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Risk level analysis of work safety and health on national road routine maintenance project using self-management system

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Abstract. Routine maintenance refers to the repair of damages on roads' sections by means of steady service condition. It is always conducted on the Blangkejeren-Laweaunan Road Section on annual basis. It is often conducted using a self-management system by Executing Officer (PPK) 08, which, according to government statistics is 65 km long. While implementing the project, PPK worked with a competent subcontractor as well as a foreman from the community surrounding the project region. To reduce the risks and enhance safety, the contractor made use of the Management System of Safety and Health (SMK3), following all the regulations that apply in Indonesia. The study aims at identifying the K3 risk level in road routine maintenance work. This is done based on the PU Ministry Regulation No 05/PRT/M/2014 through interviewing the PPK. In the same context, determination of the compliance level is done by workers (subcontractor and foreman) is done based on the Construction and Building Guideline No. 004/BM/2006 by assessing the use of Personal Protector Equipment (APD) in the routine road maintenance activities, sidewalk routine maintenance, water channel routine maintenance of cut and fill, and road equipment routine maintenance. The low risk can be found in the routine maintenance the pavements, roadsides, and road infrastructure, while the moderate risk in water channels of the excavations and the heap's routine maintenance. Among the two, moderate risk has more portions and it must be conducted by workers who can fully comply with APD.

1. Introduction

The national road is the main artery of the economy. It must be well maintained to achieve the desired targets [1-4]. Routine maintenance is a core activity that can be done to improve the service period [5-10]. The road maintenance work is characterized by openwork location (which is affected by weather), limited time, untrained workers, high energy input, and the use of working equipment that may endanger workers' safety as well as health. There are many studies conducted around the world to improve [11-24].

To address the issue of workers' health and safety, PU Minister Regulation No 05/PRT/M/2014 on The Guideline of Work Safety and Health Management System (SMK3), provides that the Executing Officer (PPK) must apply SMK3 for the general construction work. The SMK3 fields entail the K3 policy, K3 planning, operational control, inspection, K3 performance evaluation, and K3 performance review [25].

The routine maintenance in Blangkejeren-Laweaunan Road Section has been conducted by the PPK 08, which is under the National Road Construction Working Unit of Regional I Aceh and the road section, with a length of 65 km. Notably, this segment is the only road connecting Blangkejeren to South

East Aceh District, an economic artery that must be protected and well reserved to boost the local economy of the area. In its implementation, the PPK undertook the project work with the help of a competent subcontractor who could effectively pay the foreman.

In the Work Accident Theory points out that one of the basic causes of accidents is the worker compliance level [26]. In this project, some activities do not uniformly comply with the requirements of the K3 standard. This is evidenced by the use of personal protective equipment that is inconsistent, thereby endangering workers along with other road users. This study is expected to apply the K3 implementation solutions for routine maintenance work on a self-managed basis that meets the provisions of the legislation. It will address the nature of K3 risk level in the national road routine maintenance project using self-management system in the Blangkejeren-Laweaunan Road Section. Furthermore, its main objective is to identify the K3 risk level in the routine national road maintenance work using self-management system on the Blangkejeren-Laweaunan Road Section.

2. National Road

According to the Regulation No. 38 of 2004, a national road is a land transportation infrastructure consisting of the road as well as the infrastructure and facility provided for the traffic located on the soil surface, under the ground and/or water, and above the water level except train railway, lane railway, and cable network [27].

3. Routine Maintenance

The PU Minister Regulation No. 13/PRT/M/2011 identifies routine maintenance as both preservation and repair activities following the damages occurring on the road sections by means of steady service condition road. A steady service condition road refers to the road sections with conditions that meet the design period calculated following the established standards [28].

4. Self-Management

According to the Republic of Indonesia President Regulation No. 54 of 2010 concerning The Procurement of Government Good/Service, self-management is the good/service procurement activity planned, carried out and/or supervised directly by K/L/D/I like the budget responsibility, other government institution and/or community group [29].

