Knowledge E
Engaging minds

Conference Paper

Risks Control for Launching Gantry Activity Assembly at Kapten Tendean Flyover Project (Seskoal Package)

Alfina Hapsari[1], Dadan Erwandi[1], and Abdul Farid Syam[2]

[1]Occupational Health and Safety Department, Faculty of Public Health, Universitas Indonesia, Jl. Margonda Raya, Beji, Pondok Cina, Kota Depok, Jawa Barat 16424, Indonesia
[2]Persatuan Alumni Kesehatan Masyarakat Indonesia (PERSAKMI)

Abstract

Currently, the Province Government of DKI Jakarta is focusing on implementing mass transportation development, part of which is the Kapten Tendean flyover project (Seskoal Package). The construction of the Kapten Tendean flyover (Seskoal Package) uses a segmental method of girder box with a span-by-span system, in which a girder box is lifted using heavy equipment called a launching gantry. A launching gantry is a piece of heavy equipment located above the overpass structure. The function of the tool is to transport heavy objects such as box girders onto the overpass construction project. In assembly activity, the launching gantry has the potential for many accidents such as accident at the time of appointment, workers falling from a high altitude, and rolling gantry rolled. This study aims to determine the potential hazards and risks to occupational safety and health in the activity of assembling the launching gantry tool above the pier head. This research was observational, with a cross-sectional study design. The author conducted interviews with the equipment bureau of PT. ABC, which is the executing company of Kapten Tendean flyover construction. The results of this research are hazard identification, risk assessment, and risk control on assembly activity of the launching gantry tool, which, when done by JSA (Job Safety Analysis) and HIRARC (Hazard Identification, Risk Assessment, Risk Control) methods, arrived at various risk levels at all stages of assembly. The conclusion that can be drawn is that in the assembly of gantry launching tools there is extreme risk, including the risk to heavy equipment operators who can experience fatigue and fall from a height, the movement of heavy equipment that could endanger the workers and facilities around the project, and the risk of both equipment components (supporting chairs, launching girder, and winch) and the launching of the installed gantry being overturned. Suggestions can be given to ensure that all launching gantry assembly is planned and executed in accordance with safe working procedures.

Corresponding Author:
Dadan Erwandi
dadan@ui.ac.id

Received: 15 May 2018
Accepted: 3 June 2018
Published: 19 June 2018

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICOHS 2017 Conference Committee.

Keywords: risks control, launching gantry

1. Introduction

Currently, the Jakarta Government is focusing on the development of mass transportation systems. One of them is Kapten Tendean Flyover Project (Seskoal Package), which is located along the Ciledug highway— a typical four-lane and two-way street—and is being constructed using a segmental box girder method with a span-by-span system, in which the box girder is lifted using heavy equipment called a launching gantry, which is placed on the flyover structure.

A box girder is one of the overpass bridge segments and a form of girder development itself. The girder is the bridge structure that connects the bottom structure and serves as a support for the plate above it. The use of pieces of heavy equipment that are constantly used in construction activities means that the implementation of safety measures becomes very important. This is evidenced by the frequent occurrence of accidents during operation. Loads fall from the heavy equipment, causing severe hazards to nearby operators and workers. The assembly of the launching gantry also has the potential for accidents, such as workers falling from significant heights and the launching gantry rolling.

This study aims to determine the potential hazard and risk to occupational safety and health in the assembling of a launching gantry—a piece of heavy machinery that uses a winch to transport very heavy objects, like box girders—on the pier head. The launching gantry used for Kapten Tendean Flyover Project will be installed on the pier head P55 and P56. The gantry launch tool has large enough dimensions that it takes a significant amount of space to both store and assemble it. In addition, the land used must be able to accommodate as many as two tools crawler cranes with a capacity of 200 tons, which are needed to lift components of the launching gantry to the top of the pier head.

2. Methods

This research uses a descriptive observational method with cross-sectional study design. The study was conducted from January 2016 to March 2016, while data was taken from March to April 2016.

