

Co-Housing: A Solution Toward Sustainable Settlement in Batam City

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Abstract - The increasing population urges the need for space as a place to live in urban areas with limited land. In addition, the population of Batam City are dominated by millennials with low financial ability but high social capital. That can trigger the construction of illegal houses, which sometimes do not meet the criteria for settlements that are slums, reaching fifteen hectares in the Belian Village of Batam City Sub-District. It is necessary to adapt collaborative housing (co-housing) with minimal land use. However, it can provide space as a place to live and socialize as much as possible, including residents in building management. The methodology of this research is a qualitative method with a descriptive approach to the condition of the city of Batam, which is observed directly by paying attention to the strengths, weaknesses, opportunities, and threats, as well as co-housing design considerations. Thus, this study resulted in recommendations for the design of co-housing buildings with facilities and features close to the site, spatial layout and planning that are to the needs of the target user, a property model that is by the user's abilities, and screening and curation process that the user can accept. The sustainability of settlements can also be the result of adapting the co-housing concept in Batam.

Keywords – Increase in population, Limited land, Millennials, Co-housing, Sustainable settlement

INTRODUCTION

Limited land areas are generally associated with dense population areas and spatial planning (Tutuko et al., 2018). Following the data from Badan Pusat Statistik Kota Batam (2022), the population growth rate of Batam Kota Sub-District reached 1.79%, with a population of 203,370 people, and the area of Batam Kota Sub-District was 46.82 km² with a population density in Batam Kota Sub-District reaching 4,345 per km². Based on data from the analysis of the Batam Kota Sub-District population density, which can be divided into low, medium, and high densities, high density is found with a value of 67.3%, or an area of 784.3 ha has dominated Batam Kota Sub-District (Farizki & Anurogo, 2017).

The cities are often limited in supply when providing sufficient and affordable housing to communities. That proves the failure of housing policies and causes residents to fend for their housing needs themselves, which can lead to slums in urban areas (World Economic Forum, 2017). The need for houses in Batam is still very high, but many people in Batam are classified as low-income residents. (JPPN News, 2019). Based on BPS Kota Batam (2020), most of the population of Batam City is dominated by people aged 25 to 29 years which can be categorized as millennials, with a total of 138,395 inhabitants. Millennials are said to be more concerned with family and recreation than paid work, and they are more concerned with self-development and growth than

lifelong work. Millennials are interested in shaping and influencing workplace culture, practices, and management and seek social relevance at work (Childs et al., 2015). The millennial generation also has low financial ability, so they are less able to buy a house (Delvina Wijaya & Anastasia, 2021).

Based on the recorded data, the number of illegal houses in the city of Batam reached 30,868 units. Some recorded 42 thousand units, and even the Batam City Integrated Team mentioned 50 thousand units. It is spread over nine sub-districts of Batam, one of which is Batam Kota Sub-District (Batam News, 2018). The Batam Kota Sub-District is the center of the Batam city government, but part of it is also used as a residential and industrial area (Moniaga, 2018). As specified through the decision by the mayor of Batam (Keputusan Walikota Batam Nomor KPTS. 290HK/X/2019), five villages out of six in the Batam City Sub-District have been classified as slum areas, with the largest slum area of 15 ha located in Belian Village.

A residential design involving residents is needed in Batam City to provide space for the community and support the settlement's sustainability. The building concept consisting of self-contained homes equipped with shared facilities with a community that is formed and managed by the residents themselves is how the UK Co-housing Network describes co-housing. Based on research from the Alvara Research Center (ARC), millennials have a nature of sharing which can be divided into three types, namely Two Faces of Solidarity (concerned with social problems, but only limited to euphoria), sharing is better, and Followers is family (have high solidarity, especially with his followers). So that the application of the co-housing concept should be a consideration in the development of suitable settlements for millennials in Batam. But this housing concept cannot be found in Batam city yet. This research aims to adopt the concept of cohousing with a sustainable approach to the existing conditions of Batam City.

