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The Concept of Healthy Building with Green Open Space Integration on Condominium Design in Medan

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ABSTRACT

One factor that influences public health is the quality of the health of the residential environment, which is determined by the quality of the green open space. The role of green open space in housing is to make residents who stay inside feel like being in nature, not like in a crowded room, to improve the psychological health of residents. This study aims to explore condominium designs that have good oxygen levels, avoid air pollution and inhibit the spread of the virus so that the condominium can improve the physical health of residents. The method used descriptive qualitative in the form of a literature study. The results of this study produce healthy building designs with natural lighting and ventilation in housing that saves energy use, cool air humidity, a building site that is free from air pollution and noise by vehicles, reusable water quality, residential safety, green open space that can provide good oxygen levels, and green open space that connected to the indoor area.

Keywords: architectural design, condominium, healthy building

1 Introduction

Currently, vertical housing is the most selected culture for living in Indonesia. Activities executed in horizontal housing sometimes increase land constraints because population growth increases dramatically [1]. The existence of vertical housing can be used to solve various kinds of population growth problems and the availability of land that can accommodate large numbers of people. On the other hand, green open space is also limited. Green Open Space is needed to support human health and the environment, including individuals' and communities' physical, mental and social health, and the maintenance of ecosystem services and biodiversity [2]. The typology of green open space could be a sensible design solution for land efficiency, microclimate optimization, and positive user experience [3]. In Medan today, there is no optimal vertical housing yet integrating open space. Some residential units are closed with two balconies without plants, without openings, and using only artificial coolers. So that residents rarely get oxygen intake from

plants in the area morning. Therefore, to overcome all these problems, designing vertical residences with the theme of a Healthy Building with open space and Much greenery in the residential unit area can be the solution.

2 Literature Review

Healthy buildings impact the physical, psychological, and social health and well-being of people in the building environment [4]. Healthy buildings can be desperately needed by every building resident and visitor so that all people can feel, enjoy, and spend most of their time in the open space to make them healthier and wealthier. There are so many health problems that arise during people's activities in specific environments. For example, air pollution causes various environmental and health issues. In addition, some facilities may have hidden impacts that can threaten the health of people and buildings, such as building materials that use non-quality materials. Some materials can produce odors that can cause health problems, such as headaches, nausea, nightmares, nasal irritation, sneezing, and coughing, and these difficulties are exacerbated by inadequate ventilation [5]. So, to reduce health issues, a Healthy building must consider lighting, air quality, thermal comfort, auracousticmfort, colors, and textures that give positive vibes [6]. Healthy buildings must also have air filtration on each side to consider air quality improvement, filtering performance, energy, economic behavior, thermal comfort, and acoustic impact [7]. The usual way of controlling indoor air pollution is via ventilation. Ventilation helps provide fresh air into the room. It prevents indoor air from hot temperatures in the tropics so that the air quality of occupants in the indoor environment becomes more humid [8].

2.1 Healthy Building Concept in Bosco Verticale

The vertical forest concept, called ‘treescraper,’ caught m’ attention after completing the original Bosco Verticale in Milan. Although this building is a contemporary skyscraper, this building is not the same as other buildings; this is because these two towers have a genuinely spectacular shape, such as the placement of alternating trees on the façade, which makes the facility more varied and exciting [9]. This vertical residence consists of two buildings with a height of 76 meters and 111 meters. This residence has about 25 floors, of which there are 900 trees, such as 550 trees in one tower and 350 trees in the other tower [10]. There are also 11,000 seasonal plants and 5,000 potted plants scattered on each fading. These plants are placed to produce oxygen, reduce noise pollution from outside the building, reduce air pollution, and regulate the temperature in the dwelling to be more relaxed and fresher. Several components in living facilities, such as trees and greenery, are critical in providing better air quality, calm, and freshness and will give a pleasing and elegant image of the city and the environment around the location of the building. Living green walls are not new inventions either and have become a landmark as historical places [11]. Healthy Building Concept These buildings replace traditional materials on urban surfaces. Wrong one example is the facade of the walls of this building using materials using leaf polychromy (Figure 1).

