

INFRASTRUCTURE BUILDING ADJUSTMENT IN THE COVID-19 PANDEMIC

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ABSTRACT

Infrastructure building adjustment must be done during the COVID-19 pandemic to ensure the health protocol implementation. The permanent buildings cannot be changed. Therefore, the infrastructure building adjustment need to be done. There are some modifications on the places and sites, also addition of specific instrument to ensure the good air circulation. This paper aims to describe the adjustment of infrastructure building during the COVID-19 pandemic. Method: This is a narrative literature review. Articles were searched in Science Direct, PubMed, and Google Scholar. The articles were selected based on title, abstract, and full-text screening. Results of literature review revealed that the buildings should have at least an air purifier as filter and open windows to ensure the good airflow. The recirculated air from the surrounding people without circulation increases the risks of COVID-19 transmission. Joining rooms such as joined kitchens or living rooms must not be used during this time. If the room is very important and must be used together, then there should be a break period from one user to another user. This break time is important to allow fresh air circulation. The important factors in building adjustment and modification are cost, health aspects, function, and the users' safety. In conclusion, the adjustment of infrastructure building during the COVID-19 pandemic can be implemented by maintaining the good air circulation flow in the room, using an air purifier as filter, and ensuring a break period for users in using joining rooms.

Keywords: adjustment; building; COVID-19 pandemic; infrastructure

INTRODUCTION

Adaptive infrastructure must be developed during the COVID-19 pandemic. The buildings changes need to be implemented. However, the permanent buildings cannot be easily changed, therefore modification must be done. The high-risk places of being transmission sites are closed and poorly ventilated rooms (Kumar & Morawska, 2019; Somsen, van Rijn, Kooij, Bem, & Bonn, 2020; Zarrabi, Yazdanfar, & Hosseini, 2021). The high transmission rate of COVID-19 infection causes people to spend most of their time at home (Dietz, Horve, Fretz, & Eisen, 2020). Meanwhile, offices are changed into larger spaces with fewer seats. It is essential to maintain the social distancing requirement (Tokazhanov, Tleuken, Guney, Turkyilmaz, & Karaca, 2020).

The speed of reproduction (R) of the coronavirus greatly affects the health condition of a village, city, even region, and country. The rate of occurrence of new infections will increase many times as the R-value increases. On the other hand, if the R-value decreases, the transmission rate slows down and the transmission can even disappear if the R-value is below one. Therefore, all countries are implementing social distancing, closing schools, churches, bars, community centers, and entertainment venues to flatten the transmission curve (Kumar & Morawska, 2019).

The environment should be transformed in different ways to adapt to the COVID-19 pandemic. Dense spaces are at higher risk for increasing virus transmission, especially in

public spaces. Adaptive changes are needed to cope with the new reality during the COVID-19 pandemic. The important goals that must be achieved in adaptive changes are avoiding virus transmission, minimizing the impacts to the environment (due to increasing water usage), and maintaining a comfortable time while staying at home (Tokazhanov et al., 2020). When the building is equipped with air conditioning, the air circulation must be considered. A healthy home free from the potential for COVID-19 transmission is a dream home at this time. This situation is a bit difficult to be applied in closed apartments (Morawska et al., 2020; Zarrabi et al., 2021).

The research about natural ventilation was in Medan by Sihombing in 2021. It was revealed that ventilation is important for the process of air exchange in the open building. Various position of ventilation can be placed. However, the size and location should be well arranged to obtain the best function. The location of the window should be at least 80-120 cm from the floor. However, not all the windows have ideals size. Some of the windows cannot be opened at all. Therefore, the air flow and exchange cannot be maximal (Sihombing, 2021).

A healthy, safe, and comfortable environment are three aspects of ideal buildings during the COVID-19 pandemic. Proper sanitation is important to reduce the possibility of infection. New touchless technology can be a good choice to limit the spreading of infection. Developing greener space can release mental stress during the COVID-19 pandemic. There is a need for sustainability requirements for buildings (Tokazhanov et al., 2020). This paper aims to describe the adaptive infrastructure development during the COVID-19 pandemic.

METHODOLOGY

This is a narrative literature review. Articles were searched in Science Direct, PubMed, and Google Scholar. The articles were selected based on title, abstract, and full-text screening. Opinion and not peer-reviewed articles were excluded. Articles were read twice to minimize bias. The selected articles were summarized and written in narrative literature review.

RESULT AND DISCUSSION

Results of literature review revealed that the buildings should have at least an air purifier, open windows, and an un-recirculated area to maintain the fresh airflow. The recirculated air from the people surround the room increases the risks of COVID-19 transmission. Joining rooms such as joined kitchens or living rooms must not be used during this time. If they should use the rooms, then there must be a break period from one user to another user. This break time is important to allow fresh air circulation. Therefore, collaboration among architects, scientists, and stakeholders is needed to develop the best and economical design proposals. Cost, functional potential, health aspects, and safety are important factors (Zarrabi et al., 2021).