THE MATERIALS AND METHOD

Co-housing

The concept of cohousing was developed jointly by people interested in living in one location. A plan was carried out through deliberation between prospective residents to adjust development costs with the residents' abilities (Ramadhan et al., 2019). The collaborative housing reveals a new form of dwelling that undermines the concept of domestic space as a stable infrastructure and demonstrates that Inhabited love coexists in transitional and depersonalized relationships and existential security rather than drawing more attention to the home as a continuous place of traditional family life. While maintaining personal integrity in a social environment of people unknown beforehand, collaborative housing requires outspoken decisions and an equal distribution over various daily matters of responsibility (Törnqvist, 2021). Rethinking the architecture of the collaborative house as a relational process of a joint project, moving from established and well-known centers to the uncertainties and opportunities of their fringes. Limits and limitations often expose a space in which otherness can contact. However, the programs and policies of public housing about collaborative housing have always been the main disciplinary discussions as a necessary concern of modernism. Nevertheless, Catherine Krouse Bauer Wurster (an American urban planner and housing advocate) explained that the actual evolution can only achieve when all agents involved in housing production acknowledge - even if reluctantly - "The responsibility they all hold in the life of the community and the need for official action and regulation in favor of the public interest." (Gutiérrez-Mozo et al., 2021).

According to Chiodelli & Baglione (2014), fulfilling five predetermined characteristics can be said to be co-housing:

- *Communitarian multi-functionality*. the capacities and characteristics of communal spaces and facilities depend on residents' needs and finances. Still, private residential always offer community services and amenities such as streets, parks, recreational facilities, etc.
- *Constitutional and operational rules of a private nature*. There is a legal system agreed upon by the settler community, which refers to rights and obligations in private and collective spaces to ensure its function.
- *Residents' participation and self-organization*. The community/organization is privately governed by the residents.
- *Residents' self-selection*. not only access to the room or service area, but residents can also choose a resident community because of the private nature of the space and organization
- *Value characterization*. functional reasons have been considered for living in co-housing, such as: better services, safety, etc.

Following the characteristics mentioned, the functions of collaborative housing can draw as coordinating security and environment; high chance of social interaction and environmental contribution; providing more opportunities to share; saving land for green land allocation; environmentally friendly; involving family members to participate in community management discussions; and decreases middle life (Ramadhan et al., 2019).

Based on the reference of McCamant and Durrett (1994), again referred to by Wang et al. (2018), several things must be considered when designing cohousing.

Table 1. Co-Housing Design Considerations based on McCamant and Durrett (1994)

The site plan and community layout	Location of the common house	The design of private units
Car-free living space	Pedestrian circulation	Choices of housing models
A child-friendly environment	Creating an intimate atmosphere	Design of the common house
The transitional space between private and common space	Transitions between community and surrounding neighborhood	Accommodating future changes (Flexible architecture and lifetime homes)

Source: Wang et. Al, 2018.

Based on research from Sim et al. (2021), target demographics are considered in programming and shared spaces of co-housing. Most residents are involved in co-housing communities with varying levels of involvement, from self-control and co-creation to more focused participatory processes. Thus, in co-housing, there are also community managers who act as mediators who are responsible for solving problems, scheduling events, and selecting members of the co-housing community through interviews. Sim et al. (2021) also mentioned things to be in considerations based on demography.

Table 2. Co-Housing Design Considerations based on Sim et al. (2021) Demography and Prospects (DP)

Facilities and Features	Spatial Layout and Planning	Property Model	Screening and Curation Process
<ul style="list-style-type: none"> • Function: Mixed-use/Single use • Internal space/External space 	<ul style="list-style-type: none"> • Private spaces: single-group, mixed group • Shared spaces: Lounge. Kitchen, dining, etc 	<ul style="list-style-type: none"> • Rental contract/buy and sell • Pricing: all in one bill/ lump sum 	<ul style="list-style-type: none"> • Cultural acceptance or backlash • Social cohesion within the community