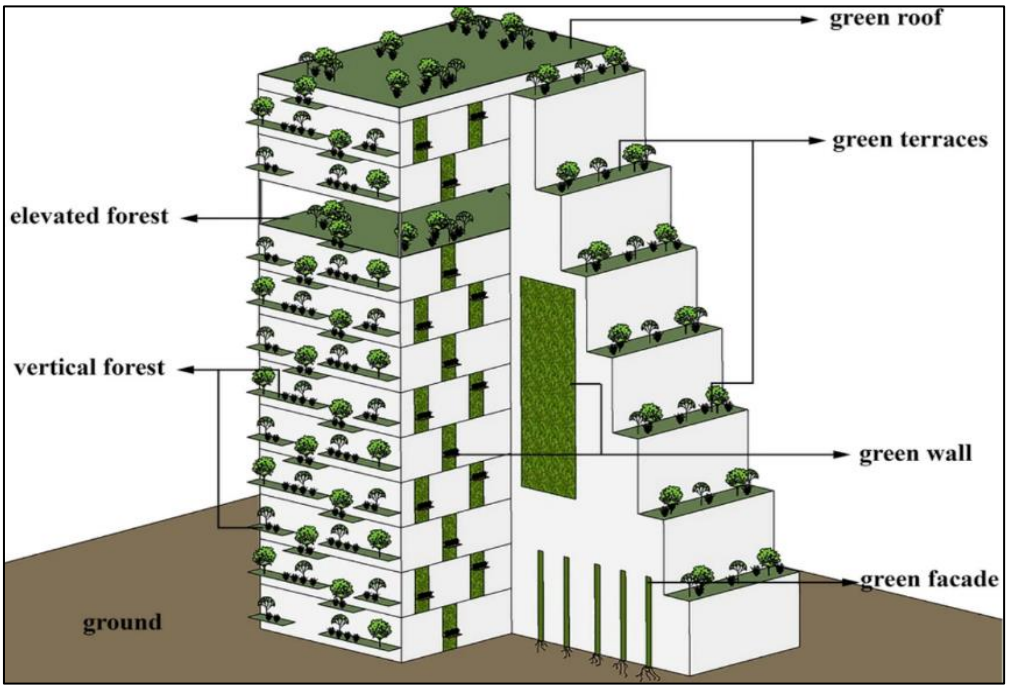

Figure 1 Bosco Verticale's Greenery and Components
(Source: https://link.springer.com/article/10.1007/s00107-020-01583-0/figures/1 [12])

The pedestrian is located around the park in the building. It can also be used as a jogging area for condominium residents. This jogging area can provide space for residents to do outdoor activities in the morning to get more sunlight and breathe oxygen from the plants around the building. Based on the Theme Interpretation, the explanation provides a concept for people's physical health, namely by jogging (Figure 2a). This building has a bicycle parking lot to keep visitors around the vast park by bicycle. In addition, cycling activities can make residents more active and feel the space open without needing to walk a more extended reach. This bicycle parking can be used by any age group of residents who live in the building. Thus, more and more activities residents can do and provide mental health. Based on the Theme Interpretation, the explanation provides the concept of Healthy Building based on the community's mental health by interacting with open spaces (Figure 2b).

Figure 2 (a) Bosco Verticale's Pedestrian **(b)** Bosco Verticale's Bicycle Park
(Source: https://www.google.com/maps/place/Bosco+Verticale/ [13])

There is Outdoor Seating scattered on each side of the park. This outdoor seating is used for residents to relax in the garden and also relax for a breath of fresh air. So the exchange of O2 and Co2 in the body of residents can be more productive. Based on Theme Interpretation, the explanation provides the Healthy Building concept based on the influence of open space and facilities for mental health and good air quality (Figure 3a). The trees on this Ground floor can also provide an exchange of fresh air for active people in the park and reduce flooding because a lot of plants and grass make More rainwater absorbed into the soil. This park has trash cans, several fire hydrants placed on the site as fire support, and drainage surrounding the garden that functions as a rainwater channel. Rainwater on buildings is then filtered as water for toilets and flushing plants. Based on Theme Interpretation, the explanation provides a Healthy Building concept with good Water Safety and Quality (Figure 3b).

Figure 3 (a) Bosco Verticale's Seating Area **(b)** Bosco Verticale's Greenery

(Source: https://www.google.com/maps/place/Bosco+Verticale/ [13])

2.2 Kampung Admiralty Function and Organization of Space

The Kampung Admiralty originated as one of the developments of public Vertical Residential in Singapore. It has widely popular with residents and the surrounding community, Because of its programming and welcoming design [14]. The word "Kampung" is the Indonesian word for naming this building because even though this vertical residence is built in the city, the village culture elements have lots of greenery and open spaces in buildings spread over several floors. The amount of space for gathering in this building also supports village culture [15].

Kampung Admiralty has Green Open Space Facilities/Community Park. The atmosphere can reduce anxiety in people, especially the elder [16]. The green area is spread out on floors 3-9 tower floors where residents can actively gather for exercise, chatting, or tend to the community farm so that 13 the concept of this building does not leave the usual village atmosphere found in the village. Several programs support the health and well-being of communities in facilities, such as the Center for Children care and Eldercare (Active Againe Hubs), which are located side by side, bringing the elderly and children together with young people to socialize and coexist with each other. Fitness Center and Playground on the 6th floor are located side by side. At the same time, the playground is used for children educated in Children's care to interact socially with other children [17]. The Section shows all the rooms and activities in Kampung Admiralty (Figure 4).