Data collection was completed via in-depth interviews using datasheets with the management of the equipment bureau of PT. ABC, the contractor of Kapten Tendean Flyover Project. In addition to in-depth interviews, observation using an observation

sheet of the launching gantry was also utilized. Interviews and observations are used to support the results of recent literature studies.

Data obtained through observation and in-depth interviews are used as primary data for the identification of hazards, at which point the next step will be to conduct risk assessments, then to make an assessment for risk control, and to conduct an assessment for residual risk.

The data obtained will be analyzed descriptively, then the results will be presented in tables, narration descriptions, and images.

3. Results

Hazard identification, risk assessment, and risk control on assembly activities of the launching gantry apparatus are performed using JSA and HIRARC methods, which in this discussion will only explain the most extreme levels of risk and control. This technique makes it easier to examine the dangers at each step of the assembly work of the launching gantry, then look for danger control so that the danger can be controlled early, thereby mitigating the possibility of accidents. For the resume can be viewed on JSA and HIRARC. Launching gantry assembling protocols are attached at the end of this article.

To fulfill OHSAS 18001: 2007 clause 4.3.1 'risk identification, risk assessment and risk control' [1], hazard identification, risk assessment and risk control activities are carried out within the existing work operations within a company.

The researcher did an initial review of the quality plan of the launching gantry assembly [2] to determine the steps of assembly for the launching gantry. Besides based on quality plan, the researcher also conducted a review on the work steps of the launching gantry [3]. Based on the results of interviews with the equipment division of PT. ABC and a document review of the quality plan for assembling the launching gantry [2] and the method statement of erection for the launching gantry [3], it is known the steps of launching gantry assembly are:

1. Surveying and stacking out

   Survey and stacking out is done to determine the placement location of the gantry launching tool when it is transported to the project location.

2. Traffic management

The existence of assembly activity of the gantry launching tool will impact the network around the project location in the form of decreasing traffic performance, which often results in traffic jams. Therefore, careful planning is required to determine the location of the assembly of gantry launching devices in order to minimize risk to both workers and motorists.

3. Utility relocation

In order for the erection process to run smoothly, the electric utility must be relocated first so that the process of erection does not endanger the operator. Electrical utility relocation is done by moving the utility pole located on the area to be used as the assembly site.

4. Launching gantry

The launching gantry has a section called a launching girder, which consists of 12 segments (as shown in Figure 1). The launch of the girder consists of three parts, including the front truss (F1, F2, F3), main girder (M1, M2, M3, M4, M5, M6), and tail truss (T1, T2, T3). The process of assembling (assembly) the launcher gantry tool will be done both under the pier head (above ground) and above the pier head.

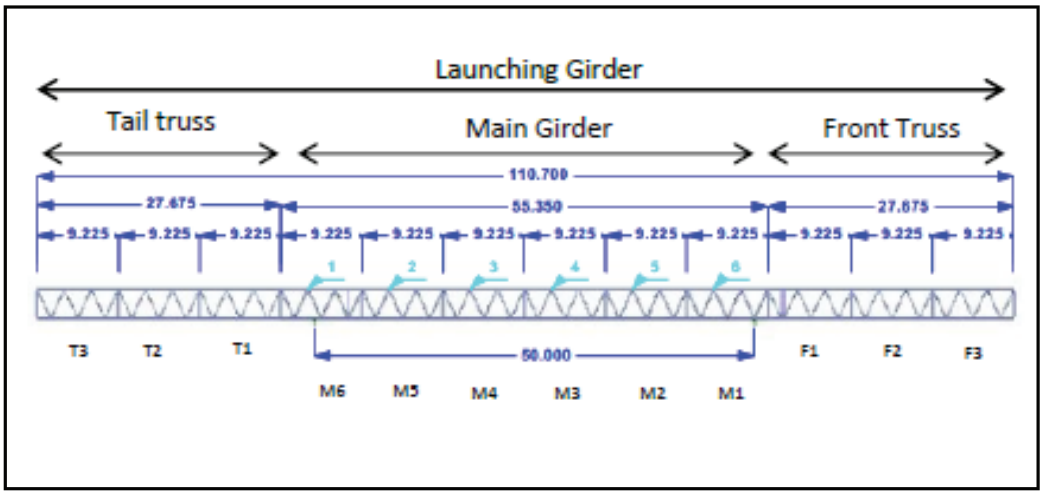

Figure 1: Launching girder.

