Analysis of risk K3 preservation of the reconstruction Gresik – Lamongan – Babat roads in East Java Province

Gebion Lysje Pagaray
Civil Engineering, Universitas Kristen Indonesia Paulus Makassar

*gebi_pagaray78@yahoo.co.id

Abstract. Preservation of Gresik – Lamongan – Babat is an activity carried out in East Java Province. Long Segment is the handling of road preservation within the boundaries of one continuous segment length (can be more than one segment) which is carried out with the aim of obtaining uniform road conditions, namely steady and standard roads. The purpose of this study is to 1) Identify the K3 risks that occur in the preservation of Gresik – Lamongan – Babat roads in East Java Province. 2) Provide risk control solutions from K3 risk identification. This research was conducted by collecting secondary data to obtain research data using direct survey method, literature study and interview. The sample for this study consists 30 respondents, including 12 supervising consultants, 2 supervising of PU, 16 workers and contractor’s management. This research uses the Fault Tree Analysis (FTA) method. The results of this study found 52 potential hazards, the work hazard potential category of 52 potential hazards are 5 Extreme Risk, 21 High Risk, 20 Moderate Risk, and 6 Low Risk, is the dominant High Risk.

1. Introduction

Road Preservation is asset management by carrying out maintenance, rehabilitation reconstruction activities. Reconstruction is the improvement of the structure is a handling activity to increase the ability of a section of road that is in a badly damaged condition so that the section of the road has a stable condition again by the determined plan age. (Minister of Public Works Regulation Number 13 / PRT / M / 2011). Long Segment is the handling of road preservation within the limits of one continuous segment length (can be more than one segment) which is carried out to obtain uniform road conditions, namely steady and standard roads (Minister of Public Works Regulation Number.19 / PRT / M / 2011).

Long Segment includes several scopes of activities (output), namely road widening, reconstruction, rehabilitation, and maintenance. Long segment realizes the handling of road preservation within the boundaries of one continuous segment length which is implemented with the aim of obtaining a steady and standard road condition. Preservation of Jalan Gresik - Lamongan - Babat is an activity carried out in East Java. Various risks can arise in each of these activities. Based on this background, research on K3 Risk Analysis for the Reconstruction of Gresik - Lamongan - Babat Roads in East Java Province was conducted, with the aim of identifying the types of accidents that might occur in the Gresik - Lamongan - Babat Road Reconstruction Preservation construction project in Java Province, Timur, to analyze the factors that cause work accidents in construction projects and to determine the
implementation of occupational health and safety in reducing the risk of work accidents in the Gresik - Lamongan - Babat Road Reconstruction Preservation construction project in East Java Province. The analysis used to determine the causes of work accidents in a systematic manner is to use the Fault Tree Analysis (FTA). The Fault Tree Analysis method is a technique used to identify risks that contribute to failure. With this method, it is expected to simulate and analyze construction problems and calculate probabilities for future safety management planning.

By using the Fault Tree Analysis method, it is expected to be able to identify the types of accidents and analyze the factors that cause accidents that may occur and to know the application of K3 used in the Preservation of Reconstruction for Gresik - Lamongan - Babat Roads in East Java Province. The following is the matrix used for risk assessment using the Fault Tree Analysis (FTA) method.

2. Methodology

Research Locations for the Preservation of Reconstruction for Gresik - Lamongan - Babat Roads In East Java Province it is located at KM 54 + 900 to KM 71 + 420 Lamongan - Babat Regency, the road that connects Surabaya City and Tuban City. To reach the research location, the distance covered is 55 km from Surabaya City, East Kalimantan Province.

The research design is based on research problems. In this study using qualitative research (mix method) with descriptive research type. The data obtained is based on field data, interviews with workers and consultants related to the Preservation and Reconstruction Work for Gresik - Lamongan - Babat Road in East Java Province. The method of collecting data using primary data is data obtained directly including by conducting direct research on the Preservation Work of the Gresik - Lamongan - Babat Road Reconstruction in East Java Province, namely by direct observation of the environment that is carefully examined to determine potential hazards, and interviews Responsible for related

![Research Methods Flowchart](image-url)
parties such as supervisory consultants, workers, and contractor management. Secondary data obtained from literature studies related to the problem under study.