Figure 4 Section That Shows Activities in Kampung Admiralty
(Source: https://repositori.usu.ac.id/handle/123456789/50264 [17])

The Admiralty Kampung Vertical facilities are designed with a Community Plaza on the podium floor and a Community Park connected to a residential unit for the elderly. The Basement is used for a carpark and supermarket. There is a Food & Beverage on the 1st and 2nd floor, which means a public area. And there is an Eco Ponds to bring Thermal Health. There is a Health Center on the n 3rd and 4th floors. Childrencare and Eldercare are on the 6th floor and 7th floors. A sky terrace in the sky garden brings many oxygens to make people healthier. The tower plan of the Kampung Admiralty has eight pieces of roof oms on each floor with connecting openings to the balcony. There are four rooms with a size of 36 m2 and four rooms with a length of 48 m2 on each floor. So, every bed has two types of room units. A core in the middle of a building serves as a vertical transport surrounded by each team. Each room is also connected to a balcony which is to open space. The Space Quality of the Residential unit in the Kampung Admiralty building is shown on the floor using wood parquet because it can lower the alkaline level. Wooden floors produce negative ions that can purify the air for residents. Brown walls and ceilings add to the building's impression of being environmentally friendly. The use of warm light lighting supports a warm appearance in the room and reduces exposure to blue light. The house has an open space balcony that blends with the exterior to save more on using electrical energy and provide fresh air daily.

3 Methodology

The selection of this location uses a method that begins with data collection and analysis of the area. Then observe directly to obtain data in Taman Teladan, such as how to access and enter the park, the atmosphere of the park, and the activities carried out in the garden, and also examine the condition of the park before the pandemic and after the pandemic. As a result of research on the relationship between open space and people's quality of life, in September 2021, every weekend, the community wants the activity to be dean with public open space.

4 Result and Discussion

The location for the Condominium is on 2.0 ha of land in Stadion Street Medan. The site is an existing building in the form of a residential area with a flat contour. Land consolidation is applied to this site so that the residents' settlements can be converted into a condominium, so this condominium is a government project. The condominium that will be built is one of the facilities for the residents of the condominium as well as the community on a city scale to visit and shop to increase the selling value of the condominium unit and the excellent park area. So that the Taman Teladan area can be more easily recognized and the cost of land consolidation can be met. Access in and out to the basement is on Sisimangaraja Street; access to every building in this area is directed to the underpass after passing the entrance gate on Stadion Street (Figure 5).

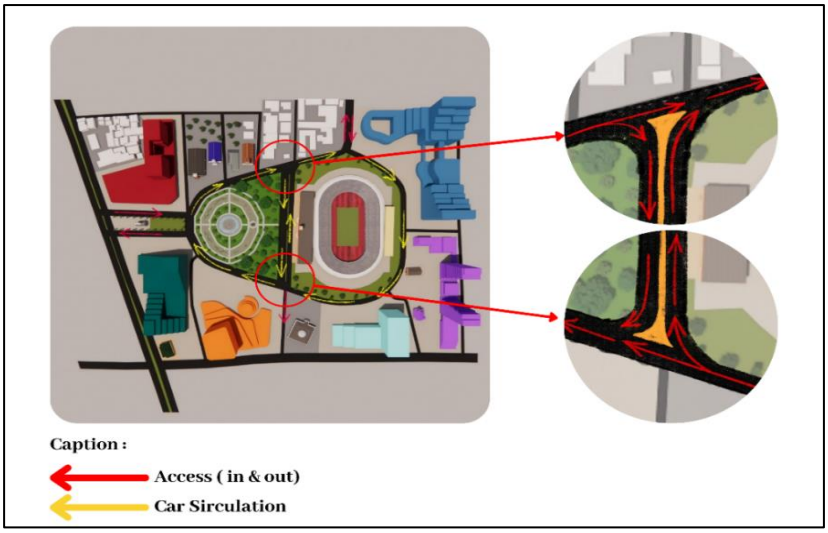

Figure 5 Underpass Concept

There is also a void on the ground as a source of natural lighting in the basement so that the basement does not seem dark and narrow. But it looks more expansive, and visitors will find marking each building from the cellar easier. Between each void is a pedestrian path on the ground. Circulation and Vehicle Access at this site are placed in the basement so that the vehicles in this building are only in the basement. It aims to create a fresh and pollution-free environment. There are also public stairs in the underpass for passengers walking in the underpass to go through the ground more efficiently. The stairs that connected this area were also used for emergencies and services admin (Figure 6).

