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Assessment of Building Reliability in the Gedung Kuliah Bersama (GKB) of State Polytechnic Fakfak West Papua

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ABSTRACT

The engineer must pay attention to strength, comfort, frugality, and impact on the environment in the building planning both in multi-storey or non-storey. Those aspects must be carefully planned and taken into a capable management system in it and to comply the comfort aspect in the building, hence disaster risk management such as fire prevention is needed. The purpose of this research is to evaluate the fire prevention and control system based on Minister of Public Works Regulation No.26/PRT/M/2008 and Indonesian National Standart 03-6574-2001, analyze the building reliability, and provide alternative solutions for the fire disaster control system in the college building of Fakfak State Polytechnic. The result of check list observation showed the average suitability was 58.89%. The calculation result of Value of the Building Safety System Components using the Pd-T-11-2005-c guideline based on *Analytical Hierarchy Process* (AHP) was 64.23 % < 80%. It was classified into GOOD ENOUGH. From the results, alternative solution that can be proposed for college building at Fakfak State Polytechnic is to establish fire prevention.

Keywords: AHP; fire; Pd-T-11-2005-c; politechnic; prevention.

INTRODUCTION

According to Ramli (2010), fire disaster should be managed and planned properly starting from prevention, countermeasure and rehabilitation after a fire occurs. By the reason of the tendency of the community so far only reacts after a fire occurs, moreover the fire hazards are often ignored and do not get attention of management system. Therefore, the program for controlling and managing fire in the college building should be a priority in building planning in West Papua, especially in Fakfak.

The objectives of this research are as follows:

1. How is the suitability of fire prevention and management in the college building at Fakfak State Polytechnic based on the Minister of Public Works Regulation No.26/PRT/M/2008 and the Indonesian National Standart 03-6574-2001?
2. How is the building reliability level?
3. What are the alternative solutions for a fire disaster control system?

RESEARCH METHODS

The object of this research is the college building of Fakfak State Polytechnic. The research location is on Jalan Air Merah, Wagom, Fakfak, West Papua.

Figure 1. Gedung Kuliah Bersama (GKB) State of Polytechnic Fakfak

This research is a descriptive and analytical research by collecting, describing, analyzing and concluding data. The observation was conducted to assess the suitability of preventing and overcoming fire hazards in the college building of Fakfak State Polytechnic. The observation result was carried out using check list based on building and environmental protection systems using standart of Minister of Public Works Regulation No.26/PRT/M/2008. Afterward, a reliability analysis was carried out based on the reliability value of the building using Pd-T-11-2005-c and the AHP guideline.

Data Collection and Analysis Technique

The data collection technique and analysis techniques can be described as follows:

1. Conducting spatial observation related system and effort to prevent and overcome fire hazards.
2. Collecting secondary data regarding building plans, area and allocation. It was to determine recommendations for the installation of fire extinguishers.
3. Conducting observation were made on several variables consisting of life-saving facilities, walls, doors and floors, electrical installations, light fire extinguishers, wall hydrants, pole hydrants, alarms and detection devices, assembly *points*, access for firefighters, and standard operating procedure.
4. Conducting study on the fire prevention and control system which regarded on government regulation. It was in the form of a *check list* using measurements:

   a. Yes: in accordance with regulations

   b. No: in accordance with regulations.

   The check list refered to the Decree of the State Minister of Public Works No.26/PRT/M/2008, on December 30, 2008 concerning technical requirements for fire protection systems in the building and the environment. It was regarded on some building criteria. The building belongs to “bangunan kelas lima”. The building type is office and edifice that used for some purposes such as professional business, administration, or commercial business.
5. Indonesia national standart 03-6574-2001 stated the procedures for designing emergency lighting, directional sign and hazard warning system must have a minimum standart for the building. It is emergency lighting, directional sign and hazard warning system. Those should be considered for all parties involved in planning, construction and maintenance of building.
6. Therefore, to complete the object will be added in the regulation of the Minister of Public Works Number: 20/PRT/M/2009 which regulates about the technical guidelines for management of fire protection in urban.