**Table 1. Risk Assessment Factors**

| Factor          | Scope                                      | Score |
|-----------------|--------------------------------------------|-------|
| Hazards         | - Not likely to cause injury               | 1     |
|                 | - Can cause minor injury                   | 2     |
|                 | - Can cause injuries requiring first aid    | 3     |
|                 | - Can cause injury requiring first aid kit  | 4     |
|                 | - May cause serious injury                 | 5     |
|                 | - Life threatening, possibly fatalities    | 6     |
| Probability     | - Most likely not                          | 1     |
|                 | - The possibilities are still far away     | 2     |
|                 | - The odds are reasonable                  | 3     |
|                 | - The possibilities are open               | 4     |
|                 | - Very likely                             | 5     |
|                 | - Almost certain                          | 6     |
| Severity        | - Injuries are negligible                  | 1     |
|                 | - Minor injury                            | 2     |
|                 | - Serious injury                          | 3     |
|                 | - Layered injury                          | 4     |
|                 | - Single death toll                       | 5     |
|                 | - The casualties are layered              | 6     |

**Table 2. Qualitative Measures of "likelihood" According to AS/NZS 4360 Standard**

| Level | Descriptor  | Description                          |
|-------|-------------|--------------------------------------|
| 5     | Almost Certain | Can happen at any time              |
| 4     | Likely       | Often                               |
| 3     | Possible     | It can happen once in a while       |
| 2     | Unlikely     | Rarely                              |
| 1     | Rare         | Almost never, very rarely           |

**Table 3. Risk Assessment Matrix**

| Level | Descriptor    | Description                                      |
|-------|---------------|--------------------------------------------------|
| 5     | Catastrophic | Fatal> 1 person, the loss was very large and the impact was very wide, all activities were stopped |
| 4     | Major         | Severe injury > 1 person                         |
| 3     | Moderate      | Moderate injuries, need medical attention       |
| 2     | Minor         | Minor injury, moderate financial loss            |
| 1     | Insignificant | No injuries, little financial loss               |

**Table 4. Risk analysis matrix According to AS/NZS 4360 Standard**

| Frequency of Risk | 1 | 2 | 3 | 4 | 5 |
|-------------------|---|---|---|---|---|
| 5                 | H | H | E | E | E |
| 4                 | M | H | H | E | E |
| 3                 | L | M | H | E | E |
| 2                 | L | L | M | H | E |
| 1                 | L | L | M | H | H |
3. Result and Discussion

3.1 Questionnaire Description

The questionnaire was filled in by 30 respondents, consisting of 12 supervisory consultants, 2 PU supervisors, 16 workers, and contractor management with the respondent's age, education level, status on the project that was being worked on, the length of experience the respondent had worked for the construction sector, and the respondent's educational background.

| Table 5. Respondent Age |
|--------------------------|
| Number | Age (Years) | Frequency | Percentage (%) |
| 1 | ≤ 20 | 0 | 0 |
| 2 | 20 – 30 | 5 | 17 |
| 3 | 31 – 40 | 10 | 33 |
| 4 | 41 – 50 | 12 | 40 |
| 5 | > 50 | 3 | 10 |
| Amount | 30 | 100 |

From Table 5 Age of Respondents, it can be seen that workers in the age group ≤ 20 years are 0 people or 0%, for workers in the 20-30 year age group are 5 people or 17%. For workers in the age, 31 - 40 years is 10 people or 33%. For workers in the age group 41 - 50, there are 12 people or 40%. And for workers in the> 50 age group as many as 3 people or 10%.

| Table 6. Respondents Education Level |
|--------------------------------------|
| Number | Respondents Education Level | Frequency | Percentage (%) |
| 1 | Primary School | 0 | 0 |
| 2 | Junior High School | 2 | 7 |
| 3 | Senior High School | 10 | 33 |
| 4 | Secondary Engineering School | 2 | 7 |
| 5 | Vocational Graduates | 2 | 7 |
| 6 | Bachelor Degree | 14 | 46 |
| Amount | 30 | 100 |

Table 6 Education Level of Respondents, workers who have an elementary education level of 0 people or 0%, workers who have a Junior high school education level of 2 people or 7%, workers who have a Senior High school education level of 10 people or 33%, Secondary Engineering School 2 people or 7%, Vocational Graduates 2 people or 7% and Bachelor Degree 14 people or 46%.

| Table 7. Respondents Work Experience |
|--------------------------------------|
| Number | Work Experience | Frequency | Percentage (%) |
| 1 | ≤ 5 | 7 | 23 |
| 2 | 6 – 10 | 10 | 34 |
| 3 | 11 – 15 | 3 | 10 |
| 4 | 16 – 20 | 3 | 10 |
| 5 | > 21 | 1 | 3 |
| Amount | 30 | 100 |
Table 7. Respondents Work Experience, there are as many as 7 people or 23% who have work experience ≤ 5 years, 10 people or 34% have work experience of 6 - 10 years, 9 people or 30% have work experience of 11-15 years, 3 people or 10% who have work experience of 16-20 years, and 1 person or 3% for work experience > 21.

