

# CHAPTER 1

## INTRODUCTION

### 1.1 Crane: Overview

Cranes are widely used in transportation and construction. A crane is a lifting machine, generally equipped with a winder (wire rope drum), wire rope or chains and sheaves that can be used both to lift and lower material and to move them horizontally. Cranes are one of the most important elements of the global economy. They are used to perform important and challenging manipulation tasks such as construction of bridges, dams, buildings, and high-rise towers. Crane operation carries with it a greater potential for disaster than nearly any other activity on a construction project. Moving large, heavy load and material is crucial in manufacturing and construction industries that cannot be handling by human. Therefore, a crane has been invented in order to move loads beyond the normal capability of a human. The basic usage of the crane is to lift, move or place the load. Cranes pose significant safety issues to be considered, crane accidents are often the most costly construction accidents. The most important thing to ensure when operating the crane is to maintain a clear view of path to make sure no one is harmed. All the workers that involved in crane operation must understand their jobs, responsibilities and their part for the safety purpose.

Cranes are indispensable in commerce, as they load and unload ship cargo at every port. Energy exploration and production are also highly dependent on cranes; they are used on oil platforms, in refineries, and nuclear power plants. There are many cases and incident regarding on the crane incident. In April 1993, the crane becomes unbalanced

during two separated incidents at DOE sites in United State of America, which is in Hanford Sites and Bryan Mound Site. For the first accidents happened in 28<sup>th</sup> April 1993, where a crane becomes unbalanced while the boom was being lowered and two day later in 30<sup>th</sup> April 1993, which crane loading the load, the weight of the load caused the crane to trip forward.

There are many cases and incident regarding on the crane's accidents. In July 2007, a worker at Nucor Steel Corp's Marion, Ohio, facility was killed after being yanked into a crane. He had been suspended in a harness 30-40ft above the ground while working on the mill's air conditioning system. The harness reportedly became tangled in the cranes shaft causing the man to be pulled into the crane. Furthermore, In February 2008, at AK Steel Corp. Coshocton, Ohio, the worker, David Wemtz was killed while performing maintenance work. He was crushed by a steel coil that was being lowered by a gantry crane. In March 2008, a crane operator, Jason Lee Blackman, fell 40ft to his death at Gerdau Ameristeel Corp's Jackson, Tennessee, facility. Reportedly he had been on a platform about to board the crane during a shift change when the crane failed to come to a complete stop, as it is required to do when a worker board the crane.

In May 2008, Russell Payne, a millwright at Arcelor Mittal USA's Burns Harbor, Indiana, facility died when he was caught between two steel beams and crushed. The crane caught one beam and dragged it to another. Reportedly the crane operator had thought that Payne had moved out of the area, and attempted to put the crane back in place via remote control. Relate to this accident, effective controller need to be applied into the crane system to meet safety requirement and smooth operation. Unfortunately, OSHA's standards do not address many of the advancements in hoisting technology or equipment used in construction today since they have not been updated since 1971 and relies heavily on outdated 1968 American National Standards Institute (ANSI) consensus standard.

Crane and rigging management are responsible for getting the job done safely. Whether consciously applied or not, risk control is embedded in the methods employed

by successful managers. On the other hand, by identifying the problems and implementing specific remedies. Risk categories where affirmative steps can be taken include pressure from cost or time constraints, inexperienced management, lack of training or skill, inadequate planning, unreasonable demands of management, environmental conditions, unclear instructions, operator errors and changed circumstances. An analysis of accidents reveals that the majority are the result of more than one contributing cause. Crane safety and productivity are intimately associated, but not in the sense often assumed to gain productivity it is necessary to sacrifice safety.

In case of the load swing, there were not only may causing an accident, but also will resulting in direct loss, the cost of which is realized by lost performance. Furthermore, it will cause a damage to material that been handled. At this moment, most of the cranes are being controlled manually. The crane will be operated by the crane operator, who is responsible for moving the load so that the cart of the crane arrives at the desired spot as soon as possible, under the limitation that only a very limited overshoot of the load in a horizontal direction is allowed. For a well-qualified crane operator, which has rich of experiences, this will not cause a big problem to them. But, it is better if the operation of the crane can be done automatically, which can reduce the possibilities that may occurs, sometimes because of the human's mistakes or careless. So that, moving a suspended load is a challenging task, especially when strict specification on the swing-angle and on the transfer time are needed to be simultaneously satisfied. Regarding on this problem, in order to find the best solution, this research has come with a new ideas related on this area, which is to develop an input shaping and PID controller to controlling the crane in order to reduce the swing.

The main purpose of controlling a crane system is transporting the load as fast as possible without causing any excessive sway to move the load from its initial position to its desired final destination in the working space along a trajectory, avoiding obstacles and sway.

## **1.2 Types of cranes**