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7. The observation result which obtained from filling out the check list was analyzed and displayed using some criteria referring to the 2002 Ministry of Health accreditation standard by using criteria as follows (Priyanto, 2006):
   a. Good: if the percentage of answers is "Yes" 76 - 100 %
   b. Medium: if the percentage of answers is "Yes" ” 60-75%
   c. Poor: if the percentage of answers “Yes” <60%
8. The data was analyzed and presented descriptively. The observation result was displayed after calculating the research instrument using following formula: (Sambudi, 2007)

$$\% \text{ standard achievement} = \frac{Total\ score\ x\ 100}{Number\ of\ parameters} \quad \text{.....(1)}$$

After obtaining the result from observation, then an assessment of fire reliability was conducted using Pd-T-11-2005-c and *Analytical Hierarchy Process* (AHP) guideline.

9. Conducting interview to the parties toward the college, technical team, consultant and contractor. This was to find out information related to fire management and protection and prevention of hazard fire. The data obtained would be used to analyze the cause of the fire.

Research Framework

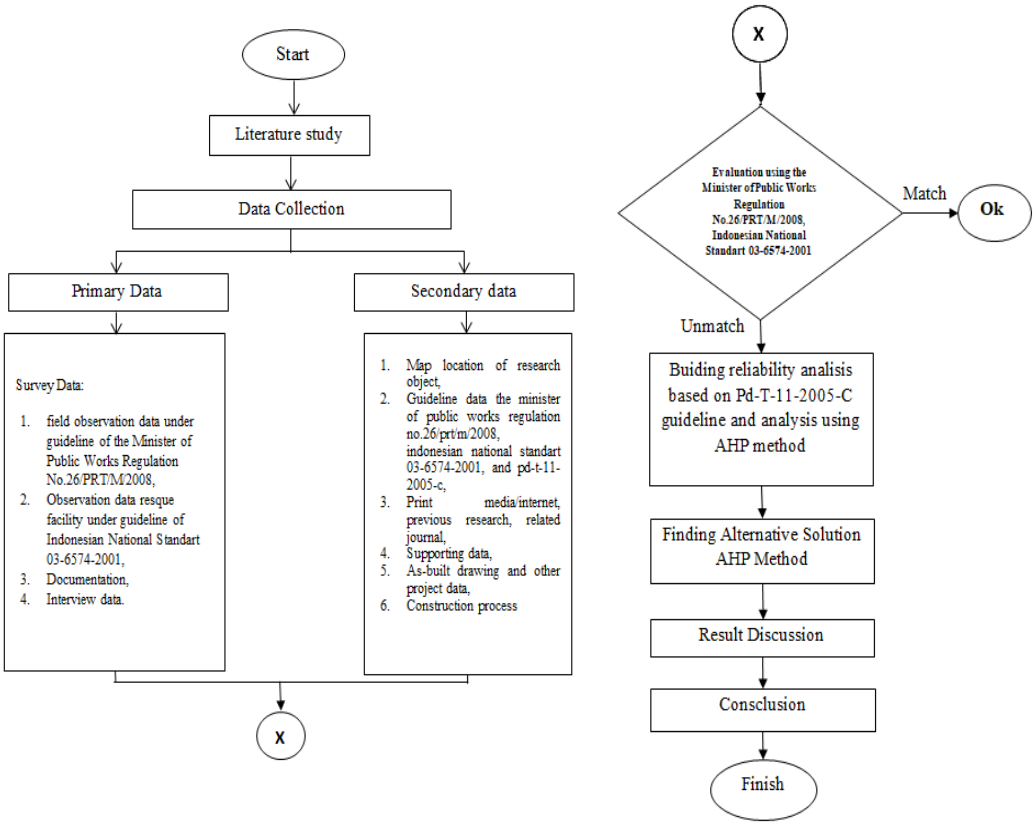

Figure 2. Research Framework.

RESULT AND DISCUSSION

Comparative Using the Minister of Public Works Regulation and Indonesia National Standart

In this study, field observation using the comparison of the Minister of Public Works and the Indonesia National Standart was an initial effort to analyze reliability and provide the alternatives toward research object.

From the checklist observation in the table above, the college buiding has 52 of a total of 90 important points on the technical requirements of the fire protection system.

% of standard achievement = $\frac{52}{90} x\ 100$ = 57.78% < 60%, hence the technical requirement for the fire protection system in the college building was classified as worse or inappropiated to the standard.

The assessment result using Indonesian national standart 03-6574-2001 shows that the college building had conformity 60%.

In conclusion, the college building does not prioritize fire safety in building construction, therefore the assessment and analysis of the building safety system reliability is needed in the building.