5. Bench beam installation

The bench beam is a supporting chair with a 450-ton jack. The bench beam serves as a foothold in the tool launching gantry. It will be mounted on top of the pier head by using a crawler crane.

6. Pedestal installation

   The steel pedestal is a supporting chair with a 350-ton jack. It serves as a foothold and support on the launching girder. Once the bench beam is attached to the pier head, the pedestal is placed on the bench beam. The pedestal will be installed on the south side first then mounted on the north side.

7. Sliding chair installation

   The sliding chair is a supporting chair with a 60-ton jack. The sliding chair serves as a support on the launching girder while moving forward (longitudinally). It is mounted on the pedestal by first installing it on the south side then on the north side.

8. Main girder M2-M6 installation

   After all segments play the girder attached, the erection process continues via the appointment of main girder segment M2-M6 to the top of the sliding chairs using two heavy crawler 200-ton cranes. The erection process is completed by installing the main girder on the south side first to facilitate the installation of main girder south side at a later stage.

9. Segment M1-T1 installation

   Deploying M1 and T1 segments is different from the previous M2-M6 segments. M1 and T1 segments are assembled at a high altitude and are directly incorporated into pre-installed M2 and M6 segments above sliding chairs with PT bars φ 32 mm.

10. Segment F1 and T2 installation

    F1 and T2 segments, just like segments M1 and T1 before, are directly assembled at altitude, united with the segment that had been previously installed on top of the sliding chairs assembled by PT bars φ 32 mm.

11. Segment F2 and T3 installation

    F2 and T3 segments will be assembled at altitude, directly united to the segment that was installed previously on top of sliding chairs put together by PT bars φ 32 mm.

12. Segment F3 installation

The F3 segment will be assembled at altitude, directly united to the segment that was installed previously on top of sliding chairs put together by PT bars φ 32 mm.

13. Front leg and rear installation

    The front leg and rear leg components serve as a temporary foothold when the supporting chairs are moving forward. The front leg will be installed at altitude, on the components of the launching girder that have already been installed.

    The front and rear benches are mounted on the south side to balance the launching gantry and will perform the role of launching the erection box girder by using span-by-span method.

14. Winch installation

    Installation of two winch holder items with 50-ton Safe Working Load, component winch, 150 kva generator set, and 50-ton hook on main girder launching gantry.

The researcher identified potential hazards and analyzed all of the identified hazards in the workplace using HIRARC and JSA (Job Safety Analysis). After identifying the hazards, the next step is conducting risk assessment, then assessing risk control, and then conducting an assessment for residual risk on the assembly of the launching girder. The hazard for each activity can be seen from 4M+1E (Man, Machine, Material, Method, and Environment). Some of the hazards on the launching gantry assembly include being hit by a vehicle, being hit by launching gantry material components, falling from heights, and being pinched by the machine.

The stage after the identification of the hazards is to conduct an assessment of the level of risk that exists in assembling the launching gantry. In order to get the value of the level of risk, we can use the impact criteria multiplied by the opportunity.

This multiplication will result in a value that can determine whether a given risk level is acceptable. If the level of risk generated in the assembly stage of a launching gantry is acceptable, then a job can be re-routed as usual, but will still require supervision from the company itself. If the risk level is unacceptable, it is necessary to conduct further risk control and also to consider the effectiveness of the control program created to reduce the possible impact of accidents.

The possible levels of risk are low, medium, high, and extreme, and risk evaluation will indicate whether or not the risks are being received and aim to reduce the level of risk. After this, risk control is one of the most important stages to be implemented, because at this stage the company must be able to choose carefully what kind of risk control is both the most effective and in accordance with the level of risk.