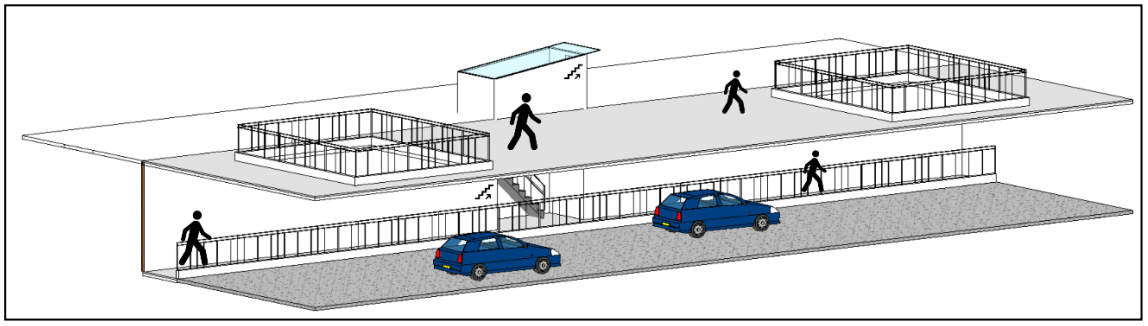

Figure 6 Underpass Void and Circulation

The Site of the building is based on the Site Plan, which is that the waterfall on the site is the center of the building. This waterfall also welcomes visitors or residents from pedestrians entering the site area. Communal Park is a public area that functions for residents who want to relax on the site; activities are carried out in the form of sitting in the outdoor seating, playing on swings, and even jogging on the jogging track on the site. An amphitheater is an area to hold live music and small gatherings. This amphitheater can be used for a fee by every visitor in the area and at a lower cost for residents of the Condo. But this amphitheater is not for the Condo's people only, but also the people in the region of Taman Teladan as the surrounding building can also muse this amphitheater. Bicycle Parking is a bicycle parking area for residents. The bicycles provided belong to the condominium and can only be used for residents surrounding the pedestrian area. There is also an Assembly Point on the west and south for people who got emergencies in the building. There can be accessed from the emergency stairs.

4.1 Vertical Building Zoning

This condominium is divided into several zoning; the following is the vertical zoning of the building on each floor: The basement on the 3rd floor has a mall parking area and management. The cellar on the 2nd floor is a parking area for the occupants of the two towers, a mall, and a drop off-mall. The basement on the 1st floor has a parking area for the occupants of the two towers, while the mall has become the Lower Ground floor with a food court area. The Ground Floor has become a retail clothing area in the mall, while the Condo is the Lobby & Lounge area. The 2nd floor has become a retail clothing area at the mall, and there is no access to the condo. The 3rd floor has become an electronic area in the mall, there is a timezone and a bar & cocktail for visitors, but there is no access to the Condominium. The 4th floor has become a Salon, Karaoke, and Bowling area at the mall, and there is already access to several function rooms in the Condo. There is also circulation to the Condo facilities, which residents can only access.

The 5th floor has become a residential area, with many facilities for residents, especially Childrencare and Eldercare. On the 5th floor, there are also two-bedroom and three-bedroom types of residential units. The typical floor is divided into two towers. 6-7th floors are an area of 3-bedroom and two-bedroom units at low prices. Floors 8-12 are studio units and one bedroom area; there is also a Public Sky Garden on the 8th floor. Floors 13-18 are the area of two-bedroom and three-bedroom units sold more expensively because they are higher up and have a more unrestricted view. The 19th floor is the Penthouse floor, which each penthouse unit can access using a private elevator. 20th is the 2nd floor of the Penthouse (Figure 7).

