical and vocational education has been imbalanced, resulting in poor quality of construction machinery professionals and a serious lack of senior professional technicians. Some enterprises hire equipment management personnel who are frontline workers or other management personnel from non related majors. In actual work, they often rely on traditional management ideas and concepts or narrow personal experience to participate in management, resulting in low quality of equipment management personnel and weak maintenance capabilities, Unable to adapt to the needs of safe use; In addition, there is a lack of special operation personnel, and the training organized by the construction administrative department for special operation personnel cannot meet market demand. Illegal individuals produce and sell fake certificates, disrupting the market environment, leading to the repeated prohibition of holding fake certificates or certificates that do not match; The third issue is the inadequate investigation and management of safety hazards in

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mechanical equipment. Enterprises implement project management, and some projects only focus on seizing construction progress and emphasizing economic benefits, without conducting daily or special inspections[6-7]. They only use equipment and do not promptly detect and propose rectification actions regardless of maintenance, resulting in mechanical operation with defects and illegal operations, causing economic losses to the enterprise, and even leading to mechanical equipment accidents.

3. Measures and suggestions

3.1 Improve the management mechanism of mechanical equipment

Scientifically and reasonably define the responsibilities of all levels of management organizations related to cranes within the enterprise, making them responsible for inspection, coordination, and management of cranes[8]. Establish a three-level management system, establish a hierarchical responsibility mechanism for the command center, project department, and equipment leasing unit, adhere to hierarchical management, and achieve division of labor based on the principle of each performing their respective duties. However, a series of relevant units must reasonably allocate professional management personnel in accordance with relevant national and industry regulations. For example, the signal company suggests that all construction teams be uniformly allocated by the project department according to on-site construction needs, ensuring direct personnel management and strengthening control efforts. This can effectively establish a scientific management network, ensure the effective implementation of national and local laws and regulations, and even the rules and regulations of enterprises in the management process, establish a technically strong professional equipment management team, and better meet the relevant needs of the development of lifting machinery equipment.

3.2 Strengthen the management of the working environment

After the truck crane enters the site, a trial lifting work should be carried out and a record of the trial lifting of the truck crane should be filled out. The model, license plate, number, and trial lifting environment of the truck crane should be clearly stated in the record. Should the format and content of the trial lifting record form of the truck crane be uniformly defined by the command center to achieve uniformity in on-site management of each section[9].

Is the daily inspection of the truck crane before operation carried out by the truck crane driver or by the signal engineer? How does the project department verify that the crane has been inspected before lifting, and what is the content of the inspection. It is recommended that the truck crane driver conduct daily inspections before the daily operation of the truck crane, including the basic condition of the truck crane (whether the level gauge is effective, whether the tire height from the ground meets the requirements, whether the sleeper steel plate is laid flat), the deployment of the truck crane legs, the status of steel wire ropes and hooks, etc.,[10] and establish a dedicated truck crane lifting operation group for the project department, The driver of the truck crane will send the daily inspection photos and information to the group, which will be reviewed by the safety management personnel of the command center. The safety management personnel of the project and operation team will inspect the working environment on site, and once the requirements are met, the lifting operation can begin.

Safety measures for truck crane operation: A lifting warning area should be set up during truck crane operation, and unrelated personnel are prohibited from entering this area. Should the area be uniformly set up, and should colored ribbons and lifting operation warning signs, fences, triangular cones, etc. be used? Should standardization be achieved? It is recommended that the command center unify the standards. Is it necessary to arrange full-time safety officers to supervise on-site truck crane operations? According to Order No. 37 of the Ministry of Housing and Urban Rural Development, it is required to designate a dedicated person for on-site supervision of dangerous lifting projects. Other management regulations do not specify the need for on-site supervision and the position of on-site personnel for routine lifting. It is recommended that the project's dedicated safety officer conduct a pre operation safety environment survey and include the management personnel of the operation team in the on-site supervision personnel system.

3.3 Strengthen the entire process safety management of truck cranes

(1) Strengthen the management of truck cranes entering the site.

Clarify the acceptance process and system for truck cranes upon entry. It is recommended to establish a sound pre entry declaration system. The property rights unit of the truck crane shall provide the

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construction unit with the entry declaration materials 3 days before entering the site. The construction unit shall review the entry declaration materials and submit them to the supervision unit for approval and report to the headquarters for filing.