Table 8. Personal Protective Equipment for Workers

| Number | Personal Protective Equipment for Workers | Frequency | Percentage (%) |
|--------|-------------------------------------------|-----------|----------------|
| 1      | Never                                     | 2         | 7              |
| 2      | Once a year                               | 25        | 83             |
| 3      | 2 years                                   | 2         | 7              |
| 4      | 3 years                                   | 1         | 3              |
| 5      | Only once during work                     | 0         | 0              |
|        | Amount                                    | 30        | 100            |

From the questionnaire given to respondents, K3 equipment is in Table 8. PPE for Workers, in the form of Personal Protective Equipment (PPE) for supervisory consultants, and PU supervisors every 1 year is given at the time of mobilization, for contractor’s various results of the questionnaire obtained, some are 3 years, 2 years, and have not received Personal Protective Equipment (PPE).

3.2 Data Processing Using Fault Analysis Method

Based on the data processing that has been carried out regarding hazard identification using the FTA method, it is found that from the work area 52 potential hazards have been found. But in this case, each potential hazard that has been identified has a different classification category such as Extreme, High, Moderate and Low. To make it easier to determine the highest rating weight for potential hazards that has been carried out, it is described in the form of a recapitulation table using FTA. The following is the result of recapitulation using FTA:

Table 9. Results of the recapitulation using the Fault Analysis Method

| Number | Activities | Potential Risks | Risk Category | Risk Control |
|--------|------------|-----------------|---------------|--------------|
| A      | Earthworks |                 |               |              |
| 1      | Ordinary excavation work | | | |
| Measurement and Standing | Health problems due to general working conditions | H | Use work equipment/ Personal Protective Equipment for Workers |
| Injured due to the wrong condition and use of the meter | M | - Use standard – compliant meter |
| Accidents due to poor traffic regulation | E | - Traffic settings must be according to standards - Flagman |
| Accidents due to the wrong type and way of using the equipment | M | - Tools, how to use must be correct and according to standards |
| Accidents due to the stake –mounting methods | L | - Installation of stakes must be correct and in accordance with the provisions |
| Excavation | An excavator accident happened due to the distance between diggers being too close | H | - Distance between diggers must be kept at a safe distance |
| Accidents due to heavy equipment operations either | E | - If the excavation is carried out at night, use sufficient lighting |
| Number | Activities and benchmarking | Potential Risks | Risk Category | Risk Control |
|--------|----------------------------|-----------------|--------------|--------------|
| 1      | Disposal of minerals       | Accidents due to piles of excavated material to be used for stockpiling | H             | - The pile of minerals to be used for stockpiling should not be too long. |
| 2      | Measurement and benchmarking | Health problems due to general working conditions | L             | - Use Personal Protective Equipment for Workers (helmets, masks, vests, gloves, safety shoes) |
|        |                            | Injured due to conditions and use of the wrong meter | L             | - Use an appropriate meter |
|        |                            | Accidents due to poor traffic regulation | H             | - Install traffic signs in the work zone |
|        |                            | Accidents due to the type and way of using the equipment | M             | - Equipment and how to use must be by the standard |
|        | Compression                | Accidents due to poor traffic regulation | E             | - Traffic settings must be by the standard, - Provide coverage in the work zone |
|        |                            | Accidents due to heavy equipment operations at the compaction site | E             | - Operation of the machine is carried out by experienced heavy equipment operators |
|        | Watering                   | Health problems due to dust that arise during watering | H             | - Use Personal Protective Equipment for Workers (helmets, masks, vests, gloves, safety shoes) |
| B      | Grained Pavement           | Injured due to improper use of steel meter and does not meet standards | L             | - Measuring instruments used are by standards, measurements are made by skilled and experienced workers and wear standard work equipment |
|        | Measurement and benchmarking | Accident due to being hit by a passing vehicle | H             | - Installation of traffic signs and assigning traffic control flags |
|        |                            | Wounded when installing a stake and hammered | M             | - The stake used is too long and the hammer used is disproportionate |
|        |                            | Vehicle traffic disruption occurred | H             | - Installation of temporary safety traffic signs and a traffic control officer |
| 2      | Stripping                  | Accidental stripping fell into a dug hole | M             | - Install safety and limit the excavation area with a safety fence. |
|        |                            | There was traffic disruption to the surrounding population | H             | - Preparing temporary roads for local residents |
|        |                            | An accident occurred due to the remnants of stripping due to improper disposal or cleaning of the stripping site | M             | - Trucks for transporting waste materials must be closed |