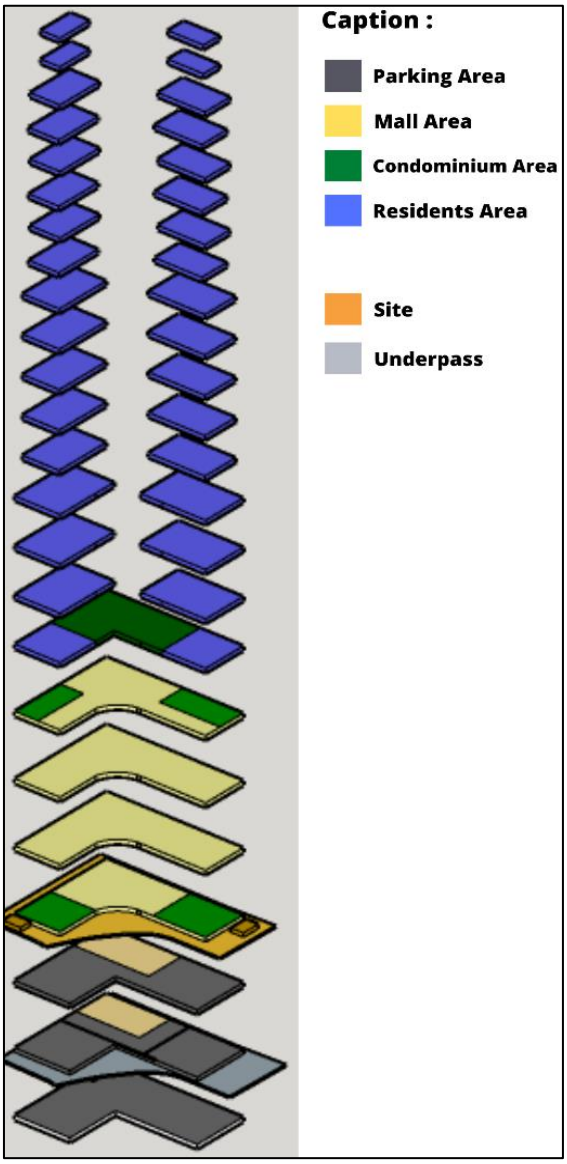

Figure 7 Vertical Zoning

4.2 Green Open Space Integration

Poor outdoor space planning can be the leading cause of non-functional and aesthetic buildings. Some aspects of the outdoor space that I designed include the function of plants in the garden. Plants function to improve air quality, such as replacing CO2 air with O2 through plants, and adding some water elements to the Sky Garden, whose function is to add details of beauty and natural ingredients and Visual control. Such as providing good oxygen levels with greenery so that it is good for the physical health of residents, providing a residential atmosphere as if it were in an ample open space even though it is indoors so that it is good for the mental/psychic health of the occupants, get natural lighting during the day, and natural ventilation in housing that saves energy use, provide excellent air humidity with lots of water elements such as fish ponds and bamboo trees in buildings, provides a complete view overlooking every side of the city, especially the Teladan Stadium and Teladan Park. In the family room, dining room, and kitchen, each unit uses a sliding door or folding door to be directly connected to the open space so that residents do not feel like

they are in a stuffy room but like being in a vast nature. Residents can open the folding door during the day so that the family room, eating room, and kitchen are connected to the open space and close the door at night so that it doesn't become a disease for visitors because the night wind is not suitable for health. Each part of the room also has a view of an open space, which can provide natural lighting and ventilation on each side of the residence to save electricity and water consumption. The family room also got an additional balcony to make the room brighter (Figure 8).

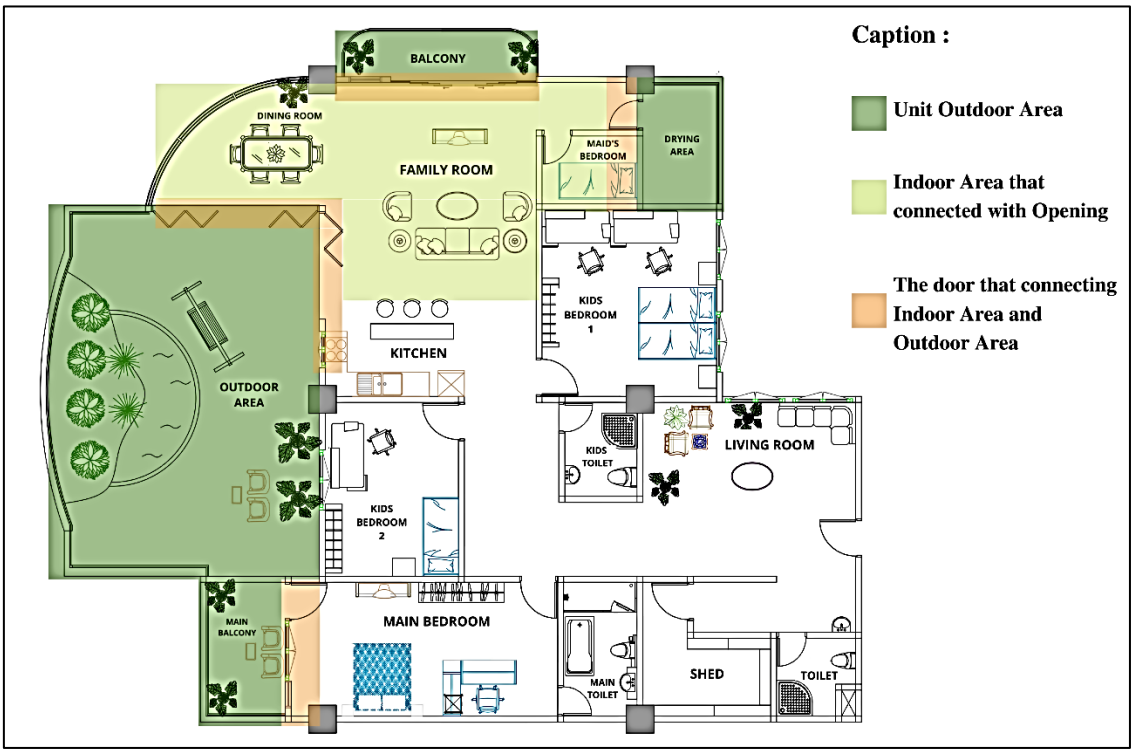

Figure 8 Green Open Spaces for Residents

Studio-type dwellings can be used for residents who want to be single or unmarried because every room is connected without a partition, so it is more practical to use. It does not require much privacy for business people who want to rent their dwellings to others, so this studio can also be used as a business facility (Figure 9a). One-bedroom-type housing is usually used for married people even though they do not have/do not have children. The difference with the studio type is that it requires privacy in the bedroom so that it is given a different space. This residence has an additional family room compared to a studio-type place, so it has room for residents to gather as a family; this residence has a more expansive balcony than the studio type because it already has a pool and swing (Figure 9b).

