## FIRE DISASTER MODEL FOR CAMPUS BUILDING, A CASE STUDY OF BRAWIJAYA UNIVERSITY

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### ABTSRACT

Fires in buildings have the significant impact on communities both socially and economically. In education facilities, fire incidents have the potential impact on academical activities and research products. Fire authorities, practitioners and relevant bodies have been addressed this issue partially on the points of physical aspects and management addressed to fire safety. This study seeks the importance element of a framework that should be implemented comprehensively increasing campus building fire protection around the clock. Number of buildings in the Brawijaya University were used as the sample study. Assessment of fire protection tools of buildings have been performed to seek potential fire risk, a questionnaire has been distributed online throughout building occupants seeking the level of awareness and knowledge toward fire incidents. Meanwhile, existing fire disaster models implemented in some campus buildings been reviewed. The study found 4 elements of the fire disaster model to be taken into account, including occupant's knowledge and awareness, the quality infrastructure of the building, incentives, and control.

**Keywords :** fire safety management, fire protection, building occupants, fire safety awareness.

## **1. INTRODUCTION**

Fire incidents may occur in all types of buildings, such as residential buildings, offices as well as educational facilities. In Indonesia, number of campuses have been caught by fire in the last decade. The incident in the Islamic University of Malang in Juni 2016 have been demolised 2 out of 3 floor levels classrooms and laboratorium. This fire was caused by shirt circuits in an electrical distribution panel.

Another campuss fire have reported in Budi Luhur University, Tangerang in December 2015. The incident took place during class hours which resulted an extreme panic and chaos amongst the staff and students to leave the buildings. The fire incident was investigated by forensic laboratory that indicate a short circuit to be the main cause of fire. A big fire also wiped out part of building in the Business and Informatics Institute of Indonesia, known as the Kwik Kian Gie School of Business, in early of January 2014. As typical campus building fires, the incident create chaos of the occupants for evacuation. The source of fire was predicted from a faulty air cooler inside a classroom. In the same year, another fire occured in the Civil Engineering Faculty of the University of Indonesia. Even though there was no any casualties reported, number of research paper and PhD dissertation have been extincted.

Fires incidents in educational facilities take place regardless how strong the building regulation are implemented. Even in the USA which has been implemented very tight building requirements, seven fire incidents were reported annualy in campuses. It was recorded from fire data of Fire Brigade that there were merely 85 cases causing 118 casualties during 2000 to 2015. Arround 58% of the fire causing death, was initiated in the university dorms that are not completed with proper smoke detectors. Meanwhile, 85% of the incidents are in buildings without fire sprinklers.

The cause of the fire varies, but it can be categorised into two aspects, such as: human error and engineering failure of the building. Both of these aspects should be manage appropriatelly in the life time of the building, from the planning, construction toward operational phase (post-habitation) of buildings. In Indonesia, the rate of engineering failure of a building is higher than human error since national fire data reported the electrical failure (short circuit) as the most frequent incident to ignite fire. (Sufianto and Green, 2012).

Mechanism control through building regulation (fire protection system) has been

implemented (PU Cipta Karya, 2000), yet fire incidents appear frequently. Presumably, these incidents were caused by the weakness of supervision and maintenance toward the performance of fire engineering across the operation of buildings, especially when building alterations have been made.

Number of fire incidents, however, were shown that in the planning stage to be supported by the development of human behaviour (occupant's behaviour) and building management. An effective control mechanism is needed to prevent fire break in earliest stage. Fire safety management mechanisms are also needed to restore a building to refunction as soon as possible (fast building recovery). A fire safety management, therefore, is essential to cover the lack of building engineering system.

Brawijaya University is one of the big 5 universities in Indonesia that is encouraged to develop their buildings vertically, this is because of the availability of land/area (58 Ha) and the increasing number of people who inhabitate campus area throughout the year. It was recorded of merely 16,000 new students inhabit the campus and near campus area every year. There are currently 16 highrise buildings require high performance fire protection system either for prevention and suppression system. This study aims to seek an effective model to lessen the risk of fire incident in campuss buildings. The Brawijaya University was chosen as sampel study.

### 2. CURRENT FIRE SAFETY FRAMEWORK

The fire safety management basically aims to guarantee the preparedness of building and its occupant toward fire incident and to prevent the level of risk and/or loss on the level acceptable to building management (Chen, Chuang, Huang, Lin, & Chien, 2012; Hassanain & Mohammed Abdul, 2005; Malhotra, 1993).

