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TRANSFORMATIONS OF COMMUNAL CIRCULATION SPACES IN ADDIS ABABA'S CONDOMINIUMS

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By

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A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN HOUSING AND SUSTAINABLE DEVELOPMENT

ADVISOR

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DECLARATION

This is to declare that this thesis work entitled “Transformations of Communal Circulation Spaces in Addis Ababa's Condominiums.” was submitted in partial fulfillment of the requirements for the award of the Degree of Master of Science in Housing and Sustainable Development is an authentic work carried out by me. All resources of material used for this thesis have been accordingly acknowledged.

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CERTIFICATION

Herewith, I state that **HAWI HIKAM ABABULGU** has carried out this research work on the topic entitled “Transformations of Communal Circulation Spaces in Addis Ababa's Condominiums.” Under my supervision, and it is sufficient for submission for defense.

Alazar Assefa (Ph.D.)

Date: _____

This thesis is submitted to the graduate programs director of the Ethiopian Institute of Architecture, Building Construction, and City Development (EiABC), Addis Ababa University, in partial fulfillment of the requirements for the masters of Science degree in housing and sustainable development.

Thesis Title:

“Transformations of Communal Circulation Spaces in Addis Ababa's Condominiums.”

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ABSTRACT

This thesis, which is titled Transformations of Communal Circulation Spaces in Addis Ababa's Condominiums, is a study of the spatial and typological evolution of communal circulation spaces particularly corridors, stairs, and shared access ways of condominium Buildings. This is aimed at understanding how the evolution of design typologies through history has affected the current spatial formations and what impact these have on the day-to-day experiences and expectations of residents. Using proportionate sampling methods, data were collected from 407 residents through self-administered questionnaires, with results further supported by research methods such as direct observation, correlation analysis, univariate analysis, and ANOVA. Systematic recording and comparison of typological differences between the four generations of condominiums were made. Analysis revealed significant differences in residents' perceptions in the areas of safety, security, health and physiological comfort, circulation flow, lighting, and visual connectivity. Earlier generations, particularly the first and second generations, were more stable, coherent, and accessible, whereas recent designs manifested numerous inconsistencies and functional limitations. The observations highlight the importance of spatial restructuring on housing satisfaction and emphasize the need for the adoption of user-friendly, inclusive, and responsive design strategies to improve the quality and functionality of communal spaces in future housing developments in Addis Ababa.

Keywords**: **Condominiums, Circulation Spaces, Communal Spaces, Evolution, Generations, Spatial Transformations, Residents

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LIST OF ACRONYMS

AACA	Addis Ababa City Administration
ANOVA	Analysis of variance
CBE	Commercial Bank of Ethiopia
CSA	Central Statistical Agency of Ethiopia
HDPO	Housing Development Program Office
IHDP	Integrated Housing Development Program
UN	United Nations

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

Addis Ababa, the capital city of Ethiopia, has experienced rapid urbanization and population growth in recent decades, leading to a severe shortage of affordable housing. To address this issue the government initiated the nationwide integrated housing development Program - IHDP in 2003 aiming at supplying affordable housing units for low and middle income Households (AHMED and BAŞDOĞAN , Keller and Mukudi-Omwami 2017, Malla, Karanjit et al. 2019, Haile 2023). Condominiums are multi-story residential buildings designed to provide affordable housing to low- and middle-income families. In an effort, to address the housing crisis along with changing the image of the city through Upgrading and renewal. Since its launch the program has supplied more than 100,000 houses to citizens and there are near to 100,000 houses which are under construction and expected to be completed in one year time. This program has benefited more than 500,000 inhabitants of the city directly by providing decent and affordable housing (Ingwani, Gondo et al. 2010). Since then, this scheme has been continuing to develop with varied alterations spatial designs to the overall design and communal circulation spaces to address the impending different challenges such as resolving the high urban housing demand, changing the image of the city by upgrading environmentally polluted areas like slums, job creation for unemployed residents of the city, creating market opportunity to small scale enterprises, Promoting affordable housing scheme, Promote targeted subsidy to the urban poor (Ingwani, Gondo et al. 2010, Keller and Mukudi-Omwami 2017). Till now variety of housing schemes named 10/90, 20/80 and 40/60 in which the dwellers are expected to save an initial amount of 10, 20 and 40 percent of the delivery price (Belcher, Suen et al. 2019). They are characterized by having variety of design transformation communal circulation spaces, both vertical (elevators and stairs) and horizontal (corridors and common areas), which play a critical role in the daily

lives of their residents. This study will strive to study the factors initiating the spatial transformation on communal circulation spaces and its effect on the daily lives of residents.