The materials that need to be provided before the truck crane enters the site need to be clearly defined. For example, it is necessary to provide product certification, operator's operation certificate, ID card, driver's license, driving license, insurance policy, inspection and testing report, etc. The headquarters will develop a material list template to guide the entry declaration work of truck cranes for each construction unit; At the same time, the service life of truck cranes should be clearly defined, and truck cranes exceeding 8 years are prohibited from entering the site.

The acceptance procedures for the entry of truck cranes need to be clear, and the acceptance unit needs to be clear, whether it is to be accepted by the construction unit itself or jointly by the construction unit and the supervision unit. The acceptance participants need to be clear, and the acceptance content needs to be clear, whether it is to accept simple mechanical safety facilities, lifting devices, or conduct deeper inspection and acceptance work. It is recommended that the command center determine the truck crane acceptance list, agree on the acceptance content of truck cranes for each construction team, making on-site truck crane acceptance more standardized and reasonable.

Suggestion for numbering management of truck cranes: Truck cranes need to adopt specialized numbering management similar to various mechanical equipment, and the use of truck crane numbering should be consistent with the equipment coding rules of each project department.

There is a high demand for truck cranes in on-site construction operations and the usage period of truck cranes is uncertain. In order to make the rental and entry work of truck cranes by construction units faster and more convenient, it is recommended that each construction unit can fix several truck crane rental units, register the truck cranes that meet the needs of each unit, and collect relevant materials to enter the project database (offline ledger), When needed, you can directly contact the leasing unit and go through an on-site acceptance process before putting it into use, effectively solving the problem of emergency use of truck cranes and slow entry application review. Of course, this method only applies to emergency and short-term truck cranes. If a long-term rental truck crane enters the site, it is recommended to adopt the procedure of declaration before acceptance.

Considering the actual management problems on the site, there are many truck cranes entering the site with high mobility, which is not conducive to the entry and management of the security guard system. Therefore, the medium and long-term rental truck cranes can be entered into the security guard system. Other truck cranes can be managed in the form of offline registration. All cranes will be issued with crane access certificates in the unified form of the headquarters (jointly sealed by the supervision unit and the construction unit).

Regarding the consideration of re entry of mobile mobile mobile cranes on site, is it necessary to reapply for acceptance after the cranes have been used and retired? In response to this consideration, it is recommended to combine the content of recommendation 4 to extract short-term mobile cranes from the backup warehouse of the project. Considering the actual management on site, it is recommended to establish an access system, by issuing an admission certificate to distinguish such truck cranes, when temporary truck cranes are needed, they can enter the site with the admission certificate and can only be put into use after passing the on-site temporary acceptance, greatly optimizing the management difficulty. In addition, does the temporary use of truck cranes require the withdrawal of access permits? If the access permit is withdrawn, the linkage of various sections will encounter difficulties. For example, if the crane that originally passed the acceptance of section 3 withdraws the access permit, when the crane goes to work in other sections, other sections cannot know that the crane originally passed the acceptance of section 3, so they need to go through the normal acceptance process before use. It is recommended that when the crane is used and exits the site, the access certificate does not need to be retrieved and should be kept by the crane itself. If it is lost, it needs to be reissued. When the driver of the same crane changes, it is necessary to verify the validity of the driver's ID on site and receive education.

Due to the fact that the construction units in our department are not far apart, there may be a phenomenon where several construction units have the same license plate of truck cranes in their databases. Can the command center consider optimizing the temporary crane entry process? For example, when it is found that temporary cranes have been used in other sections and hold access permits for other sections, there is no need for routine acceptance procedures. Simply conduct on-site inspection and acceptance, this can avoid unnecessary work by various construction units, and is convenient and fast. However, the premise is that the command center needs to clarify the acceptance standards of each construction unit, otherwise it may encounter inconsistent acceptance standards from each construction unit, resulting in

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unqualified equipment entering the site.

Suggestions for the content of the temporary truck crane access certificate, which should include the model, license plate number, production time, and testing time of the truck crane. It is recommended that the command center clarify the format and content of the access certificate, which should be printed by each construction unit. However, if the form of "One Pass" (one access certificate can be used for multiple bid sections) is adopted, a dedicated access certificate management department or personnel should be established, otherwise management confusion may occur.

