Reliability Analysis of Safety System on Fire Hazard Factory Building (Study Case at PT. Semen Baturaja)

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Abstract: PT. Semen Baturaja is one of the state owned enterprises that has the biggest factory in Baturaja, it means that its factory has highest risk of fire. The purpose of this research is to identify completeness and countermeasures of the safety system to the danger of fire in factory building and to analyze the reliability of safety system to the danger of fire in factory building in PT. Semen Baturaja Factory. The method used in this research is descriptive analysis method, where to get the required data is direct observation in the field. Observations and assessments are conducted by competent experts in the field of fire safety. The condition of each component or part of the building is then assessed and evaluated. The criteria used as reference materials for the assessment of the condition of completeness of fire prevention and prevention facilities are derived from SNI Pd-T-11-2005-C. Observations were made to determine the level of reliability of building safety systems against the danger of fire based on the above regulations. The result of this research is based on recapitulation percentage of checklist of completeness of fire prevention and control facilities, factory building that has the completeness of fire prevention and prevention facilities equal to 58.88% and 42.12% have not fulfill complete of fire prevention and control facilities, most of which are not fulfilled on the active protection system components. From the analysis of reliability level to 84 elements of the building room, for the reliability level > 80-100, there are 41 elements of building space or 49% which have "Good" reliability level as per requirement and 43 building space or 51% with reliability value of 60-80 which has a level of reliability "Enough" because it is installed but there is a small part that does not fit the requirements.

Keywords: the reliability value of building safety system, Safety system of fire

1. Introduction

The development of construction in Indonesia is increasing every year. Every year, the development of building construction is more complex and diverse. In constitution role about building [1,2] stated that every building should require the administration requirements and technical so the building is feasible function. Several fire incidents in commercial buildings and offices should be an important lesson in the face of fire dangers. Fire may occur anytime and anywhere, no workplace guaranteed to be risk free from fire dangers. Fires in the workplace can have disastrous consequences for many companies, both for companies, workers and the wider community.

PT. Semen Baturaja as a state-owned enterprise which owns the largest factory in Baturaja and has a large number of employees and operates every day certainly has a high risk in the danger of fire. Not all buildings have good fire protection planning. Fire prevention is one aspect of building safety. To know and assess the reliability level of a building, the researcher will analyze the application of building reliability system to fire danger by using five components which are the criteria of reliability.
in fire control in a building that is the completeness of the site, rescue device, active protection system, passive protection system and management fire safety.

Based on the above description and the absence of analysis on the reliability level of PT. Semen Baturaja against fire danger there are several problems and need to be investigated, that is how the application of fire protection system in building with a study case at PT. Semen Baturaja and how the reliability level of safety system to fire danger especially in factory building of PT. Semen Baturaja. This study aims to identify the completeness of means of prevention and control of fire hazards in the factory building of PT. Semen Baturaja, Evaluating the implementation of fire protection system and analyzing the reliability level of fire safety system at PT. Semen Baturaja.

2. Theoretical Framework

Fire is an unpredictable event. Prevention of fire hazards in buildings shall be any effort concerning the provisions and technical requirements required to regulate and control the construction of buildings including licensing process, execution, utilization, maintenance of building and inspection of building feasibility and reliability against fire hazard. The general definition of fire is an occurrence of unwanted flame, whereas the particular definition is an oxidation event between the three elements of the cause of fire ie solids, liquids and gases [3].

Fire building safety is a condition that ensures the safety of the building and its contents (human, equipment and goods) from the fire hazard. Preventing fire is any attempt to avoid a fire. While extinguishing the fire is a technique to stop the reaction of combustion / flame. Building safety inspection against fire hazard in building is done with Indonesian National Standard [4] that is standard used to know the level of reliability by conducting a series of examination on the ability of prevention facilities that are active and passive to obtain information level reliability of the building.

2.1 The Definition of Reliability

The reliability of the building is the level of perfection of the condition of the protective equipment that ensures the safety, functionality and comfort of a building and its environment during the lifetime of the building in terms of the dangers of fire.

