

Hazard Identification, Risk Assessment and Risk Control (HIRARC) of Safety and Health Hazards at Old High-Rise Residential Building Facilities: Case Study at Larkin Jaya Flat, Johor Bahru

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Abstract: A high-rise residential building is a form of multi-unit house constructed on a single parcel of land. The rising cost of land in cities has made this type of housing more popular every year. In high-rise residences, there are a number of shared facilities. So, the work of maintaining the high-rise facilities must be well-organized and kept in the best shape as possible, especially in older high-rise residential. On the other hand, all buildings, whether they are historic or not, need to be taken care of regularly. Before moving on to the following stage, which is maintenance, it is necessary to undertake a risk assessment in order to identify the risks. HIRARC approach is used in this research to achieve the first objective which is identify the risk of the old high-rise residential facilities to safety and health concerns. Second objectives, determined the risk rating of facilities hazard at Larkin Jaya Flat by using HIRARC. Last objectives, proceed with the risk control phase by using HIRARC. This research is focused on the Larkin Jaya flat in Johor Bahru. Old high-rise residential facilities that lack a proper risk assessment approach may not be able to operate properly, which might have an impact on the health and safety of their residents. This study used a mixed method, qualitative and quantitative. Qualitative technique which is HIRARC observation checklist at Larkin Jaya flat, supported by quantitative survey methodology at Larkin Jaya Flat. The survey distributed among the residents of Larkin Jaya Flat as the respondent. 30 people were able to take part in this study to support the qualitative data and reach its goals. The collected data been analysed by HIRARC risk matrix table for the observation method and the survey result by frequency in mode. At the end of this study, numerous methods be recommended to reduce the safety and health risk of old high-rise residential facilities by referring to the DOSH guidelines and several studies, since old high-rise buildings require critical preventative maintenance.

Keywords: Old High-Rise Buildings, Building Facilities, Risk Assessment, Safety And Health Hazards

1. Introduction

High-rise residential buildings have become popular because of the city's current lifestyle (Yahya and M. R, 2012). The world's population and income increasing, so the need for high-height residential construction. Robiah Abdul Rashid (2010), state the most valuable asset a person may own in a country is real estate and those old buildings are more than just money. They show the history of a country's identity and should be kept up for the next generation. However, the safety and hazard of old buildings are frequently questioned. Most older buildings have sustained damage to their structural parts, components and facilities. This might be because of human, animal, or environmental influences (Fatimah. et al, 2011). So, it is important to keep the building facilities in a good shape as it might influence the social issues (safety and health) to the occupants.

According to Rafhanah (2017), Larkin Jaya Flat often have problem with not enough parking aera because cars are often parked on the side of the main road or in front of the traffic light to get into the neighborhood. It can cause possibility of any hazard to occur such as property damages. Found out that the number of defects in older buildings is about twice as high as those in younger ones, and the relationship between building age and defects can be found to be in direct proportion (Cheng, 2008). According to a study by Zakaria et al. (2011), a roof leak in the Parliament building, water pipe leaks at the Kuala Lumpur Court Complex and at the Immigration Headquarters Putrajaya, a leak in the Hospital cafeteria Sultan Abdul Halim Sungai Petani caused by a clogged sewage pipe, a hot water pipe leak at Selayang Hospital, and so on are all examples of how buildings facilities are being damaged. Such incidents have embarrassed and hurt the building's reputation. They can also make people slip, fall, get hit by something, get hurt, cough, sore throat, fever, flu, headaches, and so on. This damage is caused by problems with facility management, especially with building maintenance. To avoid more serious issues, some of the defects must be handled in a proper manner. So, using the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) method is important to control the hazards. Since the goal of this research was to identify the hazard in old high- rise building facilities and propose a risk control to reduce the risk. This paper identify the risk safety and health hazards in facilities by using HIRARC as a tool at Larkin Jaya Flat, Johor Bahru, Johor. The study in Larkin Jaya Flat, Johor Bahru. The case study region's old residential high-rises facilities' safety and health issues were analysed. The structure over 20 years old, thus its facilities must be safe. This study used mixed method. To support the data and achieve the research objectives, questionnaires were delivered to Larkin Jaya Flat residents as respondent.

