

Means of Escape Assessment Procedure for Hospital's Building in Malaysia.

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ABSTRACT

Fire safety is important specifically in hospital's building. Evacuation during hospital fire is a complex phenomenon due to restriction of the movement capability of the patient. This paper explored the criteria and attributes for identifying the current fire safety conditions in a hospital's building. All design criteria were extracted from the past literature as well as relevant acts to produce observational instrument. Preliminary survey (observation) done by inspection to the building and was carried out with officer from the hospital's building. The observational instrument was analyses using qualitative method. The results found that only one out of three hospital's building allocate the refuge area in the hospital's building. Other than that, the recommendations has been generalized which could help in improving the safety level of means of escape in hospital's building.

Keywords: assessment, fire safety, hospital, means of escape.

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I. INTRODUCTION

Fire could be beneficial in our daily live, however fire could cause damages and injuries. [1] claimed, that fire may cause fatal and serious injuries to the occupants of the buildings and at the same times direct damages to the buildings. This will lead to consequential losses towards occupant in the building. This can be seen in the case of hospital fire. A hospital fire was a threatens to patient and specifically to the staff [2]. This is because in hospital, there were patients, who are weak, handicapped and they cannot evacuate independently (self-evacuation). Due to these physical and mental problems, the safe escape from building become impossible without help from the nurses. In ensuring safe evacuation, there was a need to ensure that the means of escape (MoE) route is safe for evacuation. Therefore, this paper explored the criteria and attributes for identifying the current fire safety conditions in hospital's buildings.

II. MEANS OF ESCAPE

The escape routes is very important in ensuring safe evacuation especially in hospital's building. [3] addressed that occupants normally evacuate by using their familiar routes, which mostly the main entrance of a building. However, in a hospital's building, the evacuation is a complex phenomenon [4]. This is because, the evacuation is restricted by the movement capability of the patient. Due to this restriction, National Fire Protection Act 101 require that the refuge area was established in several floors in the hospital's building. Other than refuge area, there were several design criteria which are travel distance, exit, staircase, exit door, signage and lighting, and means of escape plan (MoEP). [5] addressed that the escape route should be well maintained, free from any obstruction through the route, and lastly shall be provided with essential signage. [3] added that the photoluminescent low-level exit path markings become more effective during fire evacuation rather than the conventional escape routes signs.

III. METHODOLOGY

The methodology used in this study was summarized in the Fig.1. This research present relevant literature to MoE especially in hospital's building. Before an audit checklist take place, the checklist instrument was developed as part of the audit checklist method. This instrument is useful to ensure the audit do not deviate from the objective of the audit and act as a tool to investigate the means of escape performance of hospital's building. To developed the instrument, this study adapted a MoE checklist from[6]. However, this checklist used after making changes to ensure conformity with the hospital building.



Fig.1: Methodology Process

The checklist was designated by updating the checklist using documents analysis which reviewing the safety codes and standards, including Uniform Building By-Law 1984 (UBBL 1984), National Fire Protection Act 101 (NFPA 101) and Malaysian Standard (MS). In addition, the checklist prepared was assisted by a Fire Department officer from Balai Bomba dan Penyelamat. The checklist prepared includes all requirements related to MoE for hospital's building. The checklist was divided to three main criteria attributes which are Passive Protection System (PPS), Active Protection System (APS) and Fire Safety Management (FSM). All these criteria focusing on MoE in hospital's building.

Table 1: Sample of Inspection Checklist (APS)

WALK THROUGH INSPECTION CHECKLIST (ACTIVE PROTECTION SYSTEM)						
DESIGN CRITERIA: REFUGE AREA						
	Attributes	Ref	Design Criteria	Yes	No	Remarks
i	Signage	NFPA 101 7.2.12.3.5	Each area of refuge shall be identified by a sign "AREA OF REFUGE"			
		NFPA 101 7.2.12.3.5.1	The signage shall display the international symbol of accessibility which located as: (1) At each door opening providing access to the area of refuge. (2) where necessary to indicate clearly the direction to an area of refuge.			
			NFPA 101 7.2.12.3.5.2	The sign shall be illuminated for exit sign where exit sign illumination is required.		

The hospital's building in Malaysia were the case study used in this research. Preliminary inspection was carried out on three samples of hospital's buildings (namely Hospital A, Hospital D, Hospital E), and one of the ward in each sample was selected for the detailed inspection. The fire safety assessment was carried out with the help of checklist to verify the compliance of these existing facilities with code requirements highlighted in the Table 1 and Table 2.