In the design stage, fire safety management amis to ensure the availability of fire safety levels through an agreement on certain standards. A number of recent international standards are used in a field of rescue techniques, including: rational approach for fire building engineering by CIB 2001 and guidance for risk assessment application by SPFE 2005.

The first guide was initiated by Council International du Batiment (CIB, also known as the International Council for building issues) which is directed to assist all involved parties including regulators, architects, design engineers and construction companies, to improve and renew their understanding of fire retardance and methods in assessing fire safety design in buildings (CIB, 2001). This technical guidance is designed through a performancebased approach. The working areas of these guidelines are grouped into three sections, covering: task definition, analysis and documentation that each includes a number of procedures (Figure 1). This guideline adopts a risk management principle where the task definition is used to configure the overall work analysis context. the stage comprises assessment and evaluation processes, whilst documentation process includes avaliable instruments for monitoring and control as materials for the evaluation of success rates from the first stage. The first stage consists of 6 steps comprising: design context definition, objectives, criteria of acceptance and initial trial design. In the second stage, the initial design is tested through a set engineering tools. Only when the result is considered to fulfill the set acceptance criterias, it will move on to the third stage, a documentation of the selected fire safety design.



# Figure 1. Fire Safety Design Framework according to CIB guideline (CIB, 2001)

One of the fire safety guidelines was introduced by Society of Fire Protection Engineers (SFPE) entitled 'SFPE Fire Risk Assessment Framework'. This guideline provides a systematic guidance for quialified engineers to practice fire protection techniques. For stakeholders the guideline is useful to implement a methodology estimation of risk in fire safety design and analysis (SFPE, 2005). This guideline also provides a hand in fire risk assessment in a wider spectrum of risk management.

In this framework, fire risk was assessed through defining the context of assessment in the first place, followed with setting up of acceptance level, identifying potential hazards, and determining assumptions of fire scenarios given by fire engineers (step 1 to 5). The fire scenarios were tested on two dimensions, the frequency of the selected fire scenarios may be expected to occur per unit time and the estimation of potential impacts of a hazard event without consideration of the likelihood of the consequences occurring. In this stage, external data may be needed. In the following stage, fire risk was estimated through combination the frequencies and consequences. level was then compared Risk with acceptability thresholds after consider the uncertainties aspects (e.g. fire modelling, variability of input data). Only when risk level was over the limit, modification of fire safety design was required. However, when risks level was accepted, a proper documentation was required. This documentation was set to guide construction works and building manager or users to maintain fire measures during the operation of buildings.



Figure 2. Fire Risk Assessment Framework according to SFPE (SFPE, 2005)

The technical procedures above explain how fire safety framework or fire risk assessment that were made by various international organisations can be useful to support fire engineers and related parties in determining fire safety building solutions. As a technical document, the procedure adopts risk management principles, however, the main attention is given to engineering approach to provide the right steps in the event of fire in a building. Therefore, there needs to be a deeper emphasis on the type of reactive control issues, that are needed during a fire incident, for example: extinguisher, smoke alarm and occupants evacuation. These guidelines ignores proactive control measures or the prevention of a fire incident.

During the operational stage of the building, fire safety management is used as an operational guidance within the organisation. Fire safety management activities may vary depending on the individual operational management system within the organisation.

Fire safety management components were initiated by Malhotra in the year 1987 (Malhotra, 1987) where the fire safety management program were directed so that all the conditions or requirements of building facility evacuation are still maintained. The management program also covers external facilities that could be a threat to occupants during a fire. In 1993, fire safety management was introduced as a part of building code for a building with more than 50 people residing in it (Malhotra, 1993).

To make sure that every changes to a building will not ignore the effectiveness of construction features planned during the design phase, fire safety management consists of the following components: fire prevention steps guideline; monitoring of guidelines; maintenance of fire protection facilities; residents training; fire drills and emergency plans.

On a broader context, the fire safety management was introduced in the British Standard for public buildings and offices conducted in the UK, BS 5588-12: 1999. This management activity is majorly adopted by the government in Hong Kong (Chow 2001a, Tsui and Chow, 2004). The fire management includes technical and administratice aspects, including: details of management responsibilities; measures for commissioning of fire safety installations and fire safety manuals; the presence of fire safety security; staff and residents training programs; the design of emergency and evacuation procedures; guidance on fire prevention measures; and monitoring programs and evaluation of fire safety guidelines, extensions and changes. These management components are identical to fire safety management applied for an operational underground tunnel in Hong Kong (Chow, 2001b).