|        |                            | Injured due to improper operation of machine | M             | - Before using the heavy equipment, the suitability must be checked, the operator must... |
| Number | Activities | Potential Risks | Risk Category | Risk Control |
|--------|------------|-----------------|---------------|--------------|
|        |            |                 |               | be skilled and experienced and the method of operating the tool must be in accordance with the regulations. |
| Vehicle traffic disruption occurred | H | - Provided entry and exit for residents. |
| Accidents due to dugouts filled with stagnant water | E | - Keeping the excavation in dry condition |
| 3 Overlay | There is irritation of the skin and lungs due to dry aggregate dust | M | - The aggregate that has been spread before closing is watered |
| | There was an accident when the dump truck unloaded the aggregate | M | - The operation of a dump truck must be carried out by skilled and experienced personnel, and maintained so that no other interested person is near the dump truck that is unloading the aggregate |
| | Injured by grader due to improper operation | M | - The spreader operator must be skilled and experienced and the grader operation must be carried out |
| An accident occurred due to being hit by vehicle traffic | H | - Installation of signs and traffic control officers |
| There was an accident due to temporary stockpiling of materials | M | - Material hoarding must be in a safe place or material to be spread immediately |
| 4 Compression | There is irritation of the skin and lungs by dust on dry compaction | M | - The spread must be watered before compacting |
| Vehicle traffic disruption occurred | H | - Installation of traffic signs and assignment of traffic control flag officers |
| There was traffic disruption to the surrounding population | H | - Construction of temporary roads for local residents |
| Injured due to improper operation of the grader | M | - Check the suitability of the compactor, the operator must be skilled and experienced and the operation of the compactor must be correct |
| 5 Watering | Health problems occur because the water used for watering is not health | L | - Water used for watering must be by the provisions (not smell bad, etc) |
| Installation of traffic signs and assignment of traffic control flag officers | M | - There was an accident in the operation of the sprinklers (Water Tanker) |
| An accident hit by vehicle traffic | H | - Installation of traffic signs and assignment of traffic control flag officers |
| C Asphalt Pavement, Laston Layer Wear Modification (AC-WC Mod) | |
| 1 Measurement benchmarking and Accident or hit by a passing vehicle | H | - Measurements must be made using a meter that complies with the standard. The measuring staff must wear gloves that comply with the standard |
| Accident or hit by a passing vehicle | H | - Installation of traffic signs and assigning traffic control flags |
| Number | Activities | Potential Risks | Risk Category | Risk Control |
|--------|------------|----------------|---------------|--------------|
|        | There was a disruption to vehicle traffic | | H | - Must be installed temporary traffic signs and assigned by traffic control officers |
|        | Irritation of the skin, eyes and lungs due to dry dust | | L | - Wounded by splashing hot asphalt |
|        | Wounded by Compressor long time sweeping the pavement | | M | - Compressor workers or operators must be skilled and experienced in their field |
|        | There was a disruption to vehicle traffic | | H | - Installing temporary signs and controlling traffic to keep going smoothly by doing the ½ part work first. |
|        | Spraying | Wounded by hot asphalt splash | | H | - Burners must wear clothing and equipment (boots, gloves and masks) that comply with the standard |
|        | There is irritation to the eyes, skin and lungs due to steam and heat from the asphalt | | M | - Use goggles and a mask to prevent eye and lung irritation from smoke and heat from flames and asphalt |
|        | Vehicle traffic disruption | | H | - Installing temporary signs and controlling traffic to keep going smoothly by doing a ½ part job first. |
|        | Overlay | Wounded by hot asphalt splash | | M | - Burners must wear clothing and equipment (boots, gloves and masks) that comply with the standard |
|        | There is irritation to the eyes, skin and lungs due to steam and heat from the asphalt | | M | - Use goggles and a mask to prevent eye and lung irritation from smoke and heat from flames and asphalt |
|        | There was a traffic disrupt | | H | - Installing temporary signs and controlling traffic to keep going smoothly by doing the ½ part work first. |
|        | Compression | Wounded by hot asphalt splash | | M | - Burners must wear clothing and equipment (boots, gloves and masks) that comply with the standard |
|        | Wounded by the asphalt compactor (Tandem Roller and Pneumatic Tire Roller) | | M | - Keeping no outsiders or other workers in the compaction area when the asphalt compactor (Tandem) works to compact the Hotmix at the job site |
|        | There was a traffic disrupt | | H | - Installing temporary signs and controlling traffic to keep going smoothly by doing the ½ part work first. |

In Table 9. The results of the recapitulation using the FTA method, describe each activity with the potential risk, risk value, risk category, risk control carried out.

4. **Conclusion**
Based on the research that has been done, it can be concluded as follows:
1. The dominant occupational hazard potential category value is H which means High Risk requiring parties to provide training by High Risk management, scheduling corrective actions as soon as possible.

2. The occupational hazard potential category values out of 52 potential hazards are 5 Extreme Risk, 21 High Risk, 20 Moderate Risk, and 6 Low Risk. The dominant occupational hazard potential category value is High Risk.

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