The Data Analysis based on Pd-T-11-2005-c Guideline

The fire safety system is a passive protection system and active protection system which each component refers to the Minister of Public Works Regulation No.26/PRT/M/2008. The value and the building safety level reliability used Pd-T-11-2005-C guideline. The data analysis guidelines used was listed in the following table:

No	KSSB/SUB KSKB	Research Result	Assessment Standart	Quality	Condition Value	Total Value
1	2	3	4	5	6	7
I. SITE COMPLETENESS				**25**		
1	Spring	B	100	27	6,75	
2	The Road Of The Environment	B	100	25	6,25	
3	Distance Between The Building	B	100	23	5,75	
4	Yard Hydran	K	0	25	0	
				100		**18,75**
II. RESQUE FACILITY				**25**		
1	Exit,	C	75	52	9,75	
2	Construction Exit	B	100	48	12	
				100		**21,75**
III. ACTIVE PROTECTION SYSTEM				**24**		
1	Detection And Alarm	K	0	8	0	
2	Siames Conection	K	0	8	0	
3	Light Fire Extinguisher	B	100	8	1,92	
4	Hydrant In The Building	K	0	8	0	
5	Sprinkler	K	0	8	0	
6	Overflow Outage System	K	0	7	0	
7	Smoke Control	K	0	8	0	
8	Smoke Detection	K	0	8	0	
9	Smoke Disposal	K	0	7	0	
10	Fire Lift	K	0	7	0	
11	Emergency Light	C	75	8	1,44	
12	Emergency Electric	B	100	8	1,92	
13	Operation Controller	C	80	7	1,344	
				100		**6,624**
IV. PASSIVE PROTECTION SYSTEM				**26**		
1	Fire Resistence Of Building Structure	B	100	36	9,36	
2	Space Compartmentalization	C	75	32	6,24	
3	Aperture Protection	C	75	32	6,24	
				100		**21,84**

Figure 3. Data analysis based on the Pd-T-11-2005-c

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Table 1. The Recapitulation Result of NKSKB

No.	KSKB Parameter	Weight (%)
1	Completeness of Site	18.75
2	Rescue Means	21.75
3	Active Protection System	6.62
4	Passive Protection System	21.84
	Total	**68.96**

The value of the building fire component condition ws divided into three levels, namely: GOOD = "B", ENOUGH = "C", and Less = "K". (The equivalent value of B is 100, C is 80 and K is 60). From the recapitulation using the guideline showed 68.96 < 80%, whereas the reliability value of the building's safety was classified into GOOD ENOUGH.

Data Analysis based on *Analytical Hierarchy Process* (AHP) guideline

To know the reliability of fire, the basic principles of AHP were used. The principles were *decomposition, comparative judgment, synthesis of priority* and *consistency*. From the questionnaire was found some datas as follows:

Decompotion

The researcher defined the problem by breaking the whole problem into the elements and described in a hierarchical form. The criteria and alternative assessment were described in the hierarchical structure as follows:

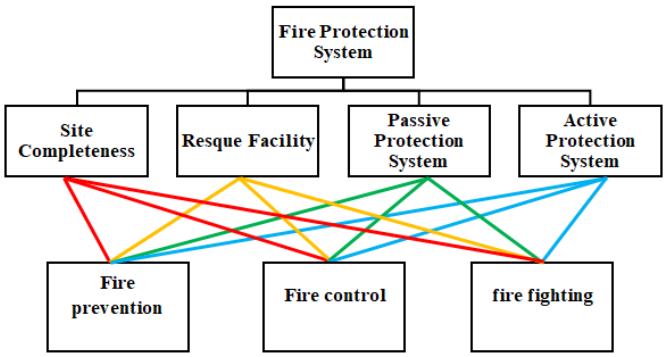

Figure 4. Hierarchical structure of fire protection systems in building

Comporative Judgment

The assessment was carried out based on the importance of elements at a certain level with the next level, afterward it was reported in the form of a pairwise comparison matrix. The matrix was filled in using numbers to represent the relative importance of an element to other elements.

The matrix figures were obtained from questionnaires that had been filled out by respondents. The selected respondents were experienced at construction industry. They were from Fakfak.

After making the hierarchical arrangement of the fire protection system in the further building, namely, a comparative assessment. Each criterion used with the following assessment:

1. Calculation of weight with reference to fire prevention was carried out by comparing each component with a comparative assessment as follows:

   a) Completeness site: means of rescue (3 :1) means the site completeness is slightly more important than means of rescue.

b) Completeness of the tread: passive protection system (1:1) means the completeness of the tread is as essensial as the passive protection system.

c) Completeness of the tread: active protection system (4:1) means the completeness of the tread is fairly more essensial than an active protection system.

d) Facility of rescue: passive protection system (1:1) means the facility of rescue is as essensial as passive protection system.

e) Facility of rescue: active protection system (2:1) means the facility of rescue is fairly important with an active protection system

f) Passive protection system: active protection system (3:1) means the passive protection system is slightly more important in supporting fire prevention than active protection system.