5. Work Accident

The Worker Minister Regulation No. Per. 03/MEN/1994 states that work accident is the mishap occurring in the work activities including the disease emerging from work activities, as well as the accidents occurring either on the way to the work location or on the way back home in the common street [30]. According to [31-33] acknowledge work accident as an unplanned, unpredictable, unexpected activity. In other words, it is something unforeseen and not intentional.

6. Work Safety and Health (K3)

According to RI Worker Minister No. Kep. 463/MEN/1993, Work Safety, and Health (K3) is a protection effort directed at the workers and other people located in the project location or company [34]. Health and safety measures should be maintained to ensure that every production resource can without harm be used efficiently. Acknowledge health and safety as two basic elements that all contractor companies must provide workers with [12, 20, 22, 23, 35].

6.1. Management System of Work Safety and Health 38

The Minister Regulation (SMK3) along with Minister Regulation No. 05/MEN/1996 perceives Management System of Work Safety and Health as a management system part. As a system, it includes activities such as organization, planning, implementation, taking responsibility, formulating the procedure

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and resources required in development, application, achievement, review, maintenance, and policy of K3 [36].

The main purpose of these activities is to control the risks related to the work activity with a view to creating a safe and productive project location. The objectives and the target of SMK3 are basically to create a K3 system in the project location involving the elements of management, worker, and condition and project location integrated in order to avoid and reduce accidents and diseases arising at the project location. It also aims at creating a safe and efficient project location [37-38].

6.2. K3 Risk

According to the PU Minister Regulation No. 05/PRT/M/2014 on Management System of Work Safety and Health according to Minister Regulation of general sector construction explains, K3 risk of the construction is a measure of loss possibility to the public safety, property, human life, and the environment arising from the current dangerous resources within the project construction [25]. The measurement of K3 risk in the construction can be carried out by combining the value of the K3 risk occurrence and the damage or the resulting impact. The determination of the occurrence value ok K3 risk in the construction can be explained as the statistics in Table 1.

Table 1. The Occurrence Value of K3 Risk in the Construction [25]

Value	Occurrence
1 (One)	Seldom occurred in the construction activity
2 (Two)	Sometimes occurred in the construction activity
3 (Three)	Often occur in the construction activity

K3 risk level can be formulated as in (1).

$$TR = P \times A \tag{1}$$

where TR is K3 risk level, P for the occurrence of K3 risk in the construction, and A is severity raised the level. The calculation result of the K3 risk in the construction can be explained in Table 2.

Table 2. The Value of K3 Risk Level in the Construction [25]

K3 Risk Level in The Construction		Severity (Caused)		
		1	**2**	**3**
Frequency	1	[illegible]	[illegible]	3
	2	2	4	6
	3	3	6	9

Remark:

- Low K3 Risk Level
- Moderate K3 Risk Level
- High K3 Risk Level

The calculation of severity level is done based on the average severity of the human, property, environmental and public safety. For the severity of the person resulting in death, the severity value level is 3 (high). If controlling efforts have been made and still high K3 risk level is high, it requires additional controlling efforts.

6.3. K3 Compliance

The compliance is a person's attitude to obey and participate in the specification, standard or regulation managed clearly in which regulations are issued by the related companies or other authorized institutions [39]. In addition, [11] mentioned that one component of safety behavior is safety compliance, that is, it is the activity that must be done by someone to protect his safety in the project location. The behavior follows the work standard procedure and the use of APD. A worker has two choices in creating the save and health project location. He or she can choose to obey K3 policy or avoid accidents and diseases due to work.

6.4. K3 Guideline for Road Routine Maintenance Project

The guideline of Construction and Building No. 004/BM/2006 states that the road routine maintenance has some references and provisions which have to be obeyed by the construction providers related to the K3 application [40].

