Crane Accidents at Construction Sites in Malaysia

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Abstract. Construction of high-rise buildings, large-scale apartment blocks, or construction in urban areas demands increasingly greater use of cranes. In the construction industry, the use of crane is common and very important regardless of the size of the project. Cranes generally use cable and pulley to deliver a mechanical advantage when it is necessary to lift heavy loads. They have the potential to move materials of different sizes that play an extraordinarily important role in the construction site. The crane operator is responsible for controlling the crane effectively and follow the safety guidelines. Life loss, injury, and property damage are the implications that will occur if the crane maintenance specifications and operations are not correctly practiced. As the result of crane accident happened every year, this paper seeks to identify the causes of crane accident at construction sites in Malaysia. With the aim that has been stated, this paper summarizes statistic and causes of crane accident of most cited papers. Thus, the causes that lead to accident from previous researcher will be highlighted. Outcomes from the study demonstrate that operational and technical problem are the major causes of crane accidents at construction site in Malaysia. Exploration of this paper will help the construction industry specially in crane monitoring for a better safety performance and regulation at all construction projects.

1. Introduction
The construction industry has an important role in the development of the economy. Although the construction industry is not the main sector that contributes to economic growth, it is actually act as a catalyst to other sectors of the economy such as education, finance, manufacturing, and others. This means that the construction industry can be represented as one type of economic engine in a country. The global construction activities are increasing nowadays and it has become a dangerous situation when there is no supervision by the authorities on safety management. This scenario will create unhealthy site management and a dangerous workplace. Over 2.78 million deaths every year caused by occupational accidents [1]. It is prevalent in several nations to hear about tragic accidents or construction incidents that lead to injury, death or disease to employees and members of the general public [2].

Construction workers use a lot of heavy machinery in their work. Earthmoving and carrying machinery used for various soil and material handling tasks are essential assets in the construction site. The use of cranes in the construction site globally is very prevalent. The use of cranes in all kinds of the building has improved the productivity level of building projects. The crane is primarily responsible for lifting moving and carrying construction materials and arranging heavy components in
each area of the construction [3]. The cranes have a heavy counterweight for stabilizing the position and can be classified into the following categories: mobile cranes and static cranes [4]. Since 2000, the world's crane accident has resulted in 1125 cases and 780 fatality losses [5]. Government agencies such as the Construction Industry Development Board (CIDB), the Department of Safety and Health (DOSH), and the National Institute of Occupational Safety and Health Malaysia (NIOSH) and many others have implemented various safety policies to strengthen crane safety practices [6]. Department of Occupational Safety and Health Malaysia (DOSH) showed that every year accident that causes by crane operation happened. According to Figure 1, the number of accidents at the construction site increased to 77% between 2015 and 2018 [7].

![Accident at Construction Sites](image)

Figure 1. Accident at construction sites from 2015 until 2018 [7]

On the 2nd of January 2018, a foreign worker was killed while three others were seriously injured after they struck by a component from falling crane in Section 7 Shah Alam [8]. A statement issued by DOSH pointed out the reason behind death to the failure in the structure of the crane. Based on this scenario, it can be assumed that a solution to crane accidents is still unsatisfactory; crane injuries are still happening and the number of accidents and death rates have increased. These are several issues involved with the crane operation at the construction site in Malaysia. Crane accidents might be categorized as technical accidents for instance mechanical failure, crane overturn and loss of momentum which would trigger more loss of liability. The crane accident effect will lead to an increase in maintenance, improvement and internal cost of reconstruction. Construction projects which require cranes as heavy machinery need to be handled efficiently and carefully.

Generally, the crane consists of various types and mechanisms of each type and shape are depending on their use. Cranes can be categorized on the basis of their application and specifications. Mostly, the crane classified into three major categories: mobile cranes, tower cranes and crawler cranes [9].

2. Crane Accidents in Malaysia

Department of Occupational Safety and Health Malaysia (DOSH) showed that every year has an accident that causes by crane operation. The main effect of crane accidents is improper lifting, which causes injuries, loss of time and assets every year DOSH [10]. Based on Figure 2, the highest past 4 years non-permanent disability and permanent disability due to the accidents in the construction site was recorded in 2015 with 138 victims and 11 victims respectively. Furthermore, the statistic in 2018 showed a high rate of death with 118 deaths in a year. Discrepancies of data gathered from SOSCO
and DOSH was due to companies involved in accident tend to avoid making report on the accident to DOSH in order to achieve zero-rating of Loss Time Injury (LTI) and to avoid accident investigation [11]. Nonetheless, they had to report to SOSCO for claim purposes. Hence in this case, data from SOCSO might represent the real numbers of accidents at construction site in Malaysia. Figure 3 indicates the decreasing number of crane accidents from 2015 to 2018. In this scenario, it indicates that the decreasing number of crane accidents because of DOSH have taken precaution steps to reduce the number of crane accident. There are several precautions steps by DOSH such as construction firm should provide a qualification worker to supervise the operation of the crane, the digital form of crane operator skill’s certificates should be upgraded and accessed through a smartphone device and improve the guideline of crane operation that have been developed since 2015 [12]. Then, DOSH also develop OSH Masterplan 2016 - 2020 to reduce the number of crane accidents [13]. Next, Figure 4 shows that a tower crane is the main type of crane with accident involvement in 7 cases followed by mobile crane and others. The majority of tower crane accidents happen due to the unavailability of a regular platform to support the crane foundation during the crane assembly [14]. Generally, the tower crane is one of the most important machinery systems often used to build multi-story buildings with larger construction areas.