The rubric assessment of pairwise comparison components used are in the following table bellow:

Criteria	Site Completeness	Resque Facility	Passive Protection System	Active Protection System
Site Completeness	1	3	1	4
Resque Facility	0,33	1	1	2
Passive Protection System	1	1	1	3
Active Protection System	0,25	0,5	0,3	1
Total	2,58	5,50	3,33	10

Figure 5. Pairwise comparison matrix between criteria based on alternatives Fire prevention

Synthesis Of Priority

After creating a pairwise comparison matrix, the next step was to look for the normalized eigen vectors. In this step, rows and columns from previous table was multiplied.

***Eigen Vector* Normalisation**						
Fire Prevention	**Site Completeness**	**Resque facility**	**Passive Protection System**	**Active Protection System**	**Total**	**EVN**
Site Completeness	4	9	6,33	17	36,33	0,44
Resque facility	2,17	4	3,00	4	13,16	0,16
Passive Protection System	3,08	6,5	2,67	12	24,25	0,29
Active Protection System	1,00	2,08	1,42	4	8,50	0,10
Total					82,25	1,00

Figure 6. Criteria vector Eigen values based on fire prevention alternatives

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Consistency

Consistency ratio was used to determine the level comparison assessment consistency criteria. This is the result of calculation using Ms. Excel.

Table 2. The ratio of alternative consistency criteria

Based on the alternative	Consistency Ratio		
	Emax	CI	CR
Fire prevention	4.04	0.012	0.014
Fire control	4.23	0.077	0.085
Fire suppression	4.15	0.049	0.054

Regarding the table the value of the consistency ratio was obtained <0.1, it was classified as consistent. The EVN result was calculated by each alternative prevention, then divided divided by 3 (the number of alternatives). Hence, the average weight of the criteria on the alternatives was obtained as follows:

Table 3. Average of weight criteria

Criteria	Weight
Site Completeness	0.35
Resque facility	0.16
Passive protection	0.30
Active protection system	0.17

No	KSSB/SUB KSKB	Research Result	Assessment Standart	Quality	Condition Value	Total Value
1	2	3	4	5	6	7
I. SITE COMPLETENESS				25		
1	Spring	B	100	27	9,99	
2	The Road Of The Environment	B	100	25	9,25	
3	Distance Between The Building	B	100	23	8,51	
4	Yard Hydran	K	0	25	0	
				100		27,75
II. RESQUE FACILITY				25		
1	Exit,	C	75	52	6,24	
2	Construction Exit	B	100	48	7,68	
				100		13,92
III. ACTIVE PROTECTION SYSTEM				24		
1	Detection And Alarm	K	0	8	0	
2	Siames Conection	K	0	8	0	
3	Light Fire Extinguisher	B	100	8	2,4	
4	Hydrant In The Building	K	0	8	0	
5	Sprinkler	K	0	8	0	
6	Overflow Outage System	K	0	7	0	
7	Smoke Control	K	0	8	0	
8	Smoke Detection	K	0	8	0	
9	Smoke Disposal	K	0	7	0	
10	Fire Lift	K	0	7	0	
11	Emergency Light	C	75	8	1,8	
12	Emergency Electric	B	100	8	2,4	
13	Operation Controller	C	80	7	1,68	
				100		8,28
IV. PASSIVE PROTECTION SYSTEM				26		
1	Fire Resistence Of Building Structure	B	100	36	6,12	
2	Space Compartmentalization	C	75	32	4,08	
3	Aperture Protection	C	75	32	4,08	
						14,28

Figure 7. Data analysis based on the results of weighting using AHP

The recapitulation result the Pd-T-11-2005-c guidelines was 64.23 > 60% <80%. It means the value of the reliability of the building safety was classified as GOOD ENOUGH.

Table 4. The recapitulation result using AHP

No.	KSKB Parameter KSKB	Weight (%)	AHP Weight (%)
1	Completeness of Site	18.75	27.75
2	Rescue Facility	21.75	13.92
3	Passive Protection System	6,624	8.28
4	Active Protection System	21.84	14.28
	Total	68.964	64.23

The researcher obtained two results refered to the building safety system reliability value (68.96%) and the weighting of respondents on AHP was 64.23%. There was a difference 4.73% in the KSKB classification. It was classified as a sufficiently reliable building.