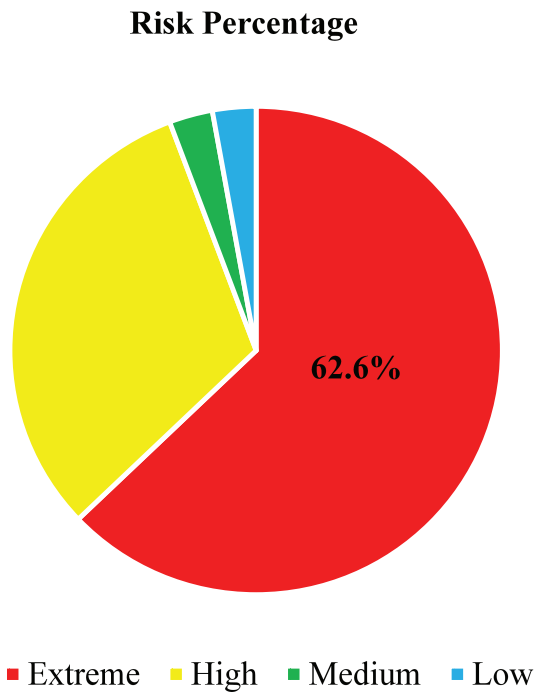

Figure 2: Risk percentage for assembly launching gantry activity. at Kapten Tendean Flyover Project (Seskoal Package).

The hierarchy of risk control implemented by PT. ABC should have considered five stages in risk control: elimination, substitution, engineering, administrative control, and personal protective equipment. From the identification result and risk analysis, it is known that 62.6 percent constitutes extreme risk, 30.8 percent high risk, 3.3 percent medium risk and 3.3 percent low risk (as shown in Figure 2). Extreme risk occurred in almost every stage of the launching gantry assembly (as shown in Table 1). Table 1 shows the results of hazard identification and risk assessment for assembly launching gantry activity, and Table 2 shows the risk control for assembly launching gantry activity.

Table 1: Hazard identification and risk assessment for assembly launching gantry activity at Kapten Tendean Flyover Project (Seskoal Package).

Activity	Hazard Identification	Risk Assessment		Risk Level
		Likelihood	Severity	
Surveying and stacking out	The meter was hit by a passing vehicle	D	5	E
Traffic management	Workers get hit by road users	D	5	E
Utility relocation	Workers get hit by public transport	D	5	E
Launching gantry	The operator is exhausted	D	5	E
	Workers/road users stricken material	C	5	E

Activity	Hazard Identification	Risk Assessment		Risk Level
	Sling dropout unloading process	C	4	E
	The foundation for putting the tool is uneven	C	4	E
Bench beam installation	Workers/road users struck bench	D	5	E
	Workers fell from the heights	C	5	E
	The movement of crawler cranes is dangerous	D	5	E
	Sling broke off while lifting the bench	C	5	E
	Bench beam rolled over the top of the pier head	D	5	E
Pedestal installation	Workers/road users hit pedestal	D	5	E
	Workers fell from the heights	C	5	E
	The movement of crawler cranes is dangerous	D	5	E
	Sling putus/terlepas saat mengangkat pedestal	C	5	E
	Sling broken/detached when lifting pedestal	D	5	E
Sliding chair installation	Workers/road users stricken by sliding chairs	D	5	E
	Workers fell from the heights	C	5	E
	The movement of crawler cranes is dangerous	D	5	E
	Sling broken/detached during the appointment process	C	5	E
Segment M1-T1 installation	Workers or road users are struck by segments	D	5	E
	Workers fell from the heights	C	5	E
	Sling broke up during girder removal	D	5	E
	Main girder overturned when it is installed	D	5	E
	Main girder carried by the wind when lifted	C	5	E
Segment F1 and T2 installation	Worker or road user stricken by segment	D	5	E
	Workers fell from the heights	C	5	E
	The movement of crawler cranes is dangerous	D	5	E
	Sling broke off during lifting segments	D	5	E
	Segments drop when assembled over pier head	D	5	E
	Segment carried by the wind when lifted	C	5	E
Segment F2 and T3 installation	Workers fell	C	5	E
	Boom crane crashed into launching girder	C	5	E
	Sling is broken or detached	D	5	E