The value and reliability level of the inspected building should be established by an examining team consisting of relevant experts and having the required qualifications. The inspection process may use visual means, measurement of system performance based on prevailing building safety standards and / or knowledge / experience in accordance with the forms in the attachment. The level of building safety reliability is classified into:

a. Good, if the reliability value of building safety system is not less between 80% - 100%.
b. Good enough, the reliability value of building safety system 60%-80%,
c. Less, if the reliability value of building safety system < 60%

2.2 The Reliability Analysis of Building

After a team has finished examining a building, the field data obtained are used to:

a. determine the reliability of building safety system.
b. determine the level of reliability of a building (good condition, enough, less).

The recommendation of the final result of the calculation of the result of the condition assessment is dependent on the result of examination of the reliability value of the building safety system which has been calculated, the recommendation may be submitted by the examining team which leads to return the condition less (K) or enough (C) to be good (B ).

Recommended steps include:

a. Periodic examination
b. Periodic maintenance / maintenance
c. Periodic maintenance and repair
d. Adjustment / repair elements
e. Complete the less components.
2.3 Previous Related Study
In a study conducted by [5] concluded that the level of risk is happening in three hotel buildings and two buildings at high risk of fire at Swarna Dwipa Hotel. While [6] in his research explains that the elements that affect the risk of occupants are human factors, fuel factor (building contents) and the potential for fire. Researchers also concluded that the study of fire risk in the shop building in Palembang City 16.67% medium risk and 83.33% high risk.

3. Research Methodology
The method of data analysis used in this study is descriptive analysis due to get an idea about the application of the rules used as a reference in this study. To find out the value of NKSKB, observation method was used with data collection based on the variables prepared in accordance with the Regulation of the Minister of Public Works [4,7] concerning Fire Inspection of Building Fires.

3.1 Variable
Research Variables Reliability Value of Building Safety System to Fire Hazards are listed in table 1 below.

| No | Variable | No | Variable |
|----|----------|----|----------|
| 1  | Completeness Of Site | 8  | Smoke Detection |
| 2  | Road Neighborhood | 9  | Smoke Disposal |
| 3  | Distance between buildings | 10 | Fire Elevator |
| 4  | Hydrant page | 11 | Emergency light |
|    | Rescue Facility | 12 | Emergency Electricity |
| 1  | Exit | 13 | Space control operation |
| 2  | Road Construction | 1 | Fire resistance of building structures |
| 3  | Helicopter Platform | 2 | Compartmentalization of space |

**Active Protection System**

| No | Variable | No | Variable |
|----|----------|----|----------|
| 1  | Alarm | 3 | Protection of openings |
| 2  | Siamese connection | 1 | Inspection and Maintenance |
| 3  | Light fire extinguisher | 2 | Coaching and Training |
| 4  | Hidran | 3 | Emergency Plan |
| 5  | Sprinkler | 4 | fire housekeeping |
| 6  | Extinguishing system | 5 | Fire Control Center |

3.2 Assessment Criteria
The data collection procedure of the research object is done by several methods including: (1) observation (2) interview and (3) photo documentation.

Value The condition of the fire protection component of the building is divided into three levels, namely Good = "B", Medium or Fair = "C" and Poor = K.

| Interval | Criteria | Reliability |
|----------|----------|-------------|
| > 80 – 100 | Fit requirement | Good |
| 60 – 80 | Installed but there are a few installations that do not fit the requirements | Fair |
| < 60 | Not at all | Poor |
4. Analysis and Discussion

To know the completeness of facilities and infrastructure of fire prevention and handling prevention in PT. Semen Baturaja (Persero) Tbk, the authors do check with fire safety experts who already have a certificate of expertise K3 Fire includes: site completeness, rescue tools, active protection system, passive protection system and fire management. After checking the completeness of facilities and infrastructure for prevention and prevention of fire hazard, then continued calculation of percentage of all samples studied so that can know the percentage of work units that have been complementary and not yet equip means of prevention and handling fire hazard. factory buildings that have fulfilled fire prevention and handling facilities include: site equipments, rescue facilities, active protection system, passive protection system 57.88%, while those not fulfill 42.12%.