Source: Author, 2022

Sustainable Settlement

The need for spaces should not be the only requirement when developing a settlement. However, all facilities and infrastructure, even environmental problems, such as floods, waste, drought, and the increasing global temperature, should be in consideration to achieve an environmentally friendly development (Widodo et al., 2015). The development should be able to meet the needs of the present by finding ways to improve the welfare usage of natural resources based on a city's social, economic, and environmental so that future generations can meet their needs. Sustainable buildings have a function to meet global goals when dealing with climate change and human rights, as well as national and local plans for poverty reduction, economic growth, job creation, community resilience, etc. (Krizmane et al., 2016). That is what we call sustainable development, the long-term sustainability of natural resources, not only environmental harmony (Zubaidi, 2012). Many countries have applied the 17 Sustainable Development Goals (SDGs), especially goal number 11, Sustainable Cities and Communities, which targeted inclusive, safe, and sustainable cities and human settlements. As the center of sustainable development, housing can portray the quality of people's life and link environmental protection to healthy economic, social, and cultural development

(Hayati et al., 2020). Akadiri et al. (2012) identified three general objectives forming the framework in the application of sustainable building design and construction has been mapped out and collated in the **Table 2.3**.

Table 3. Sustainable building’s objectives based on Akadiri et al. (2012)

Objectives	Strategies	Methods
Resource Conservation	Energy Conservation	Choice of materials and construction methods, insulating building envelope, design for energy efficient deconstruction and recycling, design for low energy intensive transportation, developing energy efficient technological process, and use of passive energy design.
	Material Conservation	Design for Waste, specify durable material, specify natural and local material, design for Pollution prevention, and specify non-toxic material.
	Water Conservation	Using water efficient plumbing fixtures, design for dual plumbing, collecting rainwater, employ re-circulating systems, designing low-demand landscaping, and pressure reduction.
	Land Conservation	Adaptive reuse of existing building, locate construction project close to existing infrastructure, and development of non-arable lands for construction.
Cost Efficiency	Initial Cost	Use locally sourced materials, employ cost saving technology that can be managed locally, utilize modular design and standardized components, use less expensive building materials, and reduce time required to assemble materials on site, use readily available materials, and use recycled and reclaimed materials.
	Cost in use	Design for regular cleaning, maintenance, and repair, ensure availability of skills required and labor supply, choose minimum-maintenance materials, ensure service life requirements of materials and components, protecting materials from destructive elements such as sun, temperature variations, rain or wind, or migration of moisture-laden air through defects in the envelope, and provide easy to understand access control for occupants.
	Recovery cost	Recycling potential and ease of demolition, adaptive reuse of an existing project, and reusing building materials or components.
Design for Human Adaptation	Protecting Human health and comfort	Thermal comfort, acoustic comfort, daylighting, natural ventilation, functionality, and aesthetics.
	Protecting Physical Resources	Design for fire protection, resist natural hazards, and design for crime prevention.

Source: Author,2022

Methodology

A qualitative approach is used to obtain the data for this study. According to (Sugiyono, 2017), qualitative research is a method based on post-positivism or entrepreneurial philosophy, which is used to examine the condition of an object naturally, where the researcher is the key instrument. The data are qualitative, with inductive data analysis and research results to understand the meaning, and uniqueness, construct phenomena and find hypotheses. This research is then supported by a

descriptive research method where researchers collect, analyze, and conclude data based on all the facts that existed when the research was conducted (Sugiyono, 2017).