Activity	Hazard Identification	Risk Assessment		Risk Level
	Front leg and rear leg fall off during installation	D	5	E
Winch installation	Workers fell during installation	C	5	E
	Sling crane broke apart when lifting the winch	D	5	E
	The attached winch is overturned	C	5	E
	The winch was carried away by the wind	C	5	E

Table 2: Risk control for assembly launching gantry activity at Kapten Tendean Flyover Project (Seskoal Package).

Activity	Risk Control	Risk Assessment		Risk Level
		Likelihood	Severity	
Survey and stacking out	Make sure the flagman manages the traffic	D	2	L
Traffic management	Make sure the flagman manages the traffic	D	2	L
Utility relocation	Flagman manages traffic and signs warning signs	D	2	L
Launching gantry	The operator is fit and has an operator's license	D	2	L
	Make sure there is no traffic of workers/vehicles under lifting work	E	1	L
	Inspection of equipment (size and capacity) and material before work	D	2	L
	If uneven grounding the leveling process is done	D	1	L
Bench beam installation	Make sure there is no traffic of workers/vehicles under lifting work	E	2	L
	Workers are required to use full body harness	E	2	L
	Make sure the operator knows the project environment	D	1	L
	Inspection of equipment (size and capacity) and material before work	D	1	L
	Make sure PT bars φ 36 mm, hydraulic jack sliding, truss elevation jack, and steel block is mounted safe and strong	E	2	L
Pedestal installation	Make sure there is no traffic of workers/vehicles under lifting work	E	2	L
	Workers are required to use full body harness	E	2	L
	Workers are required to use full body harness. Make sure the operator knows the project environment	D	2	L
	Inspection of equipment (size and capacity) and material before work	D	1	L

Activity	Risk Control	Risk Assessment		Risk Level
	Make sure the locking bolts are securely installed	E	2	L
Sliding chair installation	Make sure there is no traffic of workers/vehicles under lifting work	E	2	L
	Workers are required to use full body harness	E	2	L
	Make sure the operator knows the project environment	D	1	L
	Inspection of equipment (size and capacity) and material before work	D	1	L
Erection Main Girder Segment M2- M6	Make sure there is no traffic of workers/vehicles under lifting work	D	1	L
	Workers are required to use full body harness	E	2	L
	Make sure the operator knows the environment around the project	D	1	L
	Inspection of equipment (size and capacity) and material before work	D	1	L
	Jack break (clamp lock) play girder must be installed properly	D	1	L
	Make sure the weather is in good condition and the maximum wind speed allowed is 30 km/hr	E	2	L
Segment M1 and T1; F1 and T2; F2 and T3; F3 installation	Make sure there is no traffic of workers/vehicles under lifting work	D	1	L
	Workers are required to use full body harness	E	2	L
	Make sure the operator knows the environment around the project	D	1	L
	Inspection of equipment (size and capacity) and material before work	D	1	L
	Sling will be removed after segment has been installed correctly	E	2	L
	Make sure the weather is in good condition and the maximum wind speed allowed is 30 km/hr	E	2	L
Front leg and rear leg installation	Workers are required to use full body harness	E	2	L
	The supervisor should be located to control the movement of the equipment	D	1	L
	Inspection of equipment (size and capacity) and material before work	D	1	L
	Make sure the sling is still mounted before the front leg and rear legs are installed correctly	E	2	L
Winch installation	Make sure workers use full body harness	E	2	L
	Inspection of equipment (size and capacity) and material before work	D	1	L

Activity	Risk Control	Risk Assessment		Risk Level
	Make sure the weather is in good condition and the maximum wind speed allowed is 30 km/hr	D	1	L

4. Discussion

The first step in risk management begins with identifying hazards. Hazard identification is a systematic effort with a comprehensive technique used to determine the potential hazards of a material, tool, or system [4]. Hazard identification conducted by PT. ABC is found in the quality plan and work methods of a job. After all hazards have been identified, each hazard is examined to determine its level of risk to cause an accident or loss. Risk assessment conducted by PT. ABC adjusted to the procedures of the company [5], namely by calculating the multiplication of likelihood and severity.