From the range of activities done to manage the fire safety above, it can be concluded that fire safety management comprises at least 8 components (Chow, 2001a) such as:

- 1. Inspection.
- 2. Education and training.
- 3. Fire fighting.
- 4. Emergency services
- 5. Evaluation of potential fires.
- 6. Fire prevention.
- 7. Reports and records.
- 8. Communication.

In the University of Reading, the disaster response model emphasizes on 5 components including: the existence of the organisation and the sharing of responsibilities within the disaster organisation, building residents aspects, fire training, insurance, both on the building residents and the physical facilities of the building infrastructure, and also the planning of disaster management. The five components of the model are interconnected with each other hierarchically.



#### Figure 3. Building Safety Model by University of Reading – United Kingdom

The University of Queensland uses the fire disaster response models with emphasis on the five components to implement both during planning and building operational The first component is the maintenance of a fire supression means, aimed at ensuring the building and extinguishing equipment is in a condition suitable for use. The second component is the management of fire staff/volunteer personnels that emphasizes on cooperation mechanism, coordination, training and archiving of each of the fire volunteers of the building. The third component, building evacuation training program which is conducted every year. The fourth component is fire safety monitoring program and risks that is conducted regularly every year. While the fifth component is building design and the monitoring of its use.

In addition to building technology and management factors, human behaviour factors have always been an important part to study (Hanford, 2008; Sufianto & Green, 2012). This is because of the various actions that tend to influence the safety of the occupants during a fire incident (Meacham, 1999). Several studies have found that the occupants' interpretation of the period before the building alarm functions influences the time of occupants' evacuation overall (S. Gwynne, Purser, Boswell, & Sekizawa, 2012; Guylene Proulx & Reid, 2006).

The behaviour of building occupants is one of the 3 keys to successfully handling fire (Kobes, Helsloot, de Vries, & Post, 2010; Nilsson & Johansson, 2009), in which the behaviour is influenced by resident's individual performace, social character and the situation when a fire occurs. Factors of resident behaviour are also considered as determinants of the effectiveness of fire fighting equipment performance in buildings (Bruck & Thomas, 2010) and the performance of building alarm systems (Filippidis, Galea, Gwynne, & Lawrence, 2006; S. M. V. Gwynne, Boswell, & Proulx, 2009).



Figure 4. Fire Safety Building Management by University of Queensland – Australia

### 3. METHODS

This study is directed to assess the physical condition and building infrastructure as well as the building occupant's behaviour against fire hazards. Building information and infrastructure are collected through site observation covering: the existence of emergency exits, fire emergency stairs, fire suppression facilities, electricity network, distance between buildings, building accessibility, open spaces, water sources and fire hydrant layout. Eleven highrise building were chosen as a research sample.

The data of occupant's behaviour and perception of a resident to fire safety was obtained through a questionnaire conducted online for all academicians of Brawijaya University. Pilot studies are conducted to ensure participants have not difficulties to participate in. 37 statements should be completed by participants using 7 points scale (Likert scale). The questionnaire was grouped into 6 categories, such as:

- 1. The occupant's knowledge and awareness regarding fire safety issues.
- 2. The concern of participants toward the availability of fire protection means within their building.
- 3. The occupan's awareness of room alterations.
- 4. Essential factors to improve fire safety.
- 5. The importance of fire safety communication media.
- 6. The effectiveness of building maintenance management.

Data of building and adjacent environments are analysed based on technical requirements directed from the Indonesian Public Work Bluebook No. 10/2000 and No. 11/2000, regarding the safety technical guidelines of building. While а the questionnaire was statistically analysed to determine the propensity of the occupants' tendency towards some of the statements given.

## 4. DISCUSSION

In this article, analysis of physical condition of buildings and infrastructures is not reported in detail but summary. The article includes discussion of occupant's behavior toward fire safety issues since this should be an important aspect to develop fire safety model comprehensively.

The Brawijaya University building safety facilities less meet the requirements as commonly required in high-rise building standards. The room layout, emergency stair construction is not delivered accordingly to the provisions so that it can threaten the effectiveness of evacuation process.

The fire management system is not yet available in all buildings. Only several buildings have person appointed for fighting fire, but formally there is no institution or organization directed to manage fire safety within buildings. The existence of site hydrant should be improved in such a way that it can cover every part of high-rise buildings. Additionally, a specific parking lot for fire car need to be designed uninteruptible around the buildings.