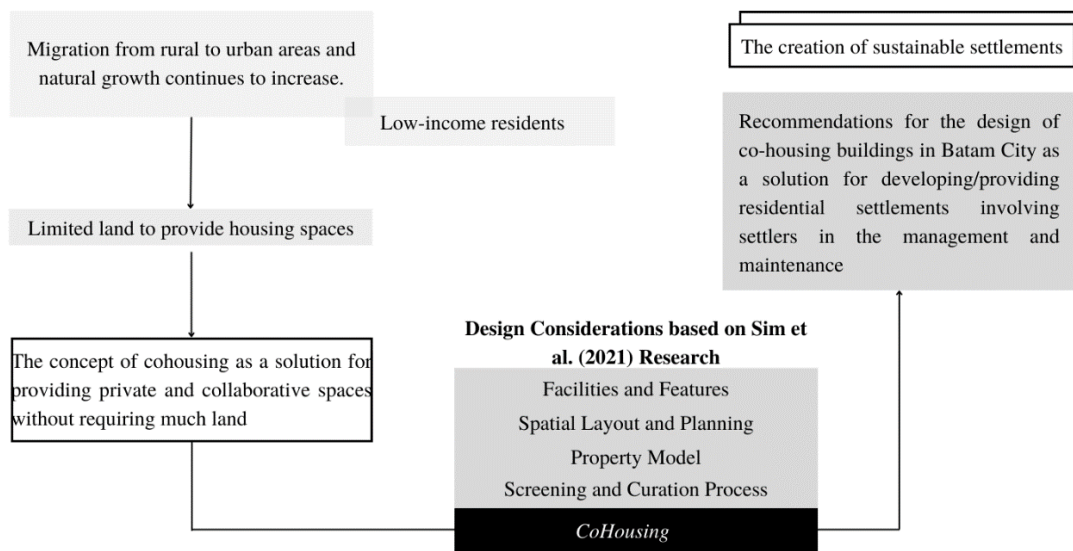


Figure 1. Visual Representation of the Research Strategy
Source: Author, 2022

Research data sources are primary data from benchmarking, surveys, observations of research locations, secondary data through previous research, and basic theory through research journals. The data that has been collected will be analyzed and considered with the design considerations of sim et al. (2021) along with sustainable building's objectives by Akadiri et al. (2012) as a design indicator in planning building designs that are more in line with the current needs of the city of Batam.

RESULTS AND DISCUSSION

Facilities and Features

Design site selection is essential to respond to the concept of sustainability. In accordance with the sustainable building's objective of Akadiri et al. (2012) in land conservation, it is stated that the planned building must be close to the existing infrastructure. Following the target users, who are millennials, employment is an object that is the primary consideration in providing design solutions. The target user will significantly benefit if the chosen site is close to the workplace, which is also supported by a recreation area. Thus, the resulting design does not become passive due to incompatibility with user activities. It will significantly help if the user's occupation is also considered in realizing the sustainability settlement.

The **Figure 2.** displaying the site recommended by visualizing the distance between the site and the existing infrastructure. The selected area is empty land with only one access road and reasonably close to industrial parks, a potential job opportunity for settlers, schools, and tourist attractions. The selected site is also not on the main road where many vehicles pass by, so it can reduce the creation of noise that can interfere with users when they want to rest. There is also vacant land on the right side of the site which can be a potential co-housing development in the future.

Thermal comfort, daylighting, and natural ventilation are also considerations in protecting human health and comfort to achieve building sustainability. Thus, it is also necessary to analyse and visualize the wind and sun directions at the recommended site.



Figure 2. Site Analysis
Source: Author, 2022

The **Table 4.** describes the author's analysis of the site, which is the recommendation for the design of co-housing buildings in Batam. The site is in Belian Village, Batam City District, Batam City, with an area of 5,500 m². The site is still vacant land with no development plan, yet there is only a 2-way road for motorized vehicles. In keeping with McCamant and Durrett's design considerations, the site having only one access road allows car-free living space and develops safer pedestrian paths. This site is recommended because many urban facilities can support building users. Site development can also be supported by providing space for cultivation by building users.