Every year crane accidents happened because of crane operator or crane failure [4]. These accidents are not only terrible human tragedies, but also huge economic losses. The significant cause of the accident is referred with the industry's unique nature, human behaviour, poor safety management and difficult working environments resulting in unsafe work procedures and equipment [15]. DOSH [16] stated that the main contractor must comply with all the Occupational Safety and Health Act (1994), and the Factories and Machinery Act (1967) during the construction project to ensure the safety of workers and the workplace.

| Year | Non Permanent Disability | Permanent Disability | Death |
|------|--------------------------|----------------------|-------|
| 2015 | 138                      | 11                   | 88    |
| 2016 | 126                      | 5                    | 91    |
| 2017 | 123                      | 6                    | 111   |
| 2018 | 106                      | 8                    | 118   |

**Figure 2.** Statistic of non-permanent disability, permanent disability, and death at a construction site [10].
3. Causes of Crane Accident at Construction Sites

According to the findings in Table 1, the combination causes of crane accidents at construction sites among the previous researcher show that operational and technical are the major causes that lead to crane failure and accident in a construction site followed by safety management, human and environment. For operational and technical, the elements that contribute to an accident is from the structure and mechanical failure of the crane component. Since they have been in use for a long time, all the crane components, such as wires, bolts and certain other parts, are not regularly maintained. In the present application, apart from the connection of the crane to the concrete platform, such as the required anchorage members were not used in the profiles fixing the crane's footings to the ground.
Table 1. Combination Causes of Cranes Accident at Construction Site among the previous researcher.

| Group          | Causes of Crane Accident at Construction Sites | References | Freq. |
|----------------|-----------------------------------------------|------------|-------|
|                |                                               | [9]        | [14]  | [15]  | [17]  | [18]  | [19]  | [20]  | [21]  |       |
| Human          | Poor communication                           | √          |        |       |       |       |       |       |       | 3     |
|                | Work in an unintended mode                   | √          |        |       |       |       |       |       |       | 3     |
|                | Operator’s carelessness                      | √          |       |       |       |       |       |       |       | 3     |
|                | Poor work supervision                        | √          |       | √      |       |       |       |       |       | 4     |
|                | Obstruction of Vision                        | √          |       |       |       |       |       |       |       | 2     |
| Environment    | Hazardous weather condition                  | √          |        |       |       |       |       |       |       | 4     |
|                | Confident/ tight working Environment         | √          |       |       |       |       |       |       |       | 3     |
| Safety         | Appropriate training by the crane            | √          |       |       |       |       |       |       |       | 2     |
| Management     | Not regularly inspection of the crane        | √          |       |       |       |       |       |       |       | 4     |
|                | Delayed or inadequate inspection of the components (diagnosis); | √          |       |       |       |       |       |       |       | 4     |
|                | Not performing the preventive maintenance on the crane | √          |       |       |       |       |       |       |       | 5     |
|                | Noncompliance with the safety measures stated in the permit while performing work on the cranes | √          |       |       |       |       |       |       |       | 4     |
|                | Contents of a technical device in a faulty condition | √          |       |       |       |       |       |       |       | 2     |
|                | The crane operated by unqualified and un-certified personnel | √          |       |       |       |       |       |       |       | 4     |
|                | Other violations requirements of safety rules | √          |       |       |       |       |       |       |       | 2     |
| Operational and Technical | The failure of the tracks and buffer of the crane stops | √          |       |       |       |       |       |       |       | 5     |
|                | Electrical appliances fail                    | √          |       |       |       |       |       |       |       | 5     |
|                | Failure of loading ropes, motorized lifting systems, and adjustable lifting devices; | √          |       |       |       |       |       |       |       | 5     |
|                | The load is lifted in an inclined position   | √          |       |       |       |       |       |       |       | 5     |
|                | Tower crane platform not adequately installed (foundation failure) | √          |       |       |       |       |       |       |       | 6     |
|                | The crane foundation was not fixed by the anchorage members | √          |       |       |       |       |       |       |       | 6     |
|                | Unused of connection between the crane and the structure of the building | √          |       |       |       |       |       |       |       | 6     |
|                | Extreme load at the end crane arm            | √          |       |       |       |       |       |       |       | 6     |
|                | Use of components that do not fulfill the required technical specifications | √          |       |       |       |       |       |       |       | 5     |
The most severe negligence in the accident is the lifting of the excessive load at the end of the crane, which was higher than the load required by a code of practice. The missing load of code practices requirement could cause the loss of the operator life, even if he had authorized license and professional experience to operate the crane [14]. On the other hand, less investigation of ground conditions can cause a failure of the tower crane foundation [22]. Safety management is the second major cause of crane accidents because of less preventive maintenance on the crane and the crane operated by non-competent person. In Malaysia, from 2018-2019, around 500 crane operators unregistered and not have a competence license and operate the tower crane, as required by DOSH. [23]. Meanwhile, human errors that lead to crane accidents are due to inadequate work supervision and weak communication between crane operators and site foreman. The operator may have handed incorrect control commands which might have been implemented differently from the intended commands [24]. On the other hand, hazardous and weather conditions also become one of the environment causes that contribute to crane accidents. This problem was due to the crane operator's low visibility and will make it difficult for lifting operations [25].

4. Conclusion
This paper presents a variety of causes of a crane accident at construction sites. Ultimately, recognizing the causes of accidents will enhance general safety at construction sites. The results may assist in improving safety performance related to cranes operations and developing more effective regulations.

5. References

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