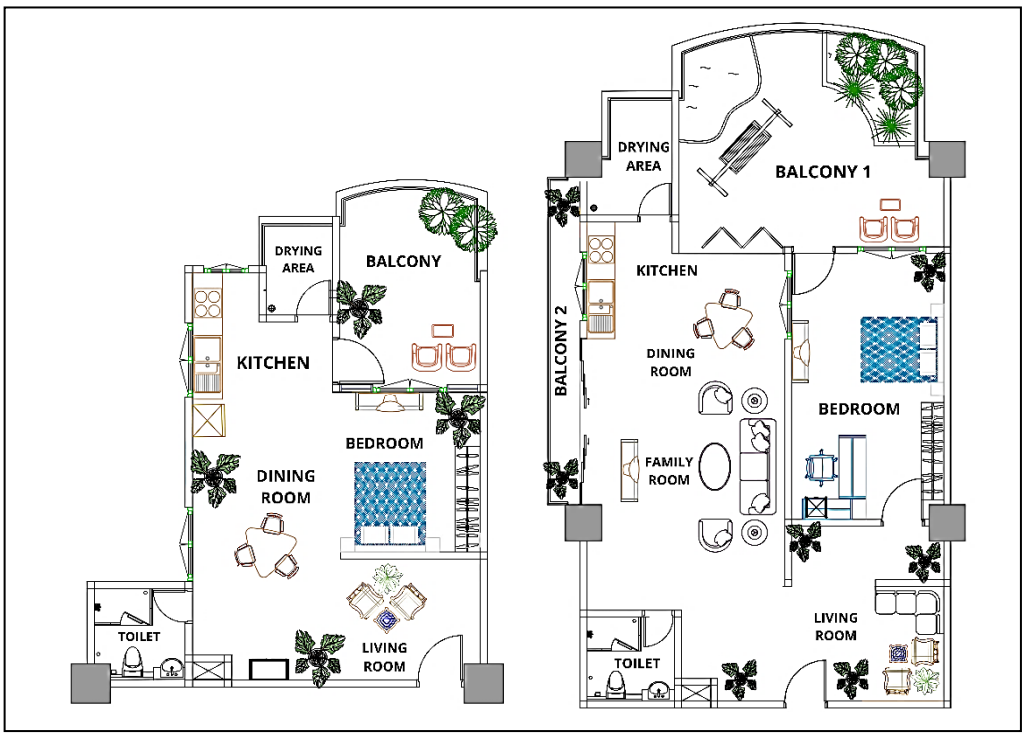

Figure 9 (a) Studio Type (b) One-Bedroom Type

Two and three-bedroom type dwellings are used for residents who are already married. Each room is also planned separately from the others. This residence has a more expansive open space due to more occupants. Two-bedroom type occupancy is facilitated for families with one child. The Two-bedroom type occupancy also has a maid's room because larger units require house maintenance that requires a maid. The two-bedroom type also has an additional bedroom, such as a children's bedroom. The two-bedroom type also got a pantry for people's seats when they want to drink only. As for the three-bedroom type occupancy, there is an additional one-child room that two children can occupy, so the three-bedroom type occupancy is facilitated for families with three children. There is one bedroom for two children of the same gender and the other room for one child. There are also bigger enormousconies than the studio type, one-bedroom type, and two-bedroom type (Figure 10a and Figure 10b).