Risk evaluation can be done in order to give meaning to the level of risk generated after doing the calculation. Based on the procedure of PT. ABC, the risk can be categorized into four levels: extreme risk, high risk, moderate risk, and low risk. This level of risk is derived from the applicable risk matrix. PT. ABC used HIRARC activity guideline for this (as shown in Figure 3).

Likelihood	Severity					Risk Level (S x L)	Likelihood (L)	Severity (S)
	1	2	3	4	5			
A	H	H	E	E	E	E = Extreme Risk	A = almost certain	1 = First Aid, minor material loss
B	M	H	H	E	E	H = High Risk	B = likely	2 = Medical Treatment Case, medium material loss
C	L	M	H	E	E	M = Moderate Risk	C = occasional	3 = Restricted Work Duty Injury, significant material loss
D	L	L	M	H	E	L = Low Risk	D = unlikely	4 = Lost time injury, major material loss
E	L	L	M	H	H		E = rare	5 = Fatality, very major material loss

Figure 3: Risk matrix from PT. ABC's procedure.

According to OHSAS 18001 [4], risk control starts with elimination control, substitution, engineering, administrative control, and Personal Protective Equipment (PPE). Risk control is performed against all potential hazards that arise in any job activity. Having determined the risk control of each potential hazard, a re-risk assessment is performed to ensure that the risk level has dropped to low. Low risk level is the level of risk still acceptable to the company, but the company must keep periodically monitoring the level of risk. In the further discussion, the explanation will be limited to the most extreme risk level and how to control it.

Surveying and stacking out activities, traffic management, and utility relocation are hazards with extreme risk levels, one example being the danger of being hit by vehicles passing around the work site, as the location where the launching gantry is

assembled is densely traveled by vehicles. To mitigate this risk, it is important to ensure that a flagman is in place to manage traffic and that safety signs and safety fences are installed during surveying and stacking out activity.

These signs serve as a communication medium providing knowledge about the dangers that exist to workers and road users around the job site. Knowledge is the result of knowing a person to the object through the sensing of an object [6]. According to Notoatmodjo [6], a person mostly acquires knowledge through the sense of hearing and sight. According Winarsunu [7], information will be easily captured if using a picture message. The things that must be considered in presenting the message through the picture is that the image is easily visible, distinguishable, and easily interpretable.

Falling material is a potential hazard that can occur in all work activities at a high altitude, which is where the major launching gantry docking work is done. Potential material hazards falling pose an extreme risk to workers and road-users around the work site. To mitigate the risk, workers and road users may be steered away from hazard zones through traffic management.

Bottom of Form

In addition, the ability of workers to work in accordance with the working matrix is critical in ensuring that the material does not fall. According to the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia No. 09 of Year 2016 [8], clause 8 Concerning Occupational Safety and Health in Work at Height, it is an obligation of the company to ensure that when working at a high altitude, there are no falling objects that may cause injury or death.

In the activity of erecting the launching gantry, there is also an extreme risk in the possibility of operators experiencing fatigue. To mitigate this risk, it must be ensured that the operator is in fit-to-work condition, both physically and mentally, and has no illness or disability. Ensuring crawler crane operators are in fit condition before operating the crane is particularly important. According to the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia Number: PER.09/MEN/VII/2010 [9], clause 7 Concerning Operator and Officer of Lifting and Hauling Equipment, one of the requirements of being a lifting equipment operator is to be in fit-to-work condition according to a doctor's statement. Rijanto [10] states that operators of lifting equipment, including crawler cranes, must have a pre-employment physical health examination to ensure that workers do not experience any fatigue when operating lifting equipment. This physical examination needs to be repeated every year and includes tests for visual acuity and color recognition, hearing, muscle coordination, and drug use [10].