4.1 The Analysis of Reliability Level in Room Building Work Unit

Assessment of the reliability level of factory buildings in this study using Indonesian National Standard (SNI-Pd-T-11-2005-C). In this study there are two elements of the criteria are ignored the helicopter and fire lift. This is because according to SNI Pd-T-11-2005-C, the helicopter base is required for buildings with a height of more than 60 meters. PT. Semen Baturaja itself has a helicopter base but is located in a field outside the factory building area. Meanwhile, fire lifts are required for buildings with a height of more than 25 meters. PT. Semen Baturaja also has an elevator but usually only used for goods. Analysis of the reliability level of building space against fire hazard through several stages, namely Seeking Space Element Reliability. To obtain the reliability value of space elements presented in the form of a condition assessment table. This assessment is conducted by author and expert of Fire K3 by referring to SNI Pd-T-11-2005 to 84 elements of factory building space with no interconnection between each other.

4.1.1 Value Calculation of Space Reliability Level

In calculating the value of the reliability level of the space all the assessment results in Table 4.3 then included in the standard table calculation of each component using tables 2.4 to 2.7. to find out the value of the condition of each component of the means of prevention and prevention of fire. After the calculation is done with the standard table, then summed the value of each element to obtain the value of the reliability level of the building under study. In the calculation of the level of reliability of the building space of this factory is given one example of the building space of the factory that is the test object with the identity of the DOP building with CCR Factory activities.

Example calculation:

For the component of the site completeness assessment, the value of the water source condition, the environmental path, the distance between the building and the hydrant of the yard.

\[
\begin{align*}
\text{Water source} & = 100 \times (27/100) \times (25/100) = 6.75 \\
\text{Circumference} & = 100 \times (25/100) \times (25/100) = 6.25 \\
\text{JAB} & = 100 \times (23/100) \times (25/100) = 5.75 \\
\text{Yard hydrant} & = 100 \times (25/100) \times (25/100) = 6.25
\end{align*}
\]

Then the value of each element summed and obtained the following component values:

a. Site completeness = 25.00
b. Rescue Means = 18.25
c. Active Protection = 16.37
d. Protection Passive = 22.67

Then the value of the component is added and obtained the reliability value for the building identity test object DOP CCR Factory space with value = 82.29

4.1.2 Reliability Value of Building Safety System to Fire Hazards

From the analysis result, it was found that the reliability level of 84 (eighty four) elements of plant building space were analyzed based on the data of each element of space, as in table 3 below.
## Table 3. Value of Building Factory Reliability Level PT. Semen Baturaja

| No | Interval | Total of Room | (%) | Criteria                  | Reliability |
|----|----------|--------------|-----|---------------------------|-------------|
|    | >80-100  | 41           | 49  | Fit requirement           | Good        |
|    |          |              |     | Installed but there are a  |             |
|    |          |              |     | few installations that do  |             |
|    |          |              |     | not fit the requirements  |             |
|    | 60-80    | 43           | 51  |                           | Fair        |
|    |          |              |     |                           |             |
|    | < 60     | 0            | 0   | Not at all                | Poor        |
|    |          |              |     |                           |             |
|    | Total    | 84           | 100 |                           |             |

### 5. Conclusion

After analysis and calculation of this research can be drawn some conclusions as follows:

- a. From the results of identification in the can section that meet the completeness of fire prevention and copying facilities is 52.88% and which does not meet completeness of fire prevention and copying facilities is 48.12% of 84 elements of the work unit of the factory building. From the data obtained in the field is mostly not met is on the active protection system components.

- b. The most dominant factor in determining the level of building reliability is the factor of active protection system because there are many criteria of components that must be equipped to improve the reliability of the building safety system against fire hazard in the factory of PT. Semen Baturaja.

- c. Level of reliability of building space elements as many as 84 samples on the work unit PT. Semen Baturaja against fire hazard is 49% or about 41 spaces have a "Good" reliability level and 51% or about 43 spaces have "Enough" reliability.

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