2. Literature Review

The literature review section describes all relevant literature related to the research and critically discussed. This section structured based on the stated objectives and focus of the study or any logical order as deemed appropriate.

2.1 HIRARC Risk Assessment

This section discussed on risk assessment right after the source of hazards have been identified. The purpose of risk assessment is to classified the level of risk that have been identified. Table 1 illustrate the level of risk and action should be taken to prevent form hazardous.

Table 1: HIRARC Risk rating in classification risk level (DOSH, 2008)

Risk	Description	Action
15 – 25	High	A HIGH risk requires immediate action to control the hazard as detailed in the hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.
5 – 12	Medium	A MEDIUM risk requires a planned approach to controlling the hazard and appliestemporary measures if required. Actions taken must be documented on the risk assessment form including date for completion.
1 – 4	Low	A risk identified as LOW may be considered as acceptable and further reduction may not be necessary. However, if the risk can be resolved quickly and efficiently, control measures should be implanted and recorded.

2.2 Safety and Health Management

The National Institute for Occupational Safety and Health (NIOSH) (2015) illustrated that the hierarchy of controls as an inverted pyramid with elimination is the most preferable to be selected and the least effective control measure is personal protective equipment at the bottom. From the identified hazards, a suitable control measure selected to reduce and prevent the hazards.

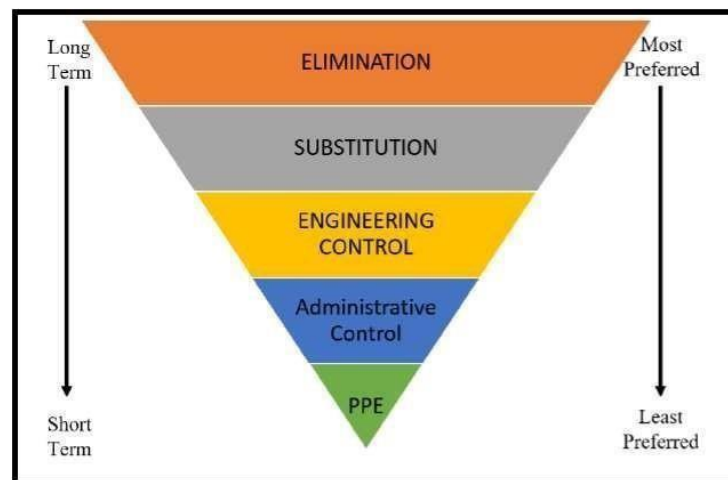


Figure 1: Hierarchy of control (DOSH, 2008)

Figure 1 indicates on method to reduce the risk. The best method preferred to control the risk is by eliminate the risk and it will benefit for long terms period. Meanwhile, the least method that can be taken is Personnel Protective Equipment (PPE) and it will benefit in reducing the risk for short term period only. Based on figure 1, the risk control also shown the level of risk, which the low level risk to high risk level indicate from bottom to top of the hierarchy. Engineering controls can be more expensive than administrative controls or PPE at the beginning. However, long-term running expenses are typically lower, particularly when protecting several employees. Additionally, engineering controls can reduce costs in other aspects of the work process or facility operation.

2.3 Larkin Jaya Flat and Facilities

Previous study from Rafhanah (2017), the region selected for her study is Larkin Jaya Flat in the Johor Bahru Parliament. Flat region Larkin is selected for the investigation because it is related to the concerns raised in this study. In this housing area, there is often a problem with not enough parking area

because cars are often parked on the side of the main road or in front of the traffic light at the entrance to the housing area and as it can cause property damage and danger towards the safety and health of residents.

2.4 HIRARC Hazard Identification and Assessment Methodology

A primary goal of hazard identification is to draw attention to those jobs that are vital to the health and safety of the workforce, as well as any equipment-specific dangers posed by factors like power sources, working circumstances, or the work itself. Health risks, safety risks, and environmental risks are the three primary categories into which hazards can be subdivided (DOSH, 2008). Table 2. Describes on source of hazards that can be identified.

