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**SUSTAINABLE BUILT
ENVIRONMENT**

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IMPORTANT OF INDOOR AIR QUALITY CONTRIBUTED OF OCCUPANT HEALTH AND SAFETY FOR OFFICE

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ABSTRACT

Indoor air quality (IAQ) in a building is a very important element to ensure the health and comfort level of the building occupants. This is because work productivity may be interrupted due to the polluted environmental condition and bad indoor air quality. Both factors may lead to bad health and physical condition and consequently to bad work performance. The study presents the understanding and knowledge of how indoor air quality (IAQ) affects psychological performance and health impact to the occupants in office buildings in Malaysia. The finding shows that in the current situation, most respondents are not satisfied with their office's current indoor air quality. This condition is believed to be one of the contributing factors affecting occupants' work productivity and stress level. Nevertheless, this research managed to provide better understanding and valuable information on how indoor air quality affects psychological performance and health condition of the occupants in office buildings. Recommendations are made to improve the indoor air quality performance in order to provide a comfortable working environment for the occupant.

Keywords: *indoor air quality (IAQ), health impact, work performance, office*

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INTRODUCTION

In Malaysia, office buildings are required to offer a healthy interior atmosphere with good indoor air quality (IAQ) to protect staff members' physical and mental well-being while they do their jobs there.

The indoor environment in a confined area is a complex and dynamic collection of physical, biological, and chemical variables that can impact the health and physical reactions of the inhabitants at any moment, whether we are aware of it or not. Furthermore, data suggests that volatile organic chemicals often present in workplace indoor air may trigger sick building syndrome symptoms. (S.N. Kamaruzzaman & N.A. Sabrani, 2011).

LITERATURE REVIEW

Definition of Indoor Air Quality

In Malaysia, office buildings are required to offer a healthy interior atmosphere with good indoor air quality (IAQ) to protect staff members' physical and mental well-being while they do their jobs there. This is since their health will impact both how well they function at work and how well the organization performs. Since Malaysia's temperature is hot and humid due to its position in the tropical climatic area, most office buildings in Malaysia use mechanical ventilation systems like ventilation and air-conditioning (HVAC) to regulate the building inside air and atmosphere. The mechanical ventilation systems, however, will only deliver fresh air if they are in good shape and are well maintained. (S.N. Kamaruzzaman & N.A. Sabrani, 2011).

The indoor air quality, or IAQ, of a building or other structure is important for the inhabitants' health and comfort. IAQ is significantly impacted by both ventilation system design and operation, which is important. Ventilation produces adequate IAQ and a healthy interior environment by replacing the stagnant indoor air with the fresh outside air. (Sun et al., 2019)

Indoor air quality is determined by a large number of different factors including the quality of outdoor air, the type and condition of the building, the furnishings, and the occupants' lifestyles and habits. Based on (World Health Organization, 1999) Over the past 20 years, there has been an increase in concern about the quality of the indoor air. This issue was first raised by reports from people who lived in different indoor environments and complained about a variety of vague symptoms, such as mucous membrane irritation or dryness, burning eyes, headaches, or exhaustion. Indoor air problems are mainly related to inadequate urban planning, design,

operation and maintenance of buildings, materials and equipment in buildings, and inappropriate energy saving.

Important of Indoor Air Quality (IAQ)

Indoor air quality can harm the occupant in the building, and it need to be care and concern because it is important to the building occupant. It might have various effects that can lead to sickness. Based on (World Health Organization, 1999), The consequences of indoor air pollution on cardiovascular disease, reproduction, and other systems and organs are still poorly understood. However, some information suggests that indoor pollution may play a significant role in the development of cardiovascular and other systemic disorders.

Lack of knowledge regarding the type, amount, and potential health effects of compounds released into interior environments is another cause for concern. For instance, thousands of chemicals, some of which are manufactured in large quantities, are frequently utilized in the manufacturing process in the building sector. Many of these substances pollute the interior air and meet everyone residing in the structures. For a very tiny part of them, toxicological and health hazard assessments are available. The transportation and consumer goods sectors must consider similar factors.