Table 2: Sample of Inspection Checklist (PPS)

WALK THROUGH INSPECTION CHECKLIST (PASSIVE PROTECTION SYSTEM)						
DESIGN CRITERIA 6: REFUGE AREA						
	Attributes	Ref	Design Criteria	Yes	No	Remarks
i	General	NFPA 101- 7.2.12.1.1	An area of refuge used as part of required accessible means of egress protected and supervised with automatic sprinkler.			
ii	Accessibility	NFPA 101 - 7.2.12.2.2	An area of refuge shall have access to a public way via an exit or elevator without requiring return to the building spaces.			
		NFPA 101 - 7.2.12.2.3	Where the exit from an area of refuge include stairs, the clear widths of landing and stair flight shall be not less than 1220mm.			
		NFPA 101 - 7.2.12.2.4	Where elevator provide access from an area of refuge, the following criteria shall be met: (1) Elevator shall be approved for fire fighters' emergency operations. (2) Power supply shall be protected against interruption from fire occurring within the building but outside the area of refuge. (3) The elevator shall be in a shaft system meeting the requirements for smokeproof enclosures.			
NFPA 101 - 7.2.12.2.5	Shall provide two-way communication system for communication between the area of refuge and a central control point. The door opening to stair or elevator door shall be identified by signage.					
iv	Details	NFPA 101 - 7.2.12.3.1	Each area shall be sized to accommodate one wheelchair space of 760mm X 1220mm based on the occupant load served by the refuge area.			

	NFPA 101 - 7.2.12.3.4	Each area shall be separated by having a barrier minimum 1-hor fire resistance.			
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The audit checklist was carried out assisted by the engineer and fire safety officer from the hospital itself. Floor plan of the building were used and measurements were made with the aid of measuring tape and Bosch laser rangefinder GLM80. Whenever safety requirements are fulfilled a tick was made in the 'Yes' column, and when not fulfilled in the 'No' column. The 'Remarks' column used for noted any important notes related to the attributes of the criteria. During the audit checklist, researcher had taken photographs by using digital camera to support the audit checklist assessment. Relevant interviews were also carried out with the engineer and fire safety officer from the hospital to identify issues that could not be audited by the researcher, i.e "What is the types of supply system used either storage battery or generator set for emergency purposed during evacuation?". This paper had employed qualitative method by audit the checklist assessment at the case studies buildings. At the end of this paper, the generalization of recommendations has done to help in improving the MoE of the hospital's building

IV. RESULT AND DISCUSSION

This sections presents the results and discussion of the audit checklist assessment for all samples. In Malaysia, the design criteria for MoE for refuge area in hospital's building was not dealt with any regulation contained in Malaysia. However, NFPA has required this criteria as one of the importance design criteria for MoE. Based on the analysis, the researcher found that among all criteria for MoE, refuge area under PPS was the critical criteria. This is because only one out of three hospital's building that comply with code requirement addressed by NFPA 101 (7.2.12.1) as in

Table 3. [7]had present several advantages for compliance of the refuge area; (1) act as a place for rest for the patients and staff, (2) the possibility of trapped in the area that filled with smoke shall be reduced, (3) act as command point and base for fire fighter to evacuate the occupants, and (4) easier the evacuation since it is located at the end of the corridor. Based on

Table 3, only Hospital A had complied with the regulations whereby Hospital D and Hospital E did not provide any refuge area in upper floor. The refuge area has been isolated with the ward by using fire rated door. In addition, the door was constructed with self-closing devices. [8] added that the door should be at least 1-hour fire resistance. To evacuate the occupants in this area, there were two methods which are firstly by using skylight provided by firefighter, and the other one using staircase located near to the refuge area. However, the area was an open area and only depend on the fire rated door to prevent the fire from spreading to the area as in Plate 1 and Plate 2.