1.2. Problem Statement

Ethiopia has been developed recently with diversified sectors residential building constructions. One of them is different types of condominiums under the IHDP. It plays a vital role overcoming numerous problems of the society (Haile 2023). However, the change or transformation of the communal circulation space design of those condominiums has changed over time till now.

The Housing Development & Administration Agency reports that 9,055 condominium buildings in four generations 1,535 in Generation One, 4,782 in Generation Two, 921 in Generation Three, and 1,817 in Generation Four have been built to date (Admassie 2008, Amde 2020). These condominium developments are distinguished by a range of design changes, especially in the horizontal (corridors and common areas) and vertical (stairwells and elevators) communal circulation areas. However, these condominium buildings common and circulation areas have serious functional and spatial problems (Zewude 2016, Charitonidou 2022). These include a general lack of user-centered design, insufficient accessibility for people with disabilities, inefficient movement flow, inadequate lighting and ventilation, inadequate space allocation, limited safety features, and more. The livability, inclusivity, and general sustainability of condominium living environments have all been severely hampered by the disparities in design and functionality between generations.

This results various effects on the residential users like insecurity, and being easily vulnerable to crimes (Weinheimer 2007), doubt on the serviceability and hinders accessibility and ruining the routine activities of residential owners (Yip, Chang et al. 2007, Lehrer and Wieditz 2009). Different studies also suggested that the circulation design changes have health and physiological effect on residential lives (Hooper, Kleeman et al. 2023). The evolution of communal circulation space design is around 40 types of topologies each having different design features (Addis Ababa Housing Development Corporation, 2020). The reasons and impact of the topological design

change in spatial designs of the circulation space over time were not studied before. The circulation designs of condominiums or multifamily residential units has had a profound impact on the daily lives of residents. Over time, the design and functionality of these spaces have undergone significant changes, responding to the shifting needs and preferences of the inhabitants. From the early days of simple corridors to contemporary multi-purpose areas, the transformation has redefined the way residents interact with their surroundings. The communal circulation spaces now offer more than just a means of moving from one point to another; they havse become limiting the vibrant hubs that impact community engagement the overall residential experience (Ingwani, Gondo et al. 2010). Therefore, this study needs to be done in order to address the above-mentioned problems and analyze the design change critical factors with their effect on the daily life of residential lives in condominiums in the case of Addis Ababa.

1.3. Objectives of the research

1.3.1. General Objective

Exploring the spatial transformation of (vertical & horizontal) through time within building typologies of condominiums buildings in Addis Ababa

1.3.2. Specific Objectives

- To assess Historical evolution of typologies and their circulation system
- To investigate the current spatial configurations of circulation space.
- To assess the effect of the spatial transformation based on residents' preferences.

1.4. Research Questions:

- How have the communal circulation spaces (vertical and horizontal) within the building typologies of a mass housing project (condominiums) in Addis Ababa transformed over time?
- What are the current spatial configurations and key features of circulation space?
- How do these spatial transformations impact the daily lives of residents?

1.5. Research hypothesis

The research hypothesis of this study targeted one assumption that was made based on a thorough analysis of relevant data and previous research in the field. The first assumption is that forms the basis of this study is to investigate the effect of the spatial transformation on residential lives. The design transformations were clustered (1st, 2nd, 3rd, and 4th generations). Eleven (11) factors were selected as shown (section four of Appendix A) whether there is a significant difference in residential lives between the four generation types. This is a crucial factor to consider, as research has shown that different designs of communal circulation designs can inhibit different factors when having different topology.