Assessment of Indoor Air Quality

The best course of action should be determined after evaluating the current circumstances before taking any action targeted at enhancing IAQ. The measurement of several parameters, such as the thermal and air quality conditions in the room, must often serve as the basis for the evaluation of IAQ in that space. The simplest thermal factor, which is room temperature may be measured quite accurately in normal conditions and rooms with quite simple instruments, while measurement and assessment of the risk of draught in a room, for example, is much more complicated. It is important to distinguish between an assessment meant to gauge the IAQ as it is experienced by a particular group and the identification of a "problem building."

International guidelines

The WHO Air quality recommendations discuss the impact of various contaminants on human health that are related to indoor exposures. Different international organizations that deal with occupational health have developed similar, even more thorough rules, although they are only applicable in industrial settings.

National actions

Depending on local laws and other factors, these rules may take on quite various forms and have very varied statuses. Numerous organizations frequently conduct examinations of IAQ while each employing a distinct set of reference standards. (World Health Organization, 1999)

Effect of Safety and Health Related to Indoor Air Quality (IAQ)

According to The World Health Organization (WHO) estimates that 700,000 people per year die from poor breathing condition. (Sun et al., 2019). For the internal environment to be adequate for human activities it is intended to confine and protect, a building modifies the outer climate. Only the minimal duties that primitive cultures require may be regularly carried out outside, and even then, only in suitable weather and conditions.

Table 1: Effects of poor indoor air quality.

No	Organ Involve	Symptom	Effect
1.	Nose	Irritated runny/ block	Congestion, nosebleed, itchy or stuffy nose
2	Throat	Dry or Sore	upper airway irritation, pharyngeal difficulties, or swallowing problems.
3	Eyes	Irritated, dry or watering	Itching, fatigue, redness, burning, or trouble using contacts
4.	Skin	Dry, itching or irritated	Rash such as xeroderma, rosacea, urticaria, erythema, and pruritis

Poor air quality where hazardous components may be present could hinder or prevent human adaptation. Furthermore, the former's impacts are anticipated to be either direct or more specific, where they produced bodily and psychological changes that were easily recognised as a response to environmental stressors.

Factor Affecting Poor Indoor Air Quality (IAQ)

Contaminants in indoor air might come from the structure itself or can be pulled in from the outside. Even if the HVAC system is well-designed and maintained, IAQ issues can still occur if pollutant sources are not regulated.

Indoor Air Pollutant

How likely it is that indoor air pollution may result in an acute reaction depends on several factors, including age and present medical conditions. According to (Sun et al., 2019) Exposure to poor indoor air is a significant cause of productivity loss, for the U.S., as productivity decreases 0.5–5% per workplace, generating a loss of 20 to

200 billion US dollars annually because inadequate ventilation, lack of air conditioning systems, human activities, and numerous materials, chemicals, and gases mainly influence indoor pollution (Mannan & Al-Ghamdi, 2021).

Ventilation

Ventilation systems play a significant role in IAQ management because they are used to provide thermal comfort by regulating temperature and humidity in indoor environments and by diluting indoor air pollutants with outdoor air, lowering their concentration to minimize adverse health effects. One of the factors contributing to poor indoor air quality is inadequate ventilation, which has an adverse effect on occupants' health and wellbeing. Ventilation systems can encourage interior airflow by using mechanical or natural forces. (Fonseca et al., 2019).

Temperature

In order to give residents adequate air quality and reduce the effects of Sick Building Syndrome, indoor temperature is crucial (SBS). Overheating will increase the components of allergens while lowering residents' pleasure and productivity (Saadoon Abdulaali et al., 2020). Acceptability of air decreased significantly with increasing temperature expose when high temperatures perceived air quality was dominated by these two magnitudes rather than by the pollutants in the air. (Fang et al., 1998).