Indonesia, as a tropical country, needs special ventilation for dwellings. It is critical for maintaining the natural ventilation for the health. Air change rate (ACH) is an important measurement for evaluating the fresh air flow (ventilation). This rate is also associated

with quality of air circulation, unwanted gas, and heat losses. The speed of the wind has an essential role in accelerating evaporative cooling process. It also acts as indoor thermal comfort. The local wind condition has some affects to the ventilation of a building. When the opening orientation is at the wind shadow zone, there will be sucking pressure due to unavailable wind in the interior space. Therefore, the area of inlet and outlet should be concerned to increase the air change rate (Indrani, 2008).

The built environment is critical to be adapted according to the COVID-19 pandemic situation nowadays. The built environment includes buildings, public transport, cars, and roads (Horve et al., 2020). Spatial dynamics and building safety should be a concern to mitigate the transmission of COVID-19 infection. Interaction in closed spaces can create fomites. Fomites are objects that carry infectious materials (Tellier, Li, Cowling, & Tang, 2019). The density of the building depends on the number of occupants, the function of the building, the occupancy schedule, and the activities. Indoor activities and higher occupant density increase the risks of transmission (Horve et al., 2020). Airflow patterns and turbulence in the indoor building also increase the transmission risk. There is also the chance of viruses transfer from the contact surfaces. This kind of viruses transfer is caused by Building Related Illness (BRI) and Sick Building Syndrome (SBS) (Zarrabi et al., 2021). The possibilities of transmission contact sites are depicted in Figure 1 (Dietz et al., 2020).

An adequate ventilation, filtration, air disinfection, and avoiding air recirculation are effective ways. This can also be achieved by avoiding crowds. This kind of condition is very important to be applied to public buildings that are often visited by many people. A healthy home is everyone's dream in this condition (Zarrabi et al., 2021). Air delivery system is very essential. Thus, high-efficiency particulate air (HEPA) filter is needed. However, no filter system is perfect. This precaution of HEPA filter is very important to be placed in co-working spaces, hospitals, transportation, and other indoor buildings. Frequent filter maintenance protocol is very critical to prevent transmission. Sunlight is good in reducing the virus half-life. Therefore, the rooms should have good sunshine access in the morning. When direct sunlight is unavailable, then UV light spectrum devices can be applied (Dietz et al., 2020).



Figure 1. The possibilities of transmission sites
(Source: Dietz et al., 2020)

During the COVID-19 pandemic, isolation occurs at home. Ideal home conditions are crucial. However, measuring the ideal home is still a bit difficult to do. This is also a challenge nowadays. Home and health conditions are not certain things, so they are always dynamic. Some of the things that are important to note are Building Related Illness (BRI) and Sick Building Syndrome (SBS). BRI is a disease caused by pollutants in a closed room. Meanwhile, SBS is a condition in which people who live in a building experience pain and symptoms of boredom without any good reason. Unhealthy housing conditions can cause asthma, lead exposure, allergies, injury, cancer, cardiovascular disease, and other diseases. Failure of the heating system can cause burns, smoke inhalation, and carbon monoxide poisoning. Those condition are related to Building Related Illness (BRI) and Sick Building Syndrome (SBS) (Zarrabi et al., 2021).

The growth of mold is also a problem in buildings. This will cause respiratory problems and allergies (Haleem Khan & Mohan Karuppayil, 2012). Treatment of this fungus is quite difficult and can even lead to death (LeBlanc, Polvi, Veri, Privé, & Cowen, 2020; Nakamura et al., 2020). The walls can sometimes be overgrown with fungus due to the high humidity (Chatterjee, Prados-Rosales, Itin, Casadevall, & Stark, 2015). This condition will worsen the COVID-19 infection. COVID-19 infection may also be accompanied by fungal infection (Song, Liang, & Liu, 2020). Therefore, the role of environmental hygiene should not be underestimated. Nosocomial infections in hospitals because of the spark of the airways and feces can cause environmental contamination in bed, light switches, glass windows, and the outside of the fan. Exposure can occur in buildings, homes, and the environment, therefore awareness of environmental cleanliness must always be increased (Jones, 2020).

Future buildings should be designed based on the principles of flexibility and efficiency. There should be a quick transformation of the building for needs such as hospitals or medical facilities. Lightweight and adaptable structures are preferable. It is useful for construction speed. Temporary structures are important because those structures can be disassembled and transported easily to the essential area. An easily sanitized building is good to create a hygienic building. The availability of green space is also a requirement for a good building in the future. Green spaces improve mental health. The spaces can be used to grow food. The benefits are better air quality and density reduction. Wastewater management and better solid-waste management are also important things to be concerned (Tokazhanov et al., 2020).

CONCLUSION

In conclusion, adaptive infrastructure development during the COVID-19 pandemic can be implemented by modifying the air circulation flow in the room, providing an air purifier, and allowing a break period for users in using joining rooms. Health aspects, safety, functional potential, and costs must be considered. The ideal building to prevent the transmission of COVID-19 has adequate ventilation and avoids recirculation. This condition is important to apply in public places such as hospitals and schools to reduce the transmission of COVID-19 infection. The ideal building also has no risk for fungal infections. Fungal infections can worsen an existing COVID-19 infection.

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