It is important to note that the significance of this assumption cannot be understated, as they serve as the foundation for all the subsequent analysis and conclusions drawn in this study. The data collected and analyzed was done with this one assumption in mind, and the results are reflective of their significant consequences due to the spatial transformations.

Assumption one: Hypothesis formulation using alternate hypothesis (Hn) to test the effect of spatial transformation on residential lives

H1: There is a significant difference on the residential lives (at least one) between the four (4) generation of spatial transformations based on resident's preferences on the communal space.

1.6. Scope of the study

The scope of the study involves exploring the spatial transformation of communal circulation spaces, both vertical and horizontal, within different building typologies over time. This research aims to understand how these spaces have evolved and adapted to the changing needs and preferences of residents. By analyzing various case studies and conducting interviews with residents, this study aims to uncover the factors that have influenced these spatial transformations. Additionally, it seeks to identify the challenges and opportunities in designing and managing communal circulation spaces to enhance the overall quality of living in condominium buildings

under IHDP. The study aims on condominiums which are constructed by an integrated housing development program in Addis Ababa. To conduct the study the probable proposed chorological frame to complete this study is six (6) months.

1.7. Significant of the study

This study will be significant on improving the upcoming housing relating projects in order to enhance better residential live in different prospects. It will also signify vital points to governmental, consultants and other organizations/ authorities to study the reasons for any design change and study their effect by evaluating the effectiveness of the spatial change.

1.8. Organization of the study

The thesis is divided into Five chapters. The first chapter serves as an overview or Introduction. The second chapter is allocated to a literature review. The research design and technique are discussed in the third chapter. Chapter four is all about results and discussion, followed by chapter five, the conclusion, and the paper's recommendation to follow.

CHAPTER TWO

LITRATURE REVIEW

2.1. Integrated Housing Development Program

The Integrated Housing Development Program in Addis Ababa is a comprehensive initiative aimed at addressing the housing needs of the city's growing population (AHMED and BAŞDOĞAN). With rapid urbanization and an increasing demand for housing, the program focuses on providing affordable, sustainable, and inclusive housing options for all residents (Belcher, Suen et al. 2019). Additionally, the program incorporates social, economic, and environmental considerations to ensure the long-term viability of the housing solutions. With its effort to address the housing demand gap in early 2000, the government has interjected as one of the leading housing suppliers. The IHDP project is unique for the reason that it aims to supply housing to those underserved by the market. The IHDP program is also unique in that it is fully government led and financed. In addition to the role that the government plays, the integrated and holistic approach to addressing urban poverty makes the IHDP program unique (Rijkers 2007, Bishu 2017, Teklemariam 2021).

The Integrated Housing Development Program in Addis Ababa aims to address the housing challenges faced by the city's growing population. With rapid urbanization and limited housing options, the program is designed to provide affordable housing solutions to low and middle-income residents (Megerssa 2010, Ejigu 2014). The objectives of the program include increasing housing supply, promoting sustainable development practices, and improving the quality of life for residents. By implementing various strategies such as land identification, infrastructure development, and financing mechanisms, the program aims to create inclusive and vibrant communities in Addis Ababa (Sunikka-Blank, Abdie et al. 2021).

2.2. The IHDP program's goal

Funding: The Addis Ababa City Administration is solely responsible for managing the finance of IHDP projects, in contrast to other housing supply schemes. In order to offer low-interest mortgage loans to program participants, the Housing Development Program Office (HDPO) and the Commercial Bank of Ethiopia (CBE) entered into an agreement in 2006. Therefore, CBE offers mortgage loans to individuals at a lower than market interest rate upon unit transfer, even if each condominium owner is supposed to make a down payment of 10%, 20%, or 40% of the total housing cost prior to property transfer (Dubale 2023).

Government subsidies has three main benefits for the IHDP project. First, the project is subsidized by the Addis Ababa City Administration, which provides urban land. Second, AACA covers the expense of basic infrastructure, such as sewerage lines, water, power, and roads (Teklemariam 2023). Third, all program administration expenses are covered. The program also receives tax benefits in addition to the significant subsidies indicated above. Lastly, cross-subsidy between the various loan categories is introduced under the program.