Table 4. SWOT of Site, 2022

	Strengths	Weaknesses	Opportunities	Threats
Location	An easily accessible location close to several work and leisure locations. Located further from downtown.	Located further from the ferry terminal and airport.	Buildings can be focused on single use as residential buildings, which also provides green open space for residents as social spaces.	
Neighborhood Context	6 minutes walking to Park Avenue 12 minutes walking to Kallista School 6 minutes driving to Welcome to Batam Monument 6 minutes driving to Global Indo-Asia School close to industrial parks and residences	Lack of green areas.	Development of buildings that can provide space for tourist users.	Close to many industrial parks that do not rule out air pollution.
Size and Zoning	The total area of the site is 5.500m ² . with the boundary line of the building to the road in the north is 10 meters, and to the other sides are 2 meters.			
Legal	Around the site, there will be a lot of residential development and recreation areas.	The site is private property PT. Intan Srijaya Raya	Co-Housing development can be known more widely.	Continuous migration
Natural Physical Features	The site is still empty, without many plants or shrubs.	Around the site there are no tall plants that can provide shadows	Planting can be adjusted to the needs of the building.	
Circulation	There can only be one access road to the site, which is a high potential for security on the site.	There is no pedestrian path on the site,	Pedestrian development becomes safer because there is only one road for motorized vehicles.	
Utilities	Clean water provided by ATB Electricity from PLN			Temporary power outage due to repairs
Sensory	The site is located with a pretty good view on each side		The use of openings can be maximized because residential areas surround it.	
Human and Cultural	Most of the users around the site are households or workers		Many industrial parks can provide job opportunities for people living on-site, and school access is also close.	
Climate	Even though it is not located in an area with many high-rise buildings, an area that is not too large can still provide shadows that can cover the heat and better airflow.		Batam's weather allows for cultivation and minimizes the high costs of building materials.	

Source: Author, 2022

After the analysis, the formation pattern of the building mass composition can be seen in **Figure 3**. The subtraction between simple prisms is carried out based on the wind direction to get a wind that can allow natural ventilation. The mass of the building is then divided into several parts, which are arranged in a zigzag manner to allow much sunlight to enter the building. The height of the mass was then modified so that the building looked dynamic. The resulting building is then detailed with wooden ornaments and adapted to the floor plan.