Table 2: Source of hazards (DOSH, 2008)

Man	Unsafe acts
Machinery	Installation, layout, and design of equipment
Material	Substances such as chemicals and gases use in a workplace
Method	The way people carried out their work
Media	Workplace condition such as ventilation, air quality, noises, and vibration

3. Research Methodology

The research methodology section describes all the necessary information that is required to obtain the results of the study. The research methodology consists of detailed information regarding workflow, strategy, and approach. The methodology adopted in carrying out the study should be well explained.

3.1 Research Design

Based on the form of the research question, this study is more focused the methodological approach of qualitative, however, a methodical approach which are quantitative in nature to support and further strengthen the study of findings as shown in Table 3. Thus, this study uses a mixed research method approach qualitative and quantitative in nature. This selection of study method based to the title and question which are more in need of both forms of this approach. In order to get the raw data for the study, two types of instruments were used, observation through HIRARC observation checklist and questionnaire.

Table 3: Research design

No.	Objectives	Methodology		Findings
		Qualitative	Quantitative	
1	To identify safety and health facilities hazard by using HIRARC as a tool at Larkin Jaya Flat, Johor Bahru, Johor.	HIRARC Observation Checklist	Questionnaire	Able to identify the risk safety and health facilities hazard at Larkin Jaya Flat, Johor Bahru, Johor.

3.2 Research Instrument

According to Othman Mohamed (2001), research tools are used in most studies. The study tool was used to get information about the subject. In order to get the raw data for the study, two types of instruments were used, observation through the HIRARC checklist and questionnaire.

3.21 HIRARC Observation Checklist

Figure 2 shows the example of HIRARC hazard checklist form.

HIRARC FORM									
Company:			Conducted by: (Name, designation)						
Process / Location:			Date: (from... to ...)						
Approved by: (Name, designation)			Review Date:				Next Review Date:		
Date:									

1. Hazard Identification				2. Risk Analysis				3. Risk Control	
No.	Work Activity	Hazard	Which can cause effect	Existing Risk Control (if any)	Likelihood	Severity	Risk	Recommended Control Measures	PIC (Due date/ status)
1									
2									
3									
4									
5									

Figure 2: Example HIRARC hazard checklist form Guideline for HIRARC, Department of Occupational and Health Ministry of Human Resource Malaysia (DOSH, 2008)

In this study, the observation method is used to figure out the condition of building facilities in Larkin Jaya Flat from a safety and health hazard point of view, based on the example of HIRARC checklist form as shown in Figure 2. The concern of the facilities area that will be observed is based on previous study.

3.3 Analysis Data

This section discuss on the matter of the collection data be analysed by several method.

3.3.1 Analysed Data: HIRARC Observation Checklist

This section explained on the process collected data of HIRARC Observation checklist been analysed.

Table 4: Likelihood rate from Guideline for HIRARC, Department of Occupational and Health Ministry of Human Resource Malaysia (DOSH, 2008)

LIKELIHOOD	EXAMPLE	RATING
Most likely	The most likely result of the hazard / event being realized	5
Possible	Has a good chance of occurring and is not unusual	4
Conceivable	Might be occur at some time in future	3
Remote	Has not been known to occur after many years	2
Inconceivable	Is practically impossible and has never occurred	1

Likelihood is the possibility that something will happen, which can be defined objectively or subjectively, qualitatively or quantitatively, and shown in general terms or with math (for example, as a probability or a frequency over a certain amount of time). Table 5 shown how likely a risk is to happen. There are 5 levels likelihood.

Table 5: Severity rate (Source: Guideline for HIRARC, Department of Occupational and Health Ministry of Human Resource Malaysia (DOSH), 2008)

SEVERITY	EXAMPLE	RATING
Catastrophic	Numerous fatalities, irrecoverable property damage and productivity	5
Fatal	Approximately one single fatality major property damage if hazard is realized	4
Serious	Non-fatal injury, permanent disability	3
Minor	Disabling but not permanent injury	2
Negligible	Minor abrasions, bruises, cuts, first aid type injury	1

Analytical results can be communicated in a variety of forms to make a choice on risk control. If the likelihood and severity of harm are used in a qualitative technique of risk analysis, showing the results in a risk matrix table in figure 4 is an excellent approach to convey how widespread the danger is throughout the facilities. Risk can be calculated by using following formula:

$$L \times S = \text{Relative Risk}$$

L =Likelihood
S =Severity

Likelihood (L)	Severity (S)				
	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

Figure 3: HIRARC Risk matrix from Guideline for HIRARC, Department of Occupational and Health Ministry of Human Resource Malaysia (DOSH, 2008)

This study identifies the dangers and their severity and risk. Follow each danger's likelihood calculation. When the likelihood and severity columns met, the study may determine the risk, as shown in Figure 3. The relative risk value can be used to prioritise risk-management measures.