Suggestions on Prohibiting the Use of Truck mounted Cranes. Considering the actual situation on site, it will greatly increase the difficulty for equipment transfer and the use of truck cranes to lift small components such as conduits, steel plates, and materials. Due to uncertain factors such as the time required to lift small components on site, the use of truck cranes may lead to delays. If the use of truck mounted cranes is prohibited, there may be frequent instances of excavators and forklifts transporting components on site, which indirectly increases the danger of the site. Therefore, can the command center introduce relevant management measures for the use of truck mounted cranes? As truck mounted cranes are commonly used for temporary transportation, they can refer to the relevant management regulations and designated methods for temporary truck mounted cranes.

(2) Increase the management of professional technical personnel and special operation personnel for truck cranes.

Each truck crane must be equipped with dedicated signal riggers for operation. In theory, there should be several signal riggers for each truck crane. In special circumstances, two signal riggers are required, such as inside and outside the foundation pit and up and down scaffolding. But from the perspective of on-site management, can the construction site coordinate the time period of on-site lifting operations, plan the allocation of riggers, and ensure that riggers and truck cranes are used together for each lifting operation.

The training arrangement for truck crane operations can be divided into on-site education, daily pre shift education, and regular monthly safety education and training (long-term leased equipment). The relevant education is uniformly organized and arranged by the project department.

Truck crane operations must hold a lifting approval certificate. How to ensure that the lifting approval certificates of each truck crane are not used falsely or mixed. So the lifting approval certificate needs to specify the model, license plate, lifting time and location, crane driver, signal operator, and so on of the crane. In addition, if the truck crane requires mobile operations, the lifting location should be specifically specified to avoid situations where the lifting order specifies different locations.

(3) Strengthen safety inspections.

The inspection work arrangement for lifting operations is as follows: Before the daily operation of the truck crane, the truck crane driver conducts a pre operation inspection. What is the frequency of other inspection work except for the pre operation inspection of the truck crane? It is recommended that each project department conduct a special inspection of the truck crane operation every half month, which includes equipment information of the truck crane, basic condition of the truck crane Whether the lifting operation meets the project regulations and whether there are any violations. In addition to the semi monthly special inspection work, attention should also be paid to the lifting operation during the monthly safety inspection.

The maintenance and upkeep work arrangement of the truck crane, who is responsible for the maintenance and upkeep of the truck crane, and it is recommended that the daily maintenance and upkeep of the truck crane be carried out by the truck crane driver. The project department provides the maintenance and upkeep record form to the truck crane driver, and the maintenance and upkeep cycle is one month or refer to the use and upkeep book. The maintenance content includes cleaning, lubrication, inspection, etc., and maintenance records should be filled out.

4. Summary and Reflection

Thinking and summarizing the research on the use of truck cranes, after conducting research on the use of truck cranes in this section, I have come up with the idea of standardizing the use of truck cranes throughout the entire line, including standardization of truck crane entry declaration, standardization of truck crane on-site management, and standardization of truck crane maintenance. The main reason for this idea is that our sections are very close and the number of truck crane rental units is limited. There is a high

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degree of overlap in the use of truck cranes. If the usage procedures of truck cranes in each bid section are different, it will have an impact on the leasing party of the truck crane and all of us, greatly reducing our work efficiency, like doing useless work. If the standards for each bid section are unified, a warehouse for the use of truck cranes is established, and the truck cranes are all in one card, so that the truck cranes in the warehouse can be used at any time. This optimizes the acceptance process for truck cranes, reduces labor costs, and greatly improves work efficiency. Of course, there are still many obstacles to implementing this idea. The high mobility of truck cranes in this management model may lead to greater arbitrariness of truck cranes, how to allocate joint safety management responsibilities for multiple sections, and how to solve the ownership and cost issues of truck cranes. But under the unified leadership of the command center, and after strict discussion by all parties, I believe these issues can be effectively resolved. Of course, these are just some of my personal ideas. The headquarters can evaluate the feasibility of this idea to see if it is suitable for our project, and if so, make a decision.

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