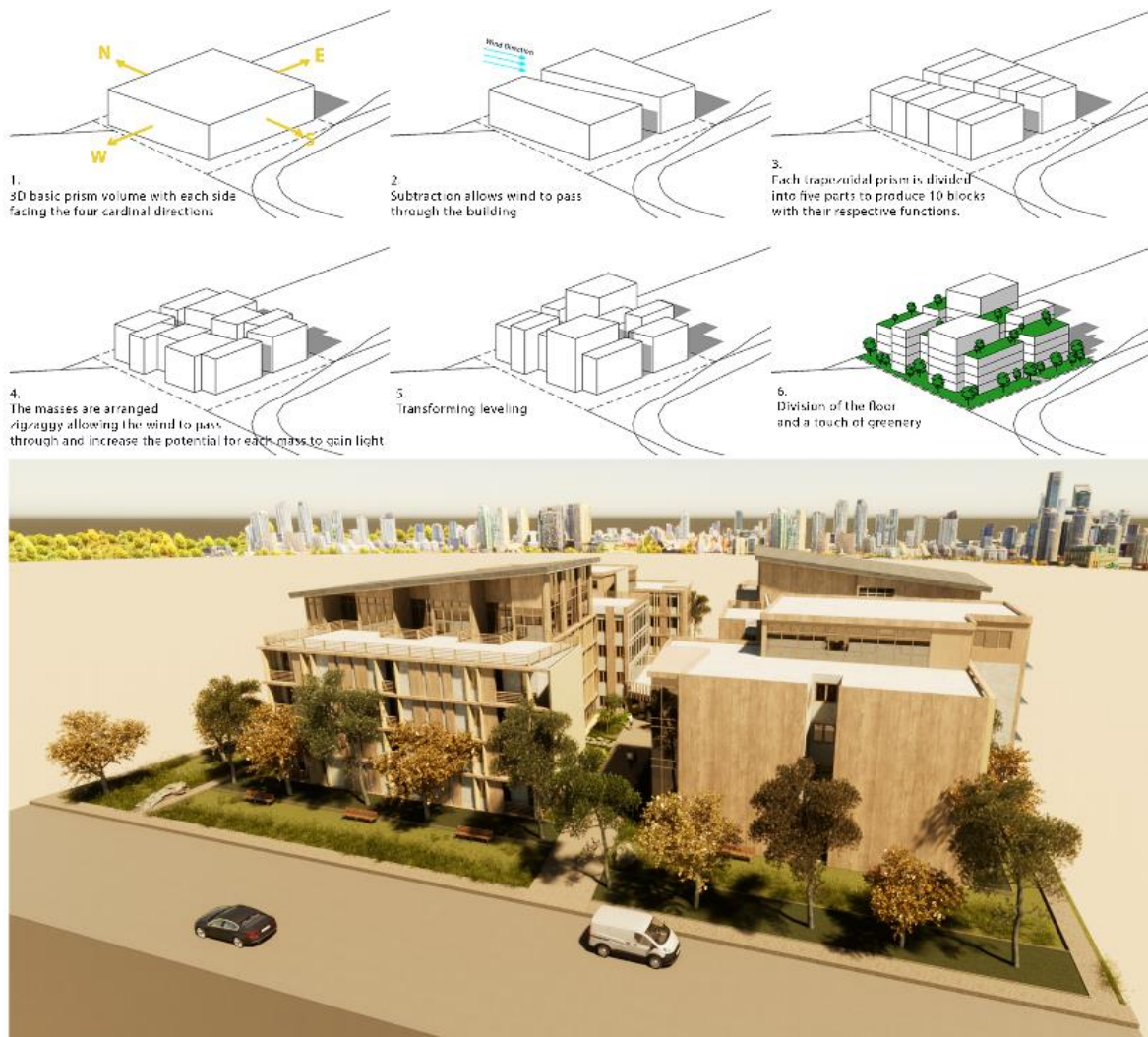


Figure 3. Mass composition transformation
Source: Author, 2022

The building is divided into ten sections and arranged linearly with different home functions depending on the number of users and their needs. Common House is in the middle of the site, with only one floor and other compositions between 4 and 5 floors. The room is arranged vertically to reduce the use of land that can be allocated as green open space.



Spatial Layout and Planning






The resulting site plan is based on the transformation of mass composition, then arranged with the type of room and facilities in **Table 5**. The type of room produced is based on the possible activities of Batam City millennial users with specific jobs so that spaces can be classified based on the time spent by users of the space in it, which can be referred to the private space, which is often used by the settler, and public space, facilities are provided for shared use since it is only used on purpose. The room is arranged as neatly as possible to maximize the amount of space that can be provided for users but still allocate aisles for air ventilation which can be seen in **Figure 4**.



Figure 4. Site plan
Source: Author, 2022

Table 5. Types of Spaces Recommended

Spaces	Rooms	Type	Visualizations	Design Considerations
Private	Single Group	House for two people with shared facilities (common kitchen, living area)	 <p style="text-align: center;"><i>Type 1</i></p>	The use of neutral colors and natural colors is effortless to compose and easy to blend without making space clutter or contradicting (Fanuel W., 2014). Thus, the design recommendations in this study use a lot of monochrome colors with a touch of wood. The use of wood materials in the design recommendations is also based on Awaludin's research (2017) that wood is one of the renewable building materials that have the most negligible impact on the environment, both from the production and recycling processes. Thus, wood can be concluded as a sustainable and suitable material for this design.
		House for two people with private kitchen and living area.	 <p style="text-align: center;"><i>Type 2</i></p>	

Spaces	Rooms	Type	Visualizations	Design Considerations
		House for family of four with private kitchen and living area.	 <p style="text-align: center;"><i>Type 3</i></p>	Natural ventilation and fixed glasses are widely applied in buildings to minimize energy usage, especially for air conditioning and lights. A private access glass door leads to a green open space only found in <i>type 2</i> and <i>type 4</i> rooms.
	Mixed Group	House for three individuals with shared bathroom and minibar.	 <p style="text-align: center;"><i>Type 4</i></p>	
Shared	Lounge			Found in the common house, which aims as the main entrance as well as reception, which settlers can easily access because it is in the center of the site plan.
	Living area			Both places are shared facilities provided for settlers in <i>type 1</i> houses located in the halls of room access doors. The minimalist design is caused by the <i>type 1</i> house user being considered a tourist or temporary user (nomads/workers) whose most activities are outside the co-housing and only rest when they are in the co-housing area.
	Kitchen and Dining			

Source: Author, 2022

Property Model

The **Figure 5.** shows a detailed 3D perspective visualization of the co-housing building. Not only based on the transformation of mass composition but also to maximize the amount of space with limited land so that the building is multi-storey. However, the highest number of floors of the building is limited to only five floors to minimize the cost of electricity distribution and the cost of constructing the building. It supports the realization of cost efficiency in creating sustainable settlements.