Cost and Affordability: IHDP is able to offer condominium housing units to recipient families at a cheaper market value because to the subsidies it receives. The majority of the program's target demographic is still not served, despite its best efforts to provide housing units at reasonable costs. Additionally, the cost of condominium housing has increased by 200–300% since the program's inception (Gianoli and Otgaar 2016, Haile 2024).

Economic and Social Impact: Although the IHDP program has made unprecedented efforts to solve the city's ongoing housing supply crisis, the initiative has had a number of unexpected or unanticipated consequences. Being separated from their social and economic ties generates stress in the lives of low-income families, who heavily rely on these networks for their everyday existence (AHMED and Başdoğan 2020, TEREFE 2022). The IHDP program has affected inhabitants who previously lived on project locations in addition to the social and economic effects it has on beneficiary households. Although attempts have been made to include displaced families in the program, a

number of families have been displaced because they do not meet the requirements to be eligible. For some, these situations perpetuate a cycle of poverty, while for others, they present an opportunity (Teklehaimanot and Housing 2016) Impact on Space A very identifiable spatial imprint has been left in the city of Addis Ababa by the IHDP housing project, in addition to its economic and social effects. Due to their lack of integration into the current urban fabric, condominium housing projects are arguably large, resulting in standalone constructions that have an impact on the city's landscape.

2.3. Features of the design

The dwelling design typologies, the availability of commercial units and common structures, the costing and quantity surveying procedures, building licenses, and land transfer agreements are all components that are shared by all condominium projects within the program (Gianoli and Otgaar 2016).

Their design ideas were predicated on the idea that, in order to "remove the stigma of housing for the poor" and to make residents feel proud of their surroundings, there needed to be a lot of outdoor green space on the property because the houses themselves could not be of such high quality due to the project's low cost (Miruts , Ingwani, Gondo et al. 2010). They made an effort to provide a well-planned neighborhood, shared buildings, and a strong connection to the land in order to handle the unavoidably challenging cultural adjustment that some residents would experience when they moved from low-rise to high-rise buildings. Sadly, the pressure to increase site density led to changes to the original master plan and its architectural principles. Specifically, a significant portion of outdoor green space and the original clarity of the master plan objectives were lost (TEREFE 2022).

The idea behind condominium housing is densification. High-rise housing should be promoted, particularly in desirable inner-city locations, as the IHDP considers that lateral development is typically more costly than vertical development. The density of IHDP projects varies between 175 and 300 households per hectare6. Since condominium buildings are currently "ground floor plus four stories (G+4) in height, and occasionally five stories (G+5)," a mechanical lift is not required, which lowers the related expenses of construction and upkeep. Nonetheless, the most current condominium development,

situated in the Lideta neighborhood of Addis Ababa, consists of ground floor plus seven story (G+7) condominium complexes. The value of the centrally placed land necessitates the higher density to maximize the use of the inner-city land on which it is located, even though this model requires an internal lift, which raises construction and maintenance expenses (Kloosterboer 2019).

Although slight adjustments are made to make each project site unique, the general design approach is used to all projects. Depending on the site, the layout of the commercial buildings, condominium complexes, and common areas is determined by the required densities, land typography, and available land area. To prevent boredom between sites, the HDPO uses a competition method to hire fresh architects (ERKIYHUN 2022, Weldeghebrael 2022).

One attempt to address the cultural requirements of the inhabitants was the construction of communal structures on condominium grounds. The purpose of the communal buildings is to give inhabitants a safe place to carry out customary duties like butchering goats, doing laundry by hand, and preparing large meals activities that the dwelling units themselves are unable to support. Usually freestanding masonry structures are situated in the open courtyards that the condominium complexes have built.

Despite the good intentions behind the supply of communal units, there is still no overall coordinated program strategy and post-occupation administration of the communal structures has proven difficult. Accessibility and use issues have arisen because the cost of the communal buildings was initially excluded from the unit purchase price (Larsen, Yeshitela et al. 2019).

However, as shown at the Gotera and Gofa sites, the cost of community buildings is currently covered by the unit purchase price. Regretfully, in an attempt to cut construction costs, community building provision has been discontinued on several project sites (Tiumelissan and Pankhurst 2013).