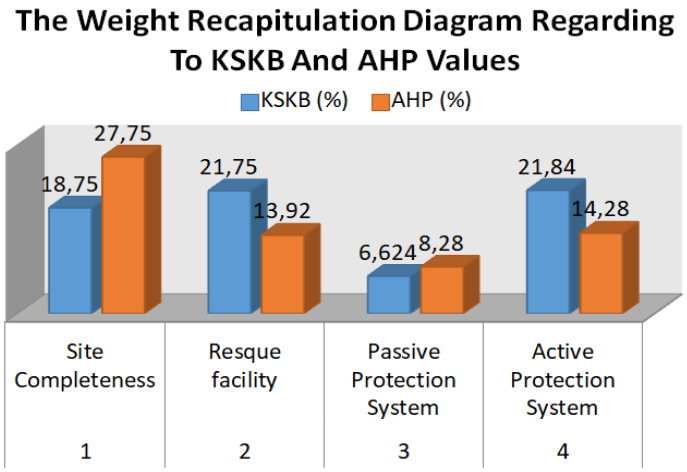

Figure 8. The weight recapitulation diagram regarding to KSKB and AHP values

Finding Alternatives Solution

This calculation was carried out in the similar method to compare between the criteria. However the calculation was conducted to compare each alternative procedure with each criterion. To reach the purpose of good fire protection, the researcher tried to find out which alternative calculation is better prioritized in fullfilment the criteria.

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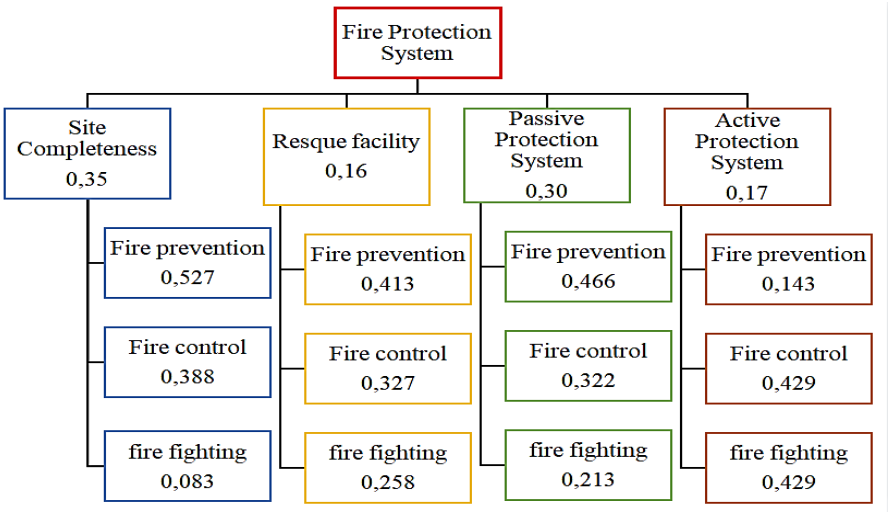

Figure 9. Sub-Hierarchy of Alternative Solution

The calculation result from the AHP was obtained from experienced respondents. The tread completeness (0.35) was more important than passive protection systems (0.30). It was more important component of the active protection system (0.17). The facility of rescue was more important in supporting fire safety (0.16).

The alternative solution for college building which can be suggested was to establish the fire prevention. The fire prevention value is higher on all criteria than others.

CONCLUSION

Based on the result of the analysis, the following conclusions can be drawn as follows: 1) The result of the checklist observation was found the college building has 52 important points on the requirements a technical fire protection system 57.78% <60%. It was classified as bad or not accordance to the standart but the assessment result had conformity 60%. 2) The result recapitulation of the NKSKB calculation using the Pd-T-11-2005-c guidelines showed 68.96 > 60% <80%, while the guideline based on the AHP was 64.23% <80%. The value of the reliability of the college building was classified as GOOD ENOUGH. The two results had 4.73% difference which classified as quite reliable. 3) The AHP calculation result showed the alternatives that appropriate to be suggested was establishment of fire prevention. The fire prevention value is higher than others. The building safety system should accustom to the regulation that have been set, improve the fire management system, and ensure safe electrical installation.

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