7. K3 Risk Analysis

The K3 Risk Analysis is carried out to identify the K3 risk level in the national road routine maintenance project using a self-management system in the Blangkejeren-Laweaunan Road Section with a length of 65 Km. The routine maintenance is divided into 4 work items such as the routine maintenance of the pavement, the roadside, the water channel of excavations and the heaps, and the road infrastructure. The assessment of K3 risk level on each work item is conducted based on [25, 41, 42] using interview and observation methods. The risk level of each work item on national road routine maintenance project can be explained as follows:

7.1. K3 Risk Level on the Pavement Routine Maintenance

The pavement routine maintenance consists of 3 work items including assessment and stacking, stripping and closing, and returning the condition. The assessment of Risk Level (TR) in this item can be determined by multiplying the occurrence (K) and the effect (A) to the person, property, environment and public safety. This occurrence or K3 hazard frequency can be found out by interviewing the owner personnel. The occurrence value is marked by an area whose score is 1, 2, or 3. The impact of the occurrence can be determined by observing the road section of Blangkejeren-Laweaunan with a length of 65 Km. The score can be 1 for low, 2 for moderate or 3 for high. The result of the multiplication between the occurrence and the effect can then interpreted. The interpretation of K3 risk level can be divided into 3 levels starting from 1 and 2 for low, 3 and 4 for moderate, and 6 to 9 for high.

7.2. K3 Risk Level on the Roadside Routine Maintenance

The roadside routine maintenance consists of 3 work items, including assessment and stacking, stripping and closing, and returning the condition. It is explained that the total mean of K3 risk level achieved is 2. This implies that K3 risk level that occurred on the Roadside Routine Maintenance in the Blangkejeren-Laweaunan Road section has low risk.

7.3. K3 Risk Level on the Water Channel of the Excavations and the Heaps Routine Maintenance

The water channel of the excavations and the heap's routine maintenance consists of 3 work items including assessment and stacking, dredging the excavations and the heaps, and stone repair. The total mean of K3 risk level achieved is 3. That means that K3 risk level that occurred on the Roadside Routine Maintenance in the Blangkeujeren-Laweaunan Road section is moderate.

7.4. K3 Risk Level on the Road Infrastructure Routine Maintenance

The road infrastructure routine maintenance also consists of 3 work items, among them being assessment and stacking, stripping and closing as well as returning the condition. The total mean of K3 risk level

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achieved is 2, meaning that the K3 risk level that occurred on the Road Infrastructure Routine Maintenance has a low risk.

7.5. K3 Risk Level on National Road Routine Maintenance.

This road routine maintenance is divided into 4 work items such as the routine maintenance of the pavement, the roadside, the water channel of the excavations and the heaps, and the road infrastructure. Based on the calculation, the statistics can be seen in Table 3.

Table 3. The Assessment of K3 Risk Level on National Road Routine Maintenance

No.	**National Road Routine Maintenance**	**Total Mean TR K3**	**Risk Level**
1	The Pavement Routine Maintenance	2	Low
2	The Roadside Routine Maintenance	2	Low
3	The Water Channel of the Excavations And The Heaps Routine Maintenance	2	Medium
4	The Road Infrastructure Routine Maintenance	2	Low

Table 3 shows that there are 2 risk levels on the National Road Routine Maintenance Project, low and moderate. The routine maintenance of the pavement, the roadside, and the road infrastructure have a low-risk level, that is, 2. Lastly, the water channel of the excavations and the heap's routine maintenance has a moderate risk level with a value is 3.

8. Conclusion

National road routine maintenance project in Blangkejeren-Laweaunan Road Section is done every year using self-management method. This road routine maintenance is divided into 4 work items such as the routine maintenance of the pavement, the roadside, the water channel of the excavations and the heaps, and the road infrastructure. The K3 risk is a condition of a national road routine maintenance project that occurred because of the uncertainty with the current frequency. It will create a negative impact on the person, property, environment and public safety.

Based on [25], K3 risk level is grouped into 3 levels: moderate and high. The assessment of the K3 Risk Level (TK) on the road routine maintenance project is determined by multiplying Occurrence (K) and Effect (A) to person, property, environment and public safety. The occurrence is the frequency of the activity and can be low, moderate or high. The occurrence can be found be established by interviewing the owner and the personnel. The effect can be determined by observation. This study establishes that there are 2 risk levels, low and moderate. The low risk can be found in the routine maintenance of the pavement, roadside, and road infrastructure. On the 0ther hand, the moderate risk can be found in the water channel of the excavations and the heaps routine maintenance.

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