### 4.1. Knowledge of fire safety awareness

The occupant's knowledge and exception to fire safety is evaluated by 10 questions (table 1). The table shows a trend that occupants are aware of things that should not be done to avoid a fire (responses 5, 6 and 7). Table 1 also shows a strong tendency that the building occupants do not want to be actively involved or have the individual skills to extinguish the fire (response 1,2,3,4,8). Cross tabulation analysis shows that most participants who did not agree to join the evacuation training and did not want to have the skills to operate the building extinguishers were the students. Most participants wanted someone was specifically responsible who for maintaining fire equipment (response 8). Whereas about 40% of participants seemed to lack understanding of the association of a large fire source possibly resulting from electrical connection failures (response 5,6,10).

 
 Table 1. Response levels of knowledge and awareness of occupants on fire safety

		1				5				
No	Knowledge and awareness Occupant of fire safety	1	2	3	4	5	6	7		
1	Every inhabitant of a building needs to undergo fire evacuation training	32	16	5	5	2	17	8		
2	Each occupant of the building follows training on fire-fighting equipment	32	19	3	8	2	15	6		

	Knowledge and							
No	awareness	1	2	3	4	5	6	7
	Occupant of fire	-	-	•		•	Ū	
3	Every occupant	6	17	17	6	4	17	18
	of the building							
	knows the							
	location of the							
	fire extinguisher							
	nearest the work							
	table					_		
4	Every occupant	9	23	9	9	/	12	16
	knows the							
	location of the							
	fire extinguisher							
	inside the							
	building							
5	Building	6	8	8	10	6	33	14
	occupants do not							
	use extension							
c	power cord	7	c	c	17	12	22	14
0	occupants are	/	0	0	1/	13	22	14
	electric T							
	branches in							
	buildings							
7	By knowing how	3	2	3	10	8	24	35
	to extinguish the							
	fire, the							
	occupants feel							
	secure and							
	working							
8	Inside the	2	5	0	6	9	31	32
	building there are							
	occupants in							
	charge of							
	maintaining fire							
•	equipment			•	-	-	20	
9	Building	T	4	0	/	/	20	46
	to understand							
	about fire safety							
10	Building	5	7	5	11	9	24	23
	managers need							
	to limit the							
	lifetime of							
	electrical &							
	electronic							
	equipment (eg							

1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: neutral, 5: somewhat agree, 6: agree, 7: strongly agree.

# 4.2. Concern for the completeness of fire building facilities

Six questions are used to see the occupants' concern for building safety infrastructure such as evacuation route signs, practical guidance of fire extinguishers, emergency ladders and other fire suppression facilities. Table 2 shows that most survey participants "agreed" to the needs of the building security supporting facilities of fire, but the conditions are apprehensive, as some of them appear to be less concerned about the fire safety support infrastructure in their work environment. This is evident from the number of responses that still lead to 'disagree' with the existence of fire extinguishers' operating instructions (response 1), emergency access instructions (2), the presence of fire extinguishers (3), emergency ladders (4). The lack of understanding of the nature of emergency ladder functions is evident from response 5, where more than 50% of participants "approve" the use of emergency stairs for normal use of daily activities. This is in line with the results of physical audit of buildings that found some emergency doors hampered and left open for everyday activities

 Table 2. Occuapant's response to building fire infrastructure facilities

No	Completeness of building fire infrastructure facilities	1	2	3	4	5	6	7
1	Each building is equipped with practical instructions to extinguish the fire	7	12	7	7	5	18	16
2	Each building is equipped with emergency access route instructions	9	13	4	3	4	15	24
3	Every building is equipped with sufficient outage equipment	2	7	11	5	8	16	23
4	very building is equipped with an emergency staircase	2	2	10	6	3	27	22
5	Emergency stairs are used for normal daily activities	6	14	8	8	9	19	8
6	Completeness of fire safety and security equipment is essential	0	2	6	7	11	25	21

1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: neutral, 5: somewhat agree, 6: agree, 7: strongly agree.

# 4.3. Occupant's awareness of space modification.

This study also looked at the awareness or knowledge of building occupants on the existence of modification of space/building. Response 1 of table 3 shows that about 50% of participants have no idea that the narrowing of corridors or access points due to the presence of furniture or office equipment can slow down the evacuation of occupants in times of emergency. In order to achieve space efficiency occupants forget the safety considerations of occupancy. Although some of them 'disagree' against the use of emergency staircases for the purpose of storing consumables (response 2). Low occupant knowledge of the possible consequences of room modification is seen in response 3, where more than 50% are in a neutral position to "agree" to changes in space/building layouts that only consider the capacity requirement.

 Table 3. Occupant's awareness of space modification

	Concern for							
No	modification of	1	2	3	4	5	6	7
	space							
1	For space efficiency, the building corridor is used as a lounge room	5	14	9	10	14	14	7
2	For space efficiency, emergency staircases can be used as storage of goods	28	18	10	3	6	5	2
3	Occupants can adjust the room in such a way to add	5	17	8	18	8	8	8

1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: neutral, 5: somewhat agree, 6: agree, 7: strongly agree.

# 4.4. Factors affect the improvement of fire safety

Five statements are designed to identify building occupants' opinions on a number of things that can be used to improve the safety of buildings from fire hazards, among others: occupant knowledge of fire risks, quality of electrical/electronic equipment used. regulations and law enforcement. Table 4 shows the majority of participants "agreeing" that with increased knowledge of hazards and fire risks (response 1), improving the quality of electronic equipment (2), and law enforcement (5) can improve occupant safety from building fires. The table also indicates that the granting of incentives gets "approval" to be used to increase occupant knowledge on matters related to fire safety (3). Incentives are also seen by most participants as appropriate to invite building occupants to comply with fire prevention procedures and behaviors.

Table 4.	Factors	to	improve	fire	safety
	1 actors	ω	mprove	me	Saluty

No	Factors for improving fire safety	1	2	3	4	5	6	7
1	Knowledge and awareness of fire and risk	0	2	0	2	6	31	31
2	Improved quality of electrical and electronic equipment	0	0	0	5	5	27	35

No	Factors for improving fire safety	1	2	3	4	5	6	7
3	Incentives in various forms to improve fire safety knowledge	0	3	1	11	16	23	18
4	Incentives in various forms to comply with fire prevention procedures	0	3	4	13	10	27	15
5	Law enforcement for those who behaves threatens fire safety	0	1	0	7	9	23	32

1: very unimportant, 2: not important, 3: somewhat unimportant, 4: neutral, 5: somewhat important, 6: important, 7: very important.

# 4.5. Media communications dissemination of knowledge of fire safety.

The type of social media for the dissemination of information that is easily accepted by building occupants is very important, some studies show that the screams of the closest people are more influential than the building emergency alarms. Table 5 shows the fire safety program can be done either through mobile apps (response 1), formal media /non formal organizational (3 and 4), even inserted in the campus introduction induction program for the Brawijaya University freshmen. In its implementation, response 1 can be followed up by software programmer to develop applications that are able to remind, directing the phone users against the potential for fire in the environment. While the campus academic activities environment, introduction of campus fire safety can be induced as a prerequisite to get ethic approvals every research activity (in the laboratory). Occupant response to the whole question indicates good acceptance of the form of information media regarding fire safety in the campus environment.

Table 5. Type of media dissemination of<br/>knowledge of fire safety

	Activities to increase							
No	knowledge -	1	2	3	4	5	6	7
	awareness							
1	Use of mobile application to identify potential fire incident	0	0	1	6	9	25	31
2	An introduction to fire safety for new students	0	0	1	5	10	29	27
3	The use of social mechanisms, to share knowledge and experience on fire	0	2	4	5	15	26	20
4	Involvement of student organizations to improve fire behavior	0	0	0	10	10	28	24

1: very unimportant, 2: not important, 3: somewhat unimportant, 4: neutral, 5: somewhat important, 6: important, 7: very important.

#### 4.6. Building management

Some questions are aimed at knowing the occupants' opinions about building management related to fire safety. The occupants' responses shown in Table 6 indicate the understanding that the building should be planned, operated in accordance with applicable provisions (responses 7 and 8). In operation, electronic and electrical equipment within the building must meet the required quality standards and routine maintenance to ensure the performance of the equipment. The table also shows that most participants agree on the feasibility of the power grid affecting the fire safety level of the building (4,5,6). Like the previous response, most building occupants in favor of law enforcement are required for the sake of meeting the technical requirements of fire safety of buildings (8). Nevertheless, some participants seem to have doubts when it comes to modification of function, space, or building for the purposes of the activity in it (2, 3). Some participants still think that the existence of fire safety infrastructure inside the building should not be planned from the planning stage (1).