Humidity


Humans have difficulties perceiving changes of the relative humidity (RH), due to lack of sensory receptors for humidity (Wolkoff & Kjærgaard, 2007). Numerous studies have found a correlation between indoor air pollutants and humidity. The indoor air pollutants may increase humidity. In comparison to a normal environment, temperatures appear to be greater in humid climatic conditions. Humidity levels are crucial for Indoor Air Quality (IAQ) and occupants' thermal happiness. Additionally, high humidity affects people's health and helps their respiratory issues. (Ries et al., 2006)

METHODOLOGY

This study methodology used the quantitative method which is questionnaire type. Used is open ended questions that allow respondents to react based on their knowledge, whereas the closed ended questions allow respondents to select multiple-choice solutions depending on the question. The questionnaire is divided by three part which is first is part A. Part A is demography question which is general about the personal information. Next part B is the question in order to achieve the first objective of the research, and lastly part C this part also is included to achieve the

second objective for this research. The secondary data collected from the previous research report. Other trusted materials such as journal are accepted as additional information. The result of these two methods of data collection, it should answer all research question.

Table 1: Scenic Drive Sdn. Bhd.

Figure	 <p style="text-align: center;">Figure 1 : Scenic Drive Sdn. Bhd.</p>
Building name	Scenic Drive Sdn. Bhd.
Building location	Scenic Drive Sdn. Bhd. Jalan Siswa 8, 06000 Jitra, Kedah
Building Information	Scenic Drive Sdn Bhd was incorporated on 2012-01-18 in Malaysia with registration number of 0975674D. Scenic Drive Sdn Bhd business includes manufacturing and sub-assemblies of semi-conductor components
Person In-Charge	Pn Rosfatimawati ismani binti ismail (Human Resources)

This observation is to know the satisfaction of occupant in the office building and factory that is related to their safety and health.

DATA COLLECTION

Data collection through online survey, the results of this research focus on only by the related parties Scenic Drive Sdn. Bhd. which are the engineer, Human Resources and Operator. The survey consists of 14 questions has been distributed to 50 respondents.

Primary Data

The primary data are based on the production team such as the engineer, Human Resources and Operator of Scenic Drive Sdn. Bhd. The survey form is to gather the

data based on the specific objective of the research. To successful the data analysis collection the used of the techniques to collect the data are based on survey, site observation and questionnaire.

Secondary Data

Secondary data are data analysis that gather from the journal, article and book. Obviously, the secondary data is completed project or research from the other author with their own objective that is related to research topic.

DISCUSSION

The questionnaire form is using Google Form because the data that has been answered by the respondents can be shown in simpler form. The results of this research focus on only questionnaires to be answered by the related parties which are the engineer, Human Resources and Operator. The questionnaire which consists of 14 questions has been distributed to 50 respondents through emails and WhatsApp application to the respondents.

Demographic

Table 2: Gender

Gender	Number of Respondent	Percentage (%)
Male	35	70
Female	15	30

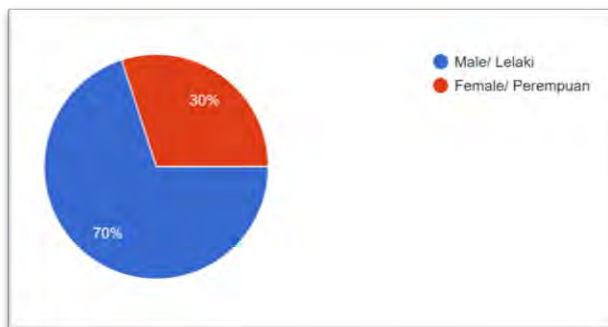


Figure 2: Gender

The pie chart displays the distribution of genders in each context, indicating that males comprise 70% of the population, while females make up 30%. This highlights

a gender disparity with a significant overrepresentation of males compared to females.

Age

Table 3: Age

Age	Number of Respondent	Percentage (%)
22- 25 Years	30	62
26-30 Years	10	20
31-35 Years	7	14
35 – Above	3	6

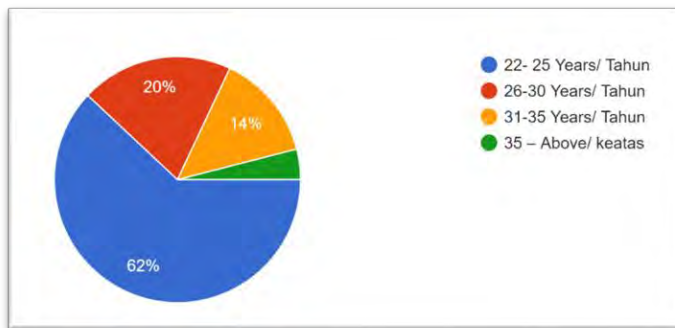


Figure 3: Age

It is apparent that most of the population falls within the 22-25 years age range, comprising 62% of the total with 30 respondents. For the sec higher in this pie chart is the 26-30 years range, representing 20% of the population. Followed by the 31-35 years range comprises 14% of the population. Lastly the aged 35 and above make up the smallest portion at 6%.