Table 3: Analysis for Design Criteria 6 under PPS

DESIGN CRITERIA 6: REFUGE AREA (Passive)				Hospital A	Hospital D	Hospital E
	Attributes	Ref	Design Criteria			
i	General	NFPA 101 7.2.12.1.1	An area of refuge used as part of required accessible means of egress protected and supervised with automatic sprinkler.	/	X	X
ii	Accessibility	NFPA 101 7.2.12.2.2	An area of refuge shall have access to a public way via an exit or elevator without requiring return to the building spaces.	/	X	X
		NFPA 101 7.2.12.2.3	Where the exit from an area of refuge include stairs, the clear widths of landing and stair flight shall be not less than 1220mm.	/	X	X
		NFPA 101 7.2.12.2.4	Where elevator provide access from an area of refuge, the following criteria shall be met: (1) Elevator shall be approved for fire fighters' emergency operations.	X	X	X
			(2) Power supply shall be protected against interruption from fire occurring within the building but outside the area of refuge.	X	X	X
			(3) The elevator shall be in a shaft system meeting the requirements for smokeproof enclosures.	X	X	X

ii	Communication	NFPA 101 7.2.12.2.5	Shall provide two-way communication system for communication between the area of refuge and a central control point.	X	X	X
iv	Details	NFPA 101 7.2.12.3.1	Each area shall be sized to accommodate one wheelchair space of 760mm X 1220mm based on the occupant load served by the refuge area.	/	X	X
		NFPA 101 7.2.12.3.4	Each area shall be separated by having a barrier minimum 1-hor fire resistance.	/	X	X

/ : Yes
X : No

On the contrary, the refuge area under APS for all the hospital's building were non-compliance with code requirements under NFPA 101 (7.2.12.3) as in Table 4. Although Hospital A did comply with the PPS requirement for refuge area, however, the area was not identified with any signage e.g "AREA OF REFUGE". In addition to that, there were none symbol nor arrow that indicate the direction towards the refuge area. This will lead to any occupant who is not familiar with the area will not be aware of the existence of this area.

Table 4: Analysis for Design Criteria 6 under APS

DESIGN CRITERIA 6: REFUGE AREA (Active)				Hospital A	Hospital D	Hospital E
	Attributes	Ref	Design Criteria			
i	Signage	NFPA 101 7.2.12.3.5	Each area of refuge shall be identified by a sign "AREA OF REFUGE"	X	X	X
		NFPA 101 7.2.12.3.5.1	The signage shall display the international symbol of accessibility which located as: (1) At each door opening providing access to the area of refuge.	X	X	X
			(2) where necessary to indicate clearly the direction to an area of refuge.	X	X	X
		NFPA 101 7.2.12.3.5.2	The sign shall be illuminated for exit sign where exit sign illumination is required.	X	X	X
iii	Communication	NFPA 101 7.2.12.2.5	The door opening to stair or elevator door shall be identified by signage.	X	X	X

/ : Yes
X : No

Some of the general recommendations that could help in improving the MoE of the hospital's building are highlighted as follows:

1. All upper surfaces of handrails at staircase should be mark with marking stripe to help occupant identify the handrail during fire.
2. The marking stripe dimension and placement should be uniform and consistent on each handrail.
3. During design stage, all designer should include the refuge area in upper floor level as one of the area in the hospital's building. This is to ease the evacuation and means of egress.
4. Each fire exit door in hospital's building should be openable from the inside without used any key or special knowledge. This is because, this will allow user to evacuate easily.
5. If the door had to be locked for security purposes, the hospital management must ensure that keys are available at the door or the door should be open automatically.
6. The exit door should have an approved vision panel is required to avoid negative consequences such as clashes between the two sides of the opposites directions when opening the door.
7. Each exit door should be identified with signage because the absence of exit signage at door may trouble occupants in finding the fire exit door.
8. The means of escape route should free of any obstruction and hazard either in ward or staircase area.
9. Any item that may be a source of fuel should never be located along the travel distance of an escape route.
10. The hospital's management should use the photoluminescent low-level exit path marking along the MoE route to safe area.
11. The MoEP should be placed at common area and can be seen by the public e.g. near to elevator or entrance of the hospital's building.

V. CONCLUSION

There was a risk of fire if the hospital's building does not take any action on this matter. It is important for all parties in ensuring the hospital's building safe for evacuation in case of fire. The evaluation of fire assessment is not a new field, there were several studies have been carried out on varying types of facilities. Though fire is not a daily occurrence in hospital's building, if it does happen, it may lead to losses to patients and to the hospitals itself. It also may affect the trusty and dependency of community towards the safety of the hospital. This paper

recommends the adoption of weighting techniques taken into consideration to get the results become robust. This is to ensure the level of safety of MoE in the hospital stay at the best, since no facility is completely fire safe. As the lesson learned, it is important for the design team and hospital's management improving the design and management of hospital's building in enhancing the MoE in hospital's building.

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