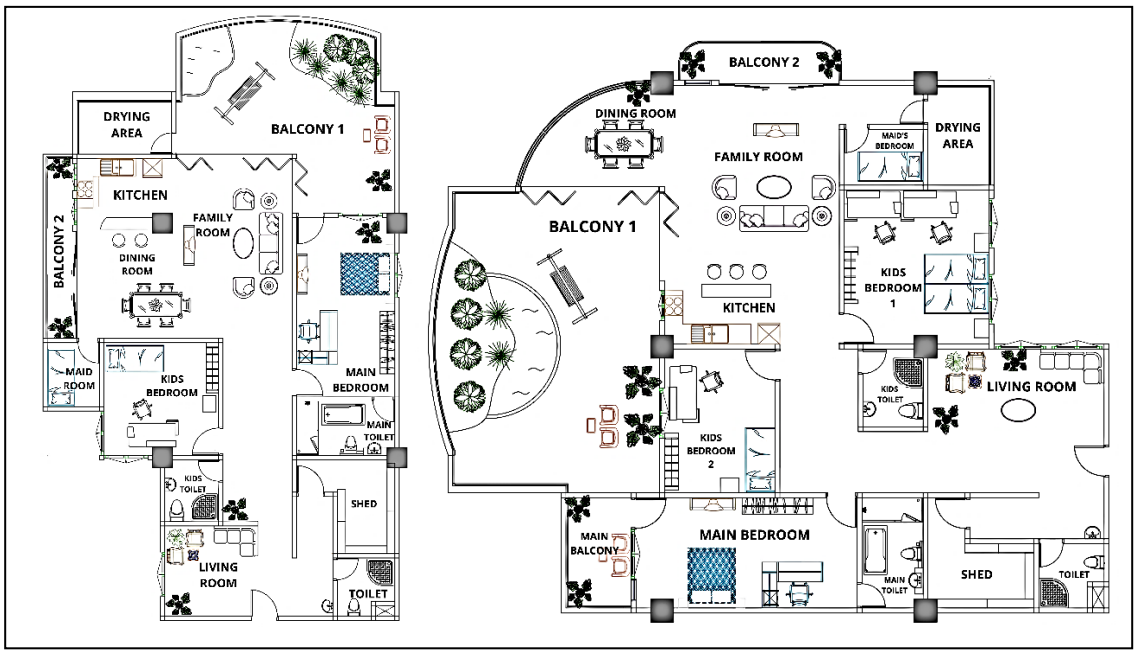

Figure 10 (a) Two-Bedroom Type (b) Three-Bedroom Type

Penthouse-type housing is the most extensive and expensive residential unit. This residence is planned for residents with two families who are related by blood. The facilities are a Private Swimming Pool and a Private Lift that make the additional points of this unit. This unit also got two floors. On the 1st floor are a family room, dining room, and balcony for a semi-public area. On the 2nd floor, there is a more private area like the main bedroom and private pool. There is also a private balcony in each main bedroom on the 2nd floor (Figure 11a and Figure 11b).

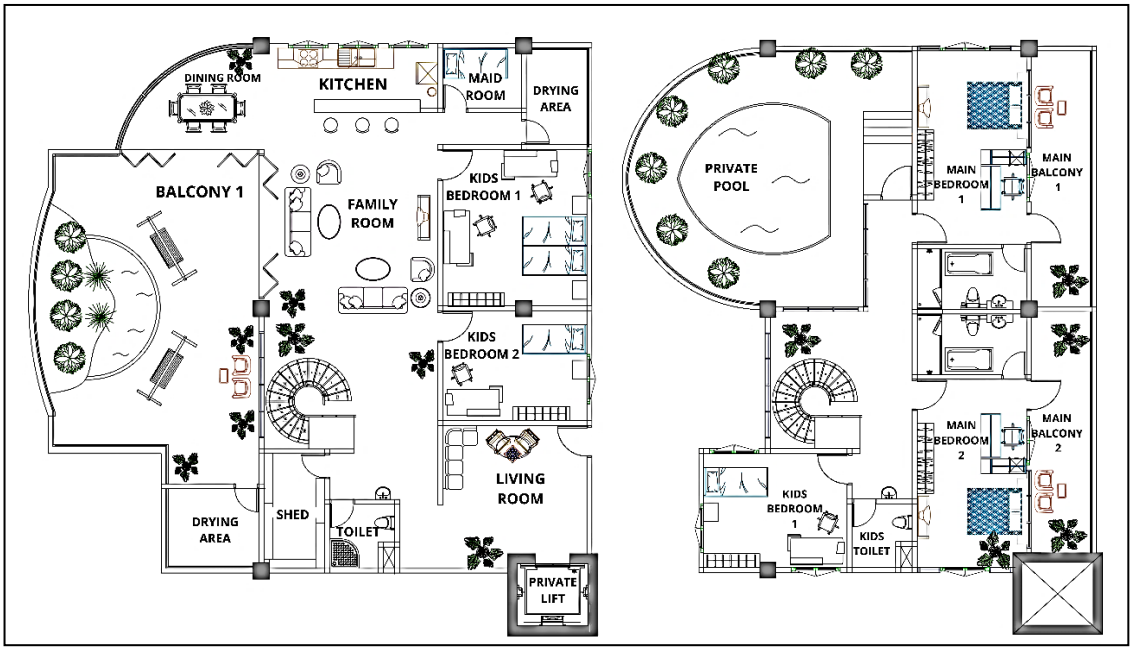

Figure 11 (a) 1st-floor Penthouse (b) 2nd-floor Penthouse

4.3 3D Impression

The mall integrates open space in one of the atriums so that visitors can breathe fresh air from morning to night to improve the welfare and physical and mental health of visitors. This open space also provides natural lighting for visitors inside the building, especially in basement level 2. So, from the 2nd-floor basement drop-off to the 4th-floor, it is not too dark in the mall area and gives a more grandiose impression. This atrium area is planted with several trees, and rain can fall and hit the atrium, so there is drainage around it; the existence of this open atrium can also provide benefits such as energy savings because the use of lights can be reduced during the day and in the mall corridor area does not use artificial cooling because it is already there is natural cooling in the form of air entering from the atrium skylight (Figure 12).

Figure 12 Open Atrium in 2nd-floor Basement

The facilities provided for residents in the 5th-floor open space include mini golf, children's pool, adult pool, playground, and fitness center. All these facilities are connected with greenery so that even residents can breathe oxygen to have a health impact on residents. These facilities are also a consideration that makes condominium units more expensive compared to other vertical residences. Because not all vertical homes have these facilities, and also all these facilities, some managers will manage them every day so that the facilities are not damaged quickly and are not dirty. Pools and the children's playground are the primary recreations in this building. The swimming pool is to make people more relaxed and healthier because swimming is a sport. In Addition, many people can swim there together without having to queue. The Children's playground is to make kids that live there happier and have lots of activity. So this building is focused on adults and kids (Figure 13a and Figure 13b).