Figure 5. 3D Visualizations of design recommendation
Source: Author, 2022

The building is designed to be multi-storey or vertical with houses arranged in it so that the housing ownership scheme can be considered the same as the apartment ownership scheme, namely with Building Use Rights (Hak Guna Bangunan) for a certain period. However, rooms like *type 1* can also be rented daily or monthly for tourists and nomads.



Figure 6. Property model recommendation
Source: Author, 2022

Screening and Curation Process

Table 6. describes the work of millennials based on the author's direct observation of the condition of the city of Batam. Batam City has a relatively advanced level of the economy, moreover since Batam was made as an area of authority during the New Order era. This has resulted in Batam being a destination for migrants looking for work, which impacts the composition of Batam society, which tends to be heterogeneous (Asrinaldi & Yoserizal, 2014). The increase in the population of Batam is also inseparable from the unique existence of the indigenous people, namely the Malay race, which is open to everyone (Rofiqah, 2017). Based on research from (Mulyono, 2010), it is stated that the people of Batam have high self-control. Hence, a harmonious relationship exists between people of different religions, and there is a dependency between one community and another. The people of Batam also have a relatively high awareness of harmony, so when there is a dispute, whether it is

due to personal problems, which sometimes later becomes an ethnic issue from the government, religious leaders and ethnic figures quickly suppress it.

Table 6. User analysis

Period	Occupation	Activities	Space Requirements
Long-term	Student	Rest, sleep, bathe, eat, study. Most of the time is spend at school.	Private: Bedroom, Bathroom Optional private or public kitchen and study area.
	Nomad/worker	Most of the time is spend at workplace. When they are on site, they will rest more than do other activities	Private: Bedroom Optional private or semi-private bathroom Public Kitchen, living room
	Family	Most of the time is spend on the site	Private bedroom, bathroom, kitchen, living area, lounge for welcoming guests.
Short-term	Tourist	Most of the time is spend exploring, traveling, and interacting with the locals	Private Bedroom Optional private or semi-private bathroom Public Kitchen, living room, lounge

Source: Author, 2022

CONCLUSION

This design differs slightly from the cohousing concept, where residents pay their costs and build their own. However, it can be used as an alternative for residential development that the government can support by providing subsidies to people in need or landowners who want to build housing that is more affordable with the conditions of the community. The millennial character who likes to share is also a potential for cohousing development. In terms of sustainability, further research is needed on renewable materials found in Batam City for development and development technologies that result ins at least carbon emissions. It also needs to be adjusted to the applicable local government regulations.

Table 7. Indicators Parsing

Indicators	(Target) Expected can be applied in Batam City
Facilities and Features	The recommended co-housing design location is in the Belian village, Batam Kota sub-district, where there are many residence, schools/universities, industrial area, and recreational areas (such as malls). Land conservation is also a consideration in site analysis as an objective of sustainable buildings. Since the building is in an industrial area, the building functions to provide internal space in the form of residences consisting of several types and rental accommodations with a typical house containing supporting shared facilities. Pedestrian roads support buildings that are close to employment opportunities, so there is a reduction in the use of cars.
Spatial Layout and Planning	The target settlers are not in the form of individuals but also on a family scale. So, it is expected that there will be a space where there is a more private kitchen, family room, and bathroom. The common house must be located where all users can easily access it.
Property model	Building users are considered to be workers, students, tourists and families. So that they are intended to live in the long term or even only for days. Thus, available houses can be sold or rented daily.

Indicators	(Target) Expected can be applied in Batam City
Screening and Curation Process	The behavior of millennials, which are claimed to like to share and care, fits the concept of co-housing. However, it would be better if the government and settlers were expected to cooperate in determining housing regulations and being managed and under the direct responsibility of both parties. Social norms are expected to be the essential guidelines for building management.

Source: Author, 2022

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