There is a strong demand from residents for shared buildings. Residents themselves have been erecting communal buildings on sites with an inadequate number of them, despite the government's prohibition on this practice and the likelihood that these

structures will soon be removed. Since then, some resident associations have purchased their shared buildings from the government.

2.4. How IHDP program impact on residential lives?

The Socio-Economic Impact of Integrated Housing Development Program has been a topic of great interest and discussion in recent years. This program aims to address the complex issue of housing inequality and promote social integration by creating mixed-income and mixed-use developments (Yip, Chang et al. 2007). By combining affordable housing units with market-rate units and incorporating amenities such as parks, schools, and community centers, the program seeks to create vibrant and inclusive communities. The impact of this program extends beyond housing, as it has been shown to have positive effects on education, health, and employment opportunities for residents. Many Authors agree besides the social and economic impact of the IHDP program to beneficiary families, the program has impacted residents that previously resided on project locations. Despite efforts made to incorporate displaced families into the program, several families have failed to meet the criteria to qualify for it; hence, resulting in their displacement. Such circumstances recreate a cycle of poverty for some while providing opportunity for others (Hsieh 2009, Lehrer and Wieditz 2009).

The Spatial Impact of Integrated Housing Development Program to the city image and cleanliness has been a topic of great debate and discussion in recent years. This program aims to address the growing need for affordable housing in urban areas while also promoting inclusivity and social cohesion. By integrating different types of housing units within the same development, such as market-rate, affordable, and subsidized housing, the program seeks to create diverse and vibrant communities. However, the spatial distribution of these developments and their impact on the overall city image and cleanliness are important considerations that need to be carefully examined (Brobbel 2015, Belcher, Suen et al. 2019).

The Impact of Integrated Housing Development Program for standardizing the life of residential people in the town has been significant. This program has brought about numerous positive changes in both the physical and social aspects of the community (Rijkers 2007, Bishu 2017). Firstly, the integration of different housing types and income

levels has resulted in a more diverse and inclusive neighborhood. Residents from various backgrounds now have the opportunity to interact and form connections, fostering a sense of unity and belonging.

Nearly 20% of Ethiopia's urban population lives in Addis Ababa, the country's capital and the country's most urbanizing metropolis (CSA, 2014). The demand for housing stock has increased beyond capacity due to rapid urbanization and increasing population migration into the city (Larsen, Yeshitela et al. 2019). There has long been tension on the housing sector, which provides the city's population with housing stock.

There was a backlog of roughly 300,000 housing units for the city's nearly 4 million residents at the start of 2000. These figures, which are frequently characterized by subpar conditions, demonstrate the city's lack of available housing (Larsen, Yeshitela et al. 2019).

The housing supply in Addis Ababa is also crucial for the population's middle-class and lower-class segments. The city's inadequate housing supply was exacerbated by a number of problems. The first is the market-oriented land management system that is commonly used and the lack of access to reasonably priced land (Tiumelissan and Pankhurst 2013). In addition to inadequate land management techniques, the city's housing stock supply is continuously shaped by the absence of diverse housing delivery channels, a strong and reasonably priced house construction sector, and a varied housing finance system. Limited access to adequate and cheap housing, especially for the urban poor, has led to the rapid growth of squatter and informal settlements throughout the city.

Early in the new millennium, the government stepped in as one of the primary housing providers in an attempt to close the housing demand gap. The goal of the IHDP initiative is to provide housing to people who are underserved by the market, which makes it special. Another distinctive feature of the IHDP program is that it is entirely funded and run by the government. The IHDP program is distinctive due to its integrated and comprehensive approach to alleviating urban poverty, in addition to the role that the government performs (MEKONNEN 2017).

2.5. Common circulation and spaces

'Circulation' describes how people move through, around, and between buildings and other elements of the created environment. Circulation spaces are areas of a building that are primarily used for movement, such as landings, stairs, hallways, foyers, and lobbies. Stairs and ramps are examples of vertical circulation spaces, while corridors and other horizontal circulation spaces are examples of circulation spaces (KIDANE 2018). Public circulation areas and private circulation areas with restricted access may be found in public buildings, but they may also be restricted to particular user groups. In certain situations, they may have several uses and might be either open or closed areas, such atria or corridors. Numerous elements, including the type of use, traffic volume, travel direction, crossing flows, and more, can influence the size of circulation areas. To assist people in navigating circulation areas, wayfinding signage or other types of signage may be required in complex structures like hospitals or transportation exchanges.