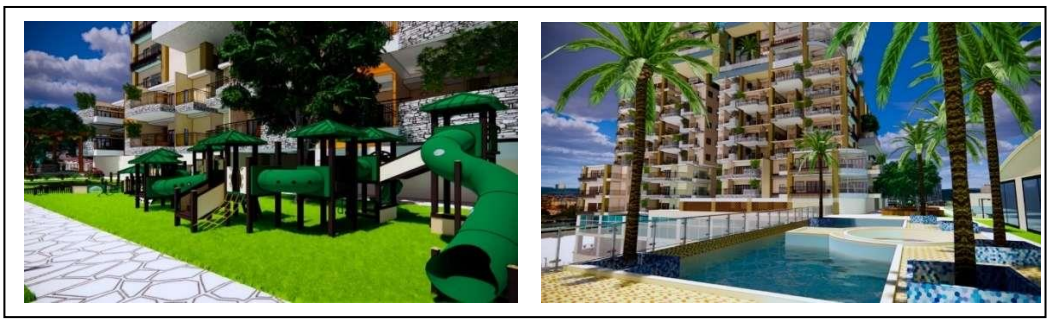

Figure 13 **(a)** Condominium's Playground **(b)** Condominium's Swimming Pool

The sky garden from the 13th, 15th, and 17th floors is almost entirely a pond with a path to connect it because the amount of water can give an excellent impression *of* the building. The number of pools also improves the residents' mental health because people will be calmer psychologically when they see the water. These waters flow from the 17th floor to the 13th floor with pavement so that if people see it from the 1st floor, it will look like a tall waterfall. However, even though the water flows from a height, it doesn't make much noise and splashes because the water flows on one floor. The sky garden on this floor is only facilitated for residents who live on the floor with *two-bedroom* and three-bedroom units sold at a higher price than the two-bedroom three-bedroom type two on the bottom below (Figure 14). Alternating appearances are seen on floors 13-18 to give an aesthetic impression of the building, and rainwater falls on residential plants more efficiently in the tower. Alternating appearances in the building also give the impression that residents who live on that floor feel the roof and ceiling are higher so that the house seems more magnificent (Figure 15).

Figure 14 13th, 15th, and 17th Sky Garden

Figure 15 Alternating Mass of Residents

The mass of the building consists of 2 towers facing southwest. The two towers are seen facing each other to welcome residents from the left and right sides. The 5th-floor Sky Garden with coconut trees as a swimming pool cooler in the middle of the two masses. The swimming area is also located right around the palm tree so that when residents swim, residents get a view of the building site (Figure 16). Every room in the Condo

unit, including spaces, uses yellowish walls and lighting. The yellow color makes the building seem majestic, even during the day and night. Yellow is a color with warm tones that can make humans more psychologically relaxed. Yellow can also make your eyes healthier by reducing ultraviolet radiation from blue light (Figure 17).

Figure 16 Mass Compotition

Figure 17 Condominium's Bedroom Interior

The green open space structure on each floor of the building uses a green roof on the roof to strengthen the roof structure that can withstand water so that it can function as a green open area in the building. It is so many there are so many functions of each layer of green roof such as the growing medium is for the trees to be planted, the filter membrane is for filtering the water to become cleaner, the drainage layer is for the water to flow to the ground from pipe, the waterproof membrane is for the water to not through to the lower floor. The height of the total layer is 1 meter, so the bottom of the roof is 1 meter higher than the floor without a green roof. The green roof can be planted with all types of plants. But the plants got more minor on the higher floor than the bigger ones. (Figure 18).

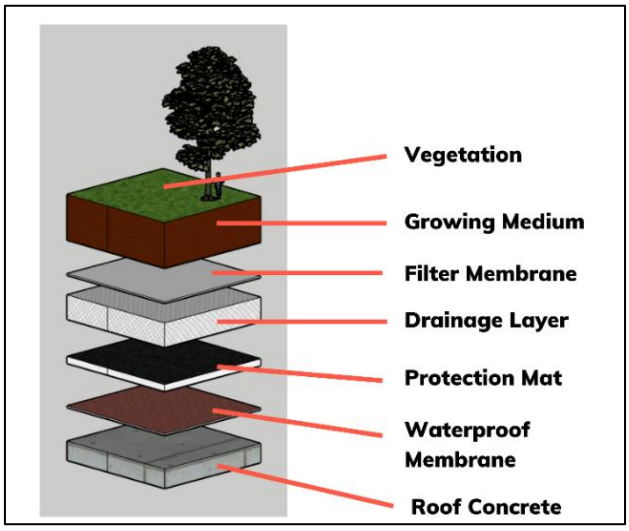

Figure 18 Green Roof Detail

5 Conclusion

The Healthy Building concept of this condominium design is integrated green open space that gives each unit good oxygen for the physical health of the occupants and makes each dwelling have an open space that blends with nature so that it is good for the psychological health of the occupants. The placing of vehicle circulation through the underpass and directly connected to the basement, so the site is free of air pollution from vehicles. The site is used as a pedestrian circulation area to increase public activities.

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