Complaint

Table 4: Complaint

Complaint	Number of Respondent	Percentage (%)
Temperature too cold	10	22
Temperature too hot	17	34
Stuffy Air	19	36
Moldy Odors	4	8

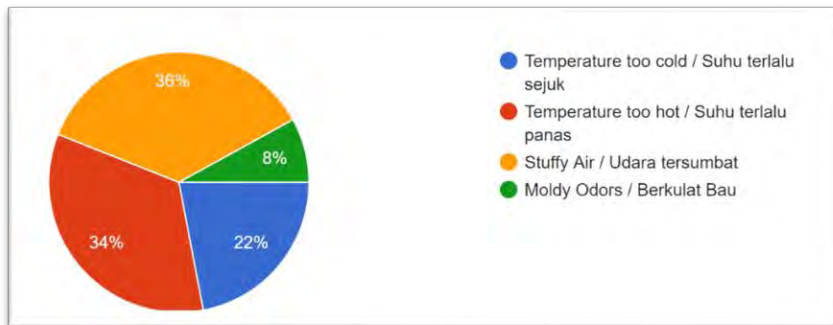


Figure 4: Complaint

The data reveals that 36% of the complaints are about Stuffy air which is the higher percentage of complaint in the pie chart with 19 of the respondent votes for this problem. Second higher in the chart is temperature being too hot with 34% contributing the 17-respondent number this because majority of them are work as operator. While 22% are related to the temperature being too cold. This indicates a significant portion of individuals experiencing discomfort due to temperature extremes. The remaining 8% of complaints are about mouldy odours, indicating a smaller but still noteworthy issue with potential health implications.

Symptoms

Table 5: Symptoms

Symptoms	Number of Respondent	Percentage (%)
Shortness of breath	10	20
Allergies	4	8
Sore Throat	2	5
Frequent Cough	2	5
Headache	22	42
None	10	20

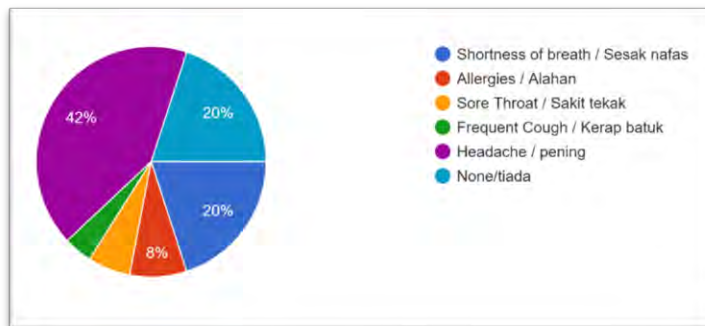


Figure 5: Symptoms

The most prevalent symptom reported is headaches, with the dominant percentage is 42%. Next followed by Shortness of breath is the second most common symptom, with a frequency of 10 respondent and representing 20%. For none (no symptoms) also contribute the higher percentage with 20% in the analysis with 10 respondents don't expose to the symptom. For allergies it also representing 8% with number of respondents is 4 people. Sore throat and frequent cough have the same frequency of 2 and account for 5% each.

CONCLUSION

Indoor Air Quality (IAQ) plays a significant role in the health and safety of occupants in office buildings. Poor IAQ can lead to various health problems, including respiratory issues, allergies, headaches, fatigue, and decreased productivity. In summary, ensuring good indoor air quality in office buildings is imperative for the health, safety, and well-being of occupants. It not only helps to reduce health risks and enhance productivity but also promotes occupant satisfaction and regulatory compliance. Therefore, proactive measures should be taken to monitor, maintain, and improve IAQ in office spaces.

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