Workers falling from a high altitude also presents an extreme risk. According to the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia No. 09 of Year 2016 [8], clause 3 Concerning Occupational Safety and Health in Work at Height, to avoid this risk, companies must engage in planning, preparation of working procedures and safe working techniques, provide special protective equipment, and provide a competent workforce to work at altitude. To mitigate the risk of falling, the company must apply a work permit system to each altitude worker and always ensure that workers use a full body harness while working at altitude.

The use of crawler cranes in the assembly work of launching gantries contains risks associated with the slings used to lift the material. Slings that break at work have an extreme risk level of danger. According to ASME B30.9 [11], the inspection frequency of slings can range from each day or shift, yearly (normal service), monthly to quarterly (severe service), and whenever a qualified person recommends doing inspection of slings (special service). To mitigate this risk, it is imperative for workers to always perform periodic checks of slings before they are used to lift the material.

After developing risk control measures, the next stage is to conduct a residual risk assessment, which measures the risk that remains despite the implementation of the risk control. The residual risk assessment will determine how effective the risk control measure was. After risk control and risk re-assessment, all extreme and medium risks involved in assembling the launching gantry decreased to low risk. However, supervision and monitoring of risk control programs in every work activity must be well implemented to ensure that such risk controls can be optimally implemented in the field.

5. Conclusion

The most extreme risk on launching gantry assembly are:

1. The fatigue of heavy equipment operator could cause accidents. The control of this risk is to ensure that the operator is in good health and fit to work before any activities commence, which means he is healthy physically and mentally and has no disease or disability.

2. The movement of heavy equipment compromises workers and facilities around the project. The risk control to mitigate this risk are to ensure that the operator recognizes the work place and ensures the supervisor or rigger is on site to control the movement of the equipment.

3. The equipment components (supporting chairs, launching girder, and winch) lifted by crawler crane are dropped and hit the workers and road users. The risk control is ensuring that the sling used is in accordance with the load capacity lifted, doing inspection on the sling before starting the work, and making sure that there is no worker and road user passing under the equipment material when it is lifted by crawler crane.

4. The workers fall from the height. To control the risk, it must be ensured that the workers who perform activities at altitudes above 1.8 meter are required to use full body harness.

5. Launching gantry that has been installed is overturned. The risk control is to ensure that PT Bars, lock clamps, and jack cylinder are securely installed.

References

[1] OHSAS Project Group. (2007). Occupational Health and Safety Management Systems-Requirement.

[2] PT. ABC. (2007). Quality Plan for Assembly Launching Gantry Activity.

[3] PT. ABC. (2014). Method Statement of Erection Launching Gantry.

[4] Ramli, S. (2010). Risk Management Practical Guidelines in Occupational Health Safety Perspective (Pedoman Praktis Manajemen Risiko dalam Perspektif K3). Jakarta: PT. Dian Rakyat.

[5] PT. ABC. (2016). Safety, Health, Environmental Plan Procedure.

[6] Notoatmodjo. (2010). Education and Health Behavior (Pendidikan dan Perilaku Kesehatan). Jakarta: Rineka Cipta.

[7] Winarsunu. (2008). Occupational Safety Psychology (Psikologi Keselamatan Kerja). Malang: UMM Press.

[8] Minister of Manpower and Transmigration of the Republic of Indonesia. Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia Number: 09 Year 2016 Concerning Safety and Health in Work at Height. Ministry Regulation, 2010;1–69.

[9] Minister of Manpower and Transmigration of the Republic of Indonesia. (2010). Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia Number: PER.09/MEN/VII/2010 Concerning Operator and Officer of Lifting and Hauling Equipment.

[10] Ir. B. Boedi Rijanto M. (2011). Accident Prevention Guidelines in Industry (Pedoman Pencegahan Kecelakaan di Industri). Jakarta: Mitra Wacana Media.

[11] The American Society of Mechanical Engineers. (2015). ASME B30.9-2014 (Revision of ASME B30.9-2010) Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings.