



IDENTIFICATION OF POST FIRE DAMAGE IN DHARMA BHAKTI MONASTERY BUILDING

James Rilatupa, Naniek Widayati, Rudy Surya, Franky Liauw, Joko Priyono

Architecture Department, Tarumanagara University, Jakarta – 11440, Indonesia

ABSTRACT

Fires can occur in buildings, both permanent and non-permanent buildings. Fire occurs due to conditions where fuel meets heat and oxygen. Fire characteristics are also determined by material and fuel factors. The burning Dharma Bhakti Monastery is located on Jl. Kemenangan III, Petak Sembilan No. 19, Kecamatan Taman Sari, West Jakarta. This monastery is the oldest monastery in Jakarta; and is a cultural heritage building. The building caught fire on March 2, 2015, and allegedly caused the fire from large candles. The monastery was renovated in January 2016 with the support of the Provincial Government of the Special Capital Region of Jakarta. The inauguration of the monastery construction was held in July 2017. But in reality the use of the main building was stopped due to consideration of the existing building structure strength and the worshipers safety. Post-fire damage identification in this building needs to be done to see damage conditions that occur in the building elements. In this research, damage identification to the building components of the Dharma Bhakti Monastery building was burned, so that further renovation or reconstruction processes could be applied in accordance with the acquisition of damage data. The results of the final calculation showed that the Monastery's reliability value was 38.76 and included in the category of moderately damaged.

Key words:reliability value, damaged category, conservation.

Cite this Article: James Rilatupa, Naniek Widayati, Rudy Surya, Franky Liauw, Joko Priyono, Identification of Post Fire Damage in Dharma Bhakti Monastery Building. *International Journal of Civil Engineering and Technology*, 9(8), 2018, pp. 1741-1750.

<http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=9&IType=8>

1. INTRODUCTION

The Dharma Bhakti Monastery is included in the oldest monastery in Jakarta which still functions today. The location is in the Chinatown area of Glodok, West Jakarta. This monastery is known as the oldest monastery that was built in 1650 by a Chinese Lieutenant, Kwee Hoen when the Dutch are still in power in the area of Indonesia [13]. The age of this monastery is 368 years and has been designated as a cultural heritage building by the Government of the Special Capital Region of Jakarta in 2009 [4]. On March 2, 2015, Dharma Bhakti Monastery experienced a fire. Allegedly the cause of the fire that occurred at this monastery was the fire from the large candles that were in the monastery. The monastery was

renovated in January 2016 with the support of the Regional Government of the Special Capital Region of Jakarta. The construction does not leave the original form using teak wood. Despite being in the process of renovation, this hundred-year-old monastery is still being opened for worship.

Cultural heritage can be assumed as savings for future generations, so it must be preserved. Therefore, it is necessary to maintain the stability of all existing cultural heritage so that they will not change at all. The existence of the cultural heritage should prioritize its preservation; this aims to ensure that existing cultural works can continue to survive; although the benefits have not been felt at this time [9]. At about the era of 1980, an expert of cultural heritage explained that efforts to implement the capability in the management include: (a) planning, (b) managing, (c) briefing, (d) controlling and (e) evaluation. These five things are done to achieve conservation goals through a political process, which in this case is to preserve important aspects of a nation's cultural heritage for the benefit of the wider community [5].

In the Law of the Republic of Indonesia Number 11 of 2010 article 1 (paragraph 21) explained that "management is an integrated effort to protect, develop, and utilize cultural heritage through a policy of planning, implementing and supervising for the greatest welfare of the people". Meanwhile at (paragraph 23), it was also explained that "protection is an effort to prevent and overcome damage, destruction, or destruction by means of saving, securing, zoning, maintenance and restoration of cultural heritage" [7]. As a cultural heritage building that needs to be preserved, identification of damage should be known as early as possible, so as not to have a bad impact on the building [14].

The study of identification of cultural heritage buildings is a preliminary study of physical conditions in terms of architecture, structure, and utilities as well as historical value and archeology of cultural heritage buildings [3]. The results of the identification study contain recommendations for preservation of cultural heritage buildings in the form of: protection, development and/or utilization [3]. By knowing as early as possible the potential damage that can occur, the Dharma Bhakti Temple can remain safe and comfortable to use, both for worship activities and other activities. In addition, instructions or guidelines on the management of building maintenance and maintenance are also explained in the Minister of Public Works Regulation No. 45/PRT/M/2007 [2].

The concept of protecting cultural heritage can be used to protect and regulate efforts to preserve cultural resources and values contained; and the authenticity of the past environment of cultural heritage [15]. The structural components of the cultural heritage building must be able to guarantee the fulfillment of the building's ability to support load loads, prevent and overcome fire hazards, lightning hazards, and natural disasters. The use of combustible original material must receive certain treatments (fireretardant treatment); and the use of the new material must be non-combustible [3].

Fires are one of the most frequent disasters, especially in densely populated urban areas and their homes are close together. Fires occur due to fire, where fire is a fast chemical (oxidation) reaction that is formed from 3 (three) elements. These three elements are heat, air, and fuel that can produce heat and light [1]. If one of the elements of the fire triangle does not exist or is removed, the fire will not exist, or if it has burned, it will be extinguished [12]. In addition, by adding a chemical process between the fuel vapor and oxygen and the help of heat (chemical properties) can trigger or maintain the reaction of the complex chain symbolizing the chemical properties of fire [10].

2. RESEARCH METHOD

2.1. Materials and Tools

The material used in this research is the Dharma Bhakti Monastery building. Meanwhile the tools used are: material moisture content meter, digital meter, digital camera, drones to record images of the roof section of Dharma Bhakti Monastery, computer, stationery and inspection forms for existing data

2.2. Research Procedure

The steps of research procedure:

- observations of building structure of the Dharma Bhakti Monastery, both on the inside building and outside areas
- determine the location of the damage and identifying the damage type.
- investigation on improvements already made to the construction component which has been repaired temporarily

2.3. Data Analysis

Data analysis is done with 2 steps, namely:

- The first step makes the weighting of each component of the building construction. this is done to determine the priority scale of building elements of the dharma bhakti monastery by bre digest 268 1988 [17], as shown in table 1.

Table 1 Assessment of architectural weighting for construction components

Construction components	Assessment of relationships with *					Total	Weight (%)
	1	2	3	4		
Outer wall							
Inner wall							
Rooftop							
Doors and windows							
Floor							
Structural system							
Building support							
						100	

*value 3: close relationship, value 2: moderate relationship, value 1: less relation

Assessment factors relate to:

(1) durability-resistance,	(6) noise prevention,
(2) stability tolerance,	(7) building construction system,
(3) weather/climate influence,	(8) air conditioning circulation,
(4) maintenance,	(9) earthquake resistance,
(5) fire prevention	(10) others

- The second step is to test the building reliability with a score and weighting system to obtain the reliability of construction and building components based on bre digest 268 in 1988 [17], as shown in table 2.

Table 2 Assessment of building conditions

Construction components	Weight	Identification results							Weight x value	
		Forensic*		good	medium	damage	light	medium		
		a	b	...	g	5	4	3	2	1
Outer wall										
Inner wall										
Rooftop										
Doors and windows										
Floor										
Structural system										
Building support										
	100									

* forensic factors observed are:

- (a) sun and light,
- (b) temperature, wind and air movement,
- (c) rain,
- (d) sand and dust,
- (e) strong wind and storms,
- (f) earthquake,
- (g) biological damage

To calculate the building reliability value is obtained based on the equation 1:

$$\text{BUILDING RELIABILITY} = \frac{\text{Total of Weight} \times \text{Value}}{500} \times 100 \dots\dots\dots (1)$$

The category of building maintenance conditions is obtained based on the previously calculated reliability values (equation 1). The condition of building maintenance is assessed based on the results of building reliability [16] can be seen in Table 3.

Table 3 Building reliability and maintenance conditions (Uzarski *et.al.*, 1997)

Building reliability	Maintenance conditions
81 – 100	Good
61 – 80	Medium
41 – 60	Light damage
21 – 40	Moderately damage
0 – 20	Heavily damage

3. RESULTS AND DISCUSSION

3.1. General Conditions at the Dharma Bhakti Monastery After the Fire

On March 2, 2015 at 03.00 (Jakarta time) in the morning, Dharma Bhakti Monastery experienced a fire. The source of the cause is thought to come from candles and incense inside the Dharma Bhakti Monastery, then spread to the people's house. According to the Monastery's Management, there was one 1.5 meter high candle that fell, while the distance between the flame and the ceiling was close enough; because in 2014 the floor of the room was raised to avoid flooding. Fortunately, there were no fatalities in the incident even though the material loss was estimated at billions of rupiah. The main building of the temple was burned down (Figure 1).

After 3 (three) years passed, Dharma Bhakti Monastery was still in the process of renovation. At present, the condition of the temple is better, although the repairs are only temporary so that they can be used for worship activities. However, since the 2015 fire incident, the Management of Dharma Bhakti Monastery restricted the burning of Hio, especially during Chinese New Year celebrations; and this is still going on today. The Chinese New Year celebration at the monastery was carried out simply, without the lion dance performance as always done before the fire incident in 2015.



Figure 1 Condition of Dharma Bhakti Monastery: (a) before and (b) after burning.
(source: Management of Dharma Bhakti Monastery)

In 2017, the Management of Dharma Bhakti Monastery carried out the initial renovation process. At this stage, the Monastery's Management involves several experts, because the building is a cultural heritage building. The monastery renovation involved the Team of Cultural Heritage Expert and Regional Government of Jakarta Restoration Assembly, so that the building was exactly like before it burned. In addition to the two teams, it is estimated that the Dharma Bhakti Monastery building will be renovated in a period of five years and requires funds around US \$ 3.6 million.

3.2. Conditions of Dharma Bhakti Monastery Building Components

The condition of the roof components in both of the building spaces within the location of the Dharma Bhakti Monastery is classified as heavily damaged, even though most of them are no longer there (burned down). The roof component in this main room is only temporary. The material used as a roof cover is white/transparent fiberglass, so some sunlight can enter. Meanwhile, the roof frame structure system in the main room was burned to the ground by leaving black sooty. The roof frame structure in the main room of the monastery besides using old wood, also uses bamboo and galvanized iron. However, in the behind room of the Dharma Bhakti Monastery, the roof frame structure has used mild steel painted in red.

The inner wall component of the building which is the main room of the Dharma Bhakti Monastery has also been classified as heavily damaged, although there are still parts of the wall that are intact. Then the painting is done on the whole wall with red paint. on the frame structure of the upper wall (ring beam) using bamboo. The bamboo is used to support and attach the fiberglass roof cover, so that the upper wall installed in the main hall of the monastery is only temporary, while waiting for the renovation process. Meanwhile, for the building behind it, where the altar of the gods was placed; has a wall with good conditions. The wall is partly still painted white, and given a red paint. The back room of this monastery is partitioned into several open spaces, so it only has 3 (three) sides of the wall for each space.

The outer wall components in the main room and the behind room of the Dharma Bhakti Monastery building are still in good condition. The wall material used is light brick, so it is

not flammable. This material is easy to clean after the fire event, but still needs to be treated again. Floor components in both buildings within the Dharma Bhakti Monastery are included in the condition of moderate damage. There was quite a lot of damage found on the floor of Dharma Bhakti Monastery; both at the front, side and behind of the monastery building. Meanwhile, in the behind room of monastery, the floor was covered with new ceramics. This is done so that worship activities for Buddhists can run well. The floor condition in the behindroom and terrace/lobby of the monastery is in a fairly good condition. The repairs carried out in the behind room aim to keep worship activities for Buddhists going well.

There are no ceilings left due to the fires that occurred in 2015. The results of a direct review to the Monastery in 2018, no ceiling was installed. In the room there are only wooden poles, system frame and roof structure. The door and window components of the Dharma Bhakti Monastery building were mostly burned in 2015. From the results of the direct observation to this monastery, only the position where the doors and windows were ever seen was only covered with red cloth or plywood. The pillars of columns in the Dharma Bhakti Monastery building are made from the best quality teak wood and are hundreds of years old. It was clearly seen that the teak wood had been charred and black sooty. The columns are partially wrapped in red cloth. Even the dimensions of the wood itself remain 50 percent, so that it can be categorized as heavily damaged. The condition of supporting the building, in this case the ornaments in the monastery building are in heavily damaged condition. Many of the ornaments on the wooden beams and the column poles have burned.

3.3. The Reliability of the Dharma Bhakti Monastery

The results of architectural weighting for each component ranged from 9.88 - 18.51 percent, as shown in Table 4. The outer wall and inner wall components have the highest architectural weight (18.51 percent), and the lowest are floor components, door and window components (9.88 percent).The inner and outer wall components have a close relationship with all the assessment factors in their architectural weighting. Then when viewed from the resistance/prevention factor against fire; then the outer wall and inner wall components also have better prevention values compared to other components (Table 4).

Table 4 Assessment of architectural weighting for construction components of Dharma Bhakti Monastery

No.	Construction components	Assessment of relationships with*										Total	Weight (%)
		1	2	3	4	5	6	7	8	9	10		
1	Outer wall	3	3	3	3	3	3	3	3	3	3	30	18.51
2	Building roof	3	3	3	2	1	2	3	3	3	1	24	14.82
3	Doors and windows	1	1	1	3	1	3	2	2	1	1	16	9.88
4	Floor	3	1	2	3	2	1	1	1	1	1	16	9.88
5	Inner wall	3	3	3	3	3	3	3	3	3	3	30	18.51
6	Frame structure system	3	3	3	2	2	2	3	1	3	1	23	14.20
7	Building support (ornament)	3	3	1	3	2	2	2	1	3	3	23	14.20
Total												162	100

*value 3: close relationship value 2: moderate relationship value 1: less relation (assessment factors can be seen in description of table 1)

When viewed from the material properties, the material from the outer wall and the inner wall is from brick. This brick is the most common building material used to build houses or other buildings in Indonesia. The brick material was chosen because it was able to absorb

good and sturdy heat. In addition, this building material also has excellent fire resistance. When a building is on fire, this brick material can last a long time (≥ 2 hours), however its resistance to fire is also very dependent on the construction and wall thickness of the building [6]. The condition of the outer wall after the fire event was moderate, meanwhile the condition of the inside walls of the temple was moderately damaged.

Floor components are made of natural stone materials, and natural stones are known to have good fire resistance. But when the fire broke out at the monastery, there were many candle spills which also burned, and then caused damage to the monastery floor (lightly damaged). While other components, namely: doors and windows, frame structure and ornament construction systems are made of best quality teak wood. However, the nature of wood is flammable; so that the building components condition of the monastery that used teak wood material became severely damaged. Monastery roofing components are made of clay, and are non-flammable materials. Meanwhile, because this tile roof is supported by a frame structure system of wood material; so if the support is burned, the tile has no support, so it falls and the condition becomes severely damaged.

Table 5 Forensic assessment of the Dharma Bhakti Monastery building

No	Construction components	Forensic*							Condition
		a	b	c	d	e	f	g	
1	Outer wall	x	x	x	x	x	x	-	medium
2	Building roof	x	x	x	x	x	x	x	heavily damaged
3	Doors and windows	x	x	x	x	x	-	x	heavily damaged
4	Floor	-	-	-	x	-	-	-	lightly damaged
5	Inner wall	x	x	x	x	x	x	-	moderately damaged
6	Frame structure system	x	x	x	-	x	x	x	heavily damaged
7	Building support (ornament)	-	-	-	-	-	x	x	heavily damaged

* forensic factors observed can be seen in description of table 2

Based on the assessment of architectural weighting (Table 4) and forensic assessment (Table 5), the reliability value of Dharma Bhakti Monastery building can be calculated after the fire incident in 2015. Calculation results based on equation (1) show that the Monastery's reliability value is 38.76 and is categorized as moderately damaged (see Table 3). The results of these calculations confirm that this monastery is in dire need of renovation and reconstruction, because it is included in the category of moderately damaged. Besides visual initial investigation that have been conducted in this research, there are still a number of further steps that are needed to strengthen the building structures, such as non destructive test, destructive test and full scale loading test. In the advanced steps of the post-fire damage investigation, it is necessary to have an expert role in building structures. The structural expert is tasked with being able to further examine the strength of the structure of the post-fire Monastery building elements. Thus, structural experts can provide advice on the technique of strengthening structural elements so that this monastery can function again as before.

3.4. Renovation/Restoration Actions Needed to be Done for Dharma Bhakti Monastery

The restoration of cultural heritage buildings is very different from the construction of new buildings. In the restoration of damaged cultural heritage buildings, it must be done to restore its physical condition. Based on this, the restoration of the Dharma Bhakti Monastery cultural heritage building must pay attention to:

- Authenticity in building materials, shape, position/location of buildings, architectural style of buildings and workmanship techniques
- Returning to its original condition, even if there is a change it must be as small as possible without disturbing the architectural style of the building.
- In the process, must use methods, techniques, and materials that are not destructive
- Using workers who are competent in the field of restoration of heritage building.
- Adjustments can be made in the future, taking into account public safety and the safety of heritage building.
- If it has a negative impact on the physical and social environment, it must make an environmental impact analysis in accordance with the provisions of existing regulations or legislation

To carry out renovation or restoration of this monastery, it is necessary to pay attention to the main principles as stated in the Law of the Republic of Indonesia No. 11 of 2010 concerning Cultural Heritage. Necessary steps in restoration of Dharma Bhakti Monastery is:

- Preparation; is the initial stage of restoration work. In this stage it is necessary to carry out the preparation of administrative, worker, and technical.
- Carry out a feasibility study; which includes all necessary data, such as archaeological, historical and technical.
- Carry out technical studies of restoration; which is an activity in determining the methods details and techniques for implementing restoration. This activity is to assess any changes that occur due to fire incidents, and technical implementation through a cause and effect approach. The data needed includes data on architectural damage, structural damage, maintenance and environmental damage (both inside and outside the monastery).
- Making management risk; which is intended to minimize the risk to the cultural heritage building of Dharma Bhakti Monastery from all possible disasters (such as large earthquakes, floods, fires and armed conflicts) and from damage caused by gradual and cumulative processes (such as degradation due to chemical, physical processes, or biological). This needs to be done to prevent the loss of the value of the assets of the Dharma Bhakti Monastery as a cultural heritage building.

Conservation activities consist of renovation, rehabilitation and preservation [8]. In conservation activities, it is possible to make physical changes and building functions. Meanwhile, there are 3 (three) basic principles of conservation, namely: understanding, implementation and evaluation. What is meant by understanding is knowing the physical condition of the building, history and location of the building. Evaluation consists of the use of appropriate functions, material improvements, traditions and technology, sustainability and historical evidence. Evaluation consists of new approaches to new problems, sustainability and interpretation [11]. The conservation activities that need to be carried out for the components of the Dharma Bhakti Monastery building are as follows:

- Outer walls: clean, repair by inserting/slipping on damaged walls with the same or no stronger cement mixture than the original
- Roof: match with original roofing material; texture, composition and color as the original.
- Doors and windows: selection of wood types adapted to the old ones, giving termite treatment, wood color or paint must be the same as the original
- Floor: clean, repair, replace improper material and try to use the same material as the original

- Inner wall: clean, repair by inserting/slipping on the damaged wall with the same or no stronger cement mixture than the original
- Frame structure system: stabilize, avoid repairs that are stronger than existing material, add or replace material that is not feasible, give termite treatment
- Ornaments: clean; fix; if the ornament of wood material adjusts to the original, if any wood material is used, give termite treatment.

The conservation activity approach at the Dharma Bhakti Monastery should follow the existing instructions and consult with experts who understand the material used (both in terms of quality and age of the material). The consultation approach must also be carried out with experts in cultural heritage, so that the preservation of the Dharma Bhakti Monastery is maintained. Honesty and authenticity are also important approaches to be applied to the monastery's conservation activities. In addition, this monastery conservation activity must pay attention to sustainability between the past to the present to the future.

4. CONCLUSIONS

In this research, conducted the investigation at an early stage is to make weighting of each component of building construction on the renovation results in early 2017. The results of the investigation show that the outer wall and inner wall components have the highest architectural weight, and the lowest are components of floor, doors and windows. The inner and outer wall components have a close relationship with all the assessment factors in their architectural weighting. Then when viewed from the resistance/prevention factor against fire; then the outer wall and inner wall components also have better prevention values compared to other components. The monastery's reliability value is 38.76 and included into the category moderately damaged. The results also confirm that this monastery is in dire need of renovation and reconstruction, because it is included in the category of moderately damaged.

Meanwhile, some suggestions for conservation of this monastery are:

- In the advanced steps of damage investigation after the results of the renovation (conservation) in early 2017 is required the role of the expert in building structures.
- The conservation activity approach at Dharma Bhakti Monastery should follow the existing instructions and consult with experts who understand the material used (both in terms of quality and age of the material).
- Consultation approach must also be carried out with cultural heritage building experts. In this case, honesty and authenticity are also important approaches applied to the monastery's conservation activities.
- Conservation activities of the Dharma Bhakti Monastery must pay attention to sustainability between the past to the present and the future.

REFERENCES

- [1] Anthony, M. Fire Theory, n.d. <https://survivalskillsindonesia.files.wordpress.com/2014/02/teori-api.pdf>
- [2] *Department of Public Works. Regulation of the Minister of Public Works Number: 45/PRT/M/2007*. Jakarta:, 2007, pp. 4-6
- [3] *Department of PWPH RI. Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 01/PRT/M /2015 concerning Preserved Heritage Buildings*. Jakarta: Departement of PWPH RI, 2015, pp. 3-24
- [4] *DKI Jakarta Provincial Government. Regional Regulation of DKI Jakarta No. 9 of 1999*. Jakarta: DKI Jakarta Provincial Government, 1999, pp. 5-11
- [5] Green, W. and J.F. Doershuk. Cultural Resource Management and American Archaeology. *Journal of Archaeological Research*, Vol.6, No.2, June 1998, pp. 121-167

- [6] Harvey, Ken W. Fundamental Building Materials, 4th Edition. Florida: Universal Publishers, 2009, pp. 32-37
- [7] *Ministry of Law and Human Rights. Republic of Indonesia Law No. 11 of 2010 concerning Cultural Heritage. Jakarta: Ministry of Law and Human Rights, 2010*, pp. 1-22
- [8] Mitra, S.S., S.A. Grover and S.R. Singh. Conservation of Heritage Building: A Guide. New Delhi: Directorate General Central Public Works Department, 2013, pp. 1-2
- [9] Mulyadi, Y. Utilization of Cultural Heritage in Academic Perspectives and Legislation. 2014.
https://www.academia.edu/8128325/Pemanfaatan_Cagar_Budaya_dalam_Perspektif_Akademik_dan_peraturan_perundangan
- [10] NFPA. NFPA 921: Guide for Fire and Explosion Investigations, NFPA Standards Development Site. 2013.
https://www.nfpa.org/Assets/files/AboutTheCodes/921/921_F2013_FIA-AAA_SDReport.pdf,
- [11] Orbasli, A. Architectural Conservation: Principles and Practice. Oxford: Blackwell Science, 2008, pp. 6
- [12] OSHA. Fire Protection and Prevention. Washington: Occupational Safety and Health Adminisratio., n.d. https://www.osha.gov/dte/grant_materials/fy09/sh-18796-09/fireprotection.pdf
- [13] Post, P. Java's Capitan Cina and Javanese Royal Families: Status, Modernity, and Power Major-titular Be Kwat Koen and Mangkunegoro VII (Some Observations). *Journal of Asia-Pasific Studies (Waseda University)*, No. 13, October 2009, pp. 49-66
- [14] Schmid, K.F. Building Inspection Manual: A Guide for Building Proffesionals for Maintenance, Safety and Assessment. New York: Momentum Press, 2014, p. 27
- [15] Tanudirjo, D. A. Cultural Landscape Heritage Management in Indonesia: An Archaeological Perspective. The First International Symposium on Borobudur Cultural Landscape Heritage 2007, in Centre for Heritage Conservation, GadjahMada University, 20 April 2007,
http://arkeologi.fib.ugm.ac.id/old/download/1179813505Borobudur_Int_Sym_Daudpaper.pdf
- [16] Uzarski, D.R., A. Laurence and Burley Jr. Assessing Building Condition by the Use Condition Indexes. In Saito, M., ed., Infrastructure Condition Assessment: Art, Science and Practice. New York: American Society of Civil Engineering, 1997, pp. 365-374
- [17] Watt, D.S. Building Pathology: Principles and Practices. Oxford: Blackwell Sciences Ltd, 2007, pp. 94-101