#### Table 6. Building management

No	Building management	1	2	3	4	5	6	7
1	Buildings must be planned from the beginning with the completeness of fire safety facilities	6	10	7	8	2	19	20
2	Changes in space function can be done without a fire safety study	5	5	12	7	11	22	10
3	Space modification can be done effectively only by looking at room function demands	8	14	9	4	5	22	10
4	Electronic equipment used in the building needs to be checked periodically	1	0	1	2	7	28	33
5	Fire buildings will be reduced if the electrical and electronic equipment used in them meet the required quality standards	2	0	1	1	7	27	34
6	Fire buildings will be reduced if the electrical and electronic equipment used in them meet the required quality standards	1	0	0	2	8	32	29
7	Fire buildings will be reduced if the entire	1	0	2	1	4	28	36

No	Building management	1	2	3	4	5	6	7
	process of building operations are based on building safety rules							
8	Fire-fighting maintenance procedures must be adhered to to reduce the potential for fire within the building	1	0	0	2	4	38	27
9	Law enforcement needs to be upheld for buildings that do not meet the technical requirements of fire safety	1	0	1	7	10	25	28

1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: neutral, 5: somewhat agree, 6: agree, 7: strongly agree.

#### 5. PROPOSED FIRE SAFETY MODEL

The existing condition above leads to proposal of strategic interventions. Performing the interventions should improve fire protection of the buildings. Number of interventions proposed in this research include:

- 1. The necessity of improving education and knowledge of building occupants against fire issues, such as: fire causes and risks.
- 2. Program to improve fire knowledge and skills for fire suppression, including skill to operate fire extinguisher means available in the buildings.
- 3. Improving occupant's skill to evacuate from buildings.
- 4. Reguler inspections and assessment of building infrastructures, electrical and electronic equipments.
- 5. Restore the proper function of rooms and facilities accordingly, such as: fire stair, fire shafts, fire lifts.
- 6. Development of manual procedures or operational guidelines for evacuation and maintain buildings equipment properly.
- 7. The procurement of fire safety management and organisation.
- 8. The availability of incentives programs
- 9. Implementation of law enforcement, such as: reward and punishment system.

These interventions lead to the establishment of essential components for fire safety model, aplicable for Brawijaya University (Figure 5).



Figure 5. Proposed Fire Safety Model for Campus Buildings

The proposed fire response model is made of four main components including:

- 1. knowledge and awareness,
- 2. building infrastructures,
- 3. incentives and
- 4. control

The four components all work together and interline and influence each other. The occupants and manager of the building need to increase their education and knowledge of fires, thus raising awarenesss among them. This leads to the selection of building facilities quality, adopting affective control mechanism whteher or not involving incentives for improving fire safety behaviour. Incentives play a role in stimulating occupants and managers for improved education and skills. Incentives also play a role in improving the quality of building facilities both in terms of architectural design drawings, the feasibility of the utility network system as well as the detection and suppression facilities. Building facilities have to be well planned especially electrical facilities, fire measures and infrastructure improving fire safety, controlled and maintained in top shape to eliminate the failure of the building system. An accurate control system that is implemented in a professional and consistent manner are needed so that the awareness raising program of occupants, incentives and physical facilities of the building can run and always be well maintained.

## 6. CONCLUSION

Some general conclusions are derived from the analysis and discussion above, such as: 1. High-rise building rescue facilities of

Brawijaya University still doesn't quite meet

the standards outlined in the high-rise building standards. The layout and construction of emergency staircases are not yet in accordance with the standards so as to threaten the smoothness of the evacuation process.

- 2. The fire management system isn't fully available in all high-storey buildings, only a small part has a specific personnel appointment for fire fighting, but it's not formally met with institution or organisation that specifically deals with fire prevention and extinguishing.
- 3. Layout of the campus building is able to accommodate the needs of a gathering place during an occupant evacuation process, but the entrance gate needs to be modified to be wider for easier access to fire extinguisher vehicles.
- 4. The existence of fire hydrant and source of water facilities needs to be improved in the campus environment in such a way that it serves every corner of a high-rise building.
- 5. The level of awareness of each individual occupant of a building on the potential of fire sources is considered relatively low, they (especially uni students) are less interested to actively engage in efforts to increase fire awareness.
- 6. Building occupants in general do not consider the aspects of safety when making changes/modifications to the function of a room/space area.
- 7. Incentives may affect the behaciour of building occupants in improving the knowledge of fire safety of a building.
- 8. The safety aspects of a building has to be considered from the planning stage to the operation of the building with regard to fire fighting and the quality of electronic electrical equipment used.
- 9. Campus fire safety promotion can be done through popular media information forms among occupants and various campus organisational programs.

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