3.3.2 Analysed Data: Questionnaire

Next, the questionnaire data be analysed by using the Statistical Package for the Social Sciences (SPSS). SPSS version 2.3 is one of several computer software programs used to process and analyse research data, particularly for social and educational studies. The collected data analysed by frequency in mode.

4. Findings and Discussion

4.1 HIRARC Observation Checklist of Facilities Hazard at Larkin Jaya Flat, Johor Bahru

This section illustrate the collection data through the HIRARC observation checklist of facilities hazard at Larkin Jaya Flat, Johor Bahru. The results show each of facilities can be seen the possibilities of hazard are shown below.

4.2 HIRARC Risk Assessment of Facilities Hazard at Larkin Jaya Flat, Johor Bahru

Risk Assessment produced by the formula outlined in the HIRARC risk matrix in Figure 3. The level of risk was determined. Table 6 represent the result of risk assessment of facilities hazard at Larkin Jaya Flat, Johor Bahru by using HIRARC.

Table 6: Risk Assessment by using HIRARC

No	Potential Hazard	Likelihood	Severity	Numberof risks	Level of risk
1	Possibility the roof will collapse	1	1	1	Low
2	Potential for objects to be thrown towards the main road.	1	2	2	Low
3	Heavy and hard fallen object from the above.	3	4	12	Medium
4	Difficulty to put out the fire	3	5	15	High
5	Construction materials may go through out from the construction site.	3	4	12	Medium
6	Electrical short circuit	2	4	8	Medium
7	Smell pollution from garbage disposal house	4	2	8	Medium
8	Occupants possible to get stuck in the elevator	5	2	10	Medium
9	Possibility of getting fracture	2	2	4	Low
10	Chemical object might spill	2	2	4	Low
11	May cause fall while using the emergency exit	2	2	4	Low
12	Feasible for the roof to collapse	2	4	8	Medium

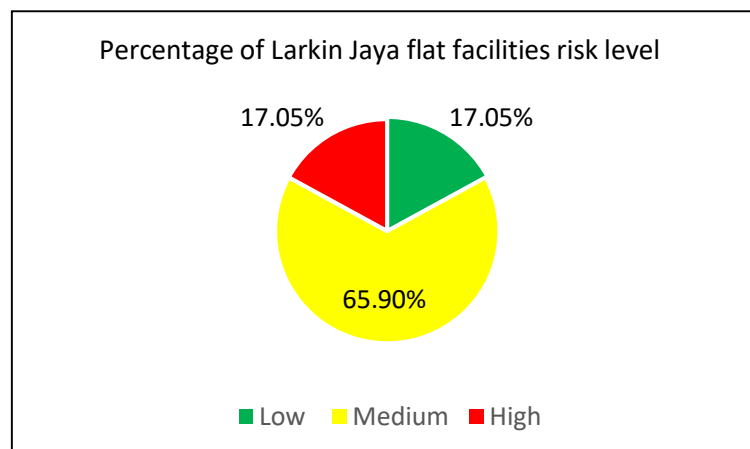


Figure 5: Percentage of Larkin Jaya flat facilities risk level

Figure 5 indicates that the risk level of facilities in Larkin Jaya Flat was mostly medium, with a percentage of 65.90%. Simultaneously, both the low and high risk levels recorded the same percentage at 17.05%.

4.3 HIRARC Risk Control

Risk control is needed to make sure that the safety and health of occupant is not put at risk by a potential hazard. Using the hierarchy of control, the right risk control was chosen to stop the possible danger from happening. Table 7 shows the risk control for each facility at Larkin Jaya Flat, Johor Bahru, Johor.