Common circulation and spaces within a building are shared communally by residents. They include lobbies, internal corridors and external galleries, vertical circulation such as lifts and stairs, as well as community rooms and other spaces. Common circulation spaces provide opportunities for casual social interaction among residents and can assist with social recognition (Hasriyanti, Zulestari et al. 2018). Important design considerations include safety, amenity and durability. In addition, the choice of common circulation types has a direct influence on the apartment types provided, building form, articulation and the building’s relationship to the street (Kleeman, Hooper et al. 2023).

2.6. Types of communal circulation spaces

2.6.1. Vertical circulation

In brand-new structures, level changes within a story should be avoided. People should be given the option of using steps or a ramp in existing structures when there is a level change that cannot be removed. When there is a significant change in level and installing a ramp is impractical, the availability of a passenger lift or vertical platform lift should be taken into consideration. Safety must always come first, no matter how vertical circulation is accomplished. Even though stairs are the most usual way to change levels, falling on

them can result in significant injuries (Mahdavinejad, Mashayekhi et al. 2012, Wu, Ge et al. 2020).

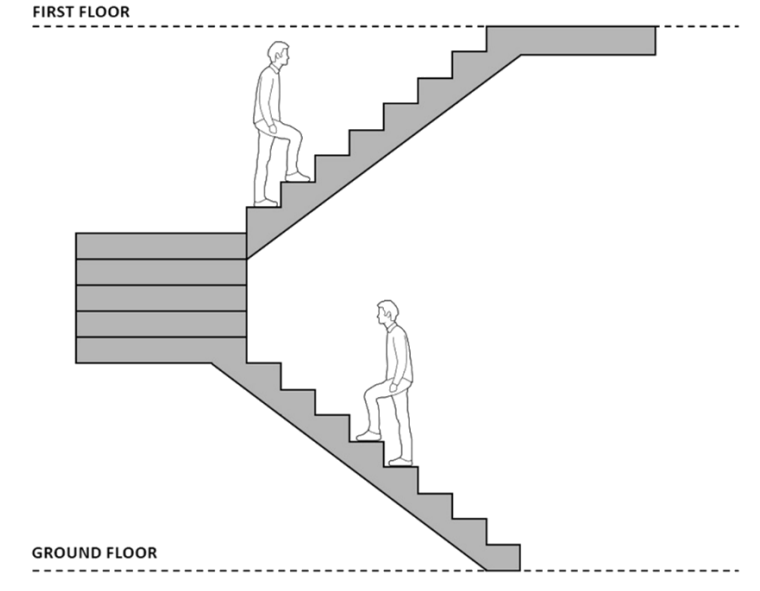

Figure 1: Vertical Circulation (Stairs)

Source (Wascha Architects, 2024)

The stairwells in many buildings with lifts may never be used at all during normal building operations. However, it is crucial that the stairs be constructed, finished, and cared for in a way that will guarantee everyone's safety in the event of an emergency. The most practical and secure method of entrance and egress for building occupants is the provision of a passenger/evacuation lift (or lifts) to all floors (Hasriyanti, Zulestari et al. 2018). Passenger/evacuation lifts need to be big enough, have enough room for circulation on the landings, and have simple controls.

2.6.2. Horizontal circulation

Access routes through open-plan rooms, walkways, corridors, and lobby spaces can all be considered a part of a building's horizontal circulation. In order to provide access to important facilities, the overall layout of access routes should be sensible, clear, practical, and as direct as possible (Born 2013). Travel distances should be kept to a minimum, however this will obviously depend on the building's size and type. Everyone will benefit from a well-planned building layout with easy-to-follow circulation channels. If at all

possible, level changes within a stores should be avoided. The addition of a ramp, passenger lift, or platform lift may need to be explored and made accessible if this is not practicable in an existing building.