Table 7: HIRARC risk control

No	Work Activity	Risk Control
1	Multipurpose hall	Administrative Control <ul style="list-style-type: none"> • Proper Cleaning efforts • Scheduling Maintenance
2	Outdoor sport activities	Administrative Control <ul style="list-style-type: none"> • Scheduling Maintenance
3	Carpark	Engineering Control <ul style="list-style-type: none"> • Build Carpark Roof
4	Firefighting equipment	Engineering Control <ul style="list-style-type: none"> • Place a New Firefighting Equipment
5	Outdoor Sport Court under maintenance	PPE <ul style="list-style-type: none"> • Place Safety Net
6	Electrical conduit placement	Engineering Control <ul style="list-style-type: none"> • Place a New Electrical Conduit
7	Garbage disposal house	Administrative Control <ul style="list-style-type: none"> • Proper Cleaning Effort • Scheduling Maintenance
8	Elevator	Administrative Control <ul style="list-style-type: none"> • Proper Cleaning Effort • Scheduling Maintenance
9	Playground	Engineering Control <ul style="list-style-type: none"> • Place a Soft Surface
10	Restaurant/ Cafeteria	Administrative Control <ul style="list-style-type: none"> • Proper Cleaning Effort
11	Emergency Exit	Engineering Control <ul style="list-style-type: none"> • Place a Handrail
12	Shop	Engineering Control <ul style="list-style-type: none"> • Place a New Roof and Column

Table 7 shows that administrative and engineering controls are more effective at reducing facility risk at Larkin Jaya Flat. Long-term safety requires engineering controls. Engineering controls cost more than administrative or PPE controls. Protecting several people reduces long-term costs. Engineering

controls can reduce process or facility expenses (NIOSH, 2015). Risk control taken based on each facility's risk level.

4.4 Section B Survey Analysis: Identify Safety and Health Facilities Hazard by Using HIRARC as a Tool at Larkin Jaya Flat, Johor Bahru, Johor.

In Section B, respondents were asked for their experience on whether or not the facilities at Flat Larkin Jaya, Johor Bahru posed any safety or health hazard. Respondents may choose "Yes" if they thought there was a risk of danger at the listed facility or "No" if they thought there was none. Value 1= Yes, 2 = No. The result can be shown at Table 8.

Table 8: Identify safety and health facilities hazard by using HIRARC as a tool at Larkin Jaya Flat, Johor Bahru, Johor

No	Facilities			Mean	Mode
		Valid	Missing		
1	Multipurpose hall	30	0	1.97	2
2	Field	30	0	1.57	1
3	Carpark	30	0	1.07	1
4	Firefighting equipment	30	0	1.10	1
5	Outdoor Sport Court	30	0	1.27	1
6	Electrical conduit placement	30	0	1.17	1
7	Garbage disposal house	30	0	1.13	1
8	Elevator	30	0	1.27	1
9	Playground	30	0	1.37	1
10	Restaurant/Cafeteria	30	0	1.70	1
11	Emergency Exit	30	0	1.27	1
12	Shop	30	0	1.63	2

Based on Table 8, the study found that the respondents were able to identify the facilities hazard at Larkin Jaya Flat, Johor Bahru, Johor as the mode 1 recorded the highest. This shows that the source of hazard draw the attention to those facilities that are vital to the health and safety of the residents, as well as any equipment-specific dangers posed by factors like power sources, working circumstances, or the work itself (DOSH, 2008). The results show each of facilities in Larkin Jaya Flat has the potential of hazard towards the safety and health of the residents.

5. Conclusion

As a conclusion, this study has met the objectives. The researcher able to identified the hazard based on the table in Appendices 1. To support the data, the collection data from questionnaires in table 8 shows most of the respondent able to identified the hazard because they were more experienced in used the facilities at the Larkin Jaya Flat, Johor Bahru. It clearly shows that the objectives to identify the facilities hazard are met.

Based on the results of the research, the researcher can make some suggestions that might improve the safety and health of the building's facilities. In addition, the researcher provided future researchers with suggestions for future research to be utilised as a reference and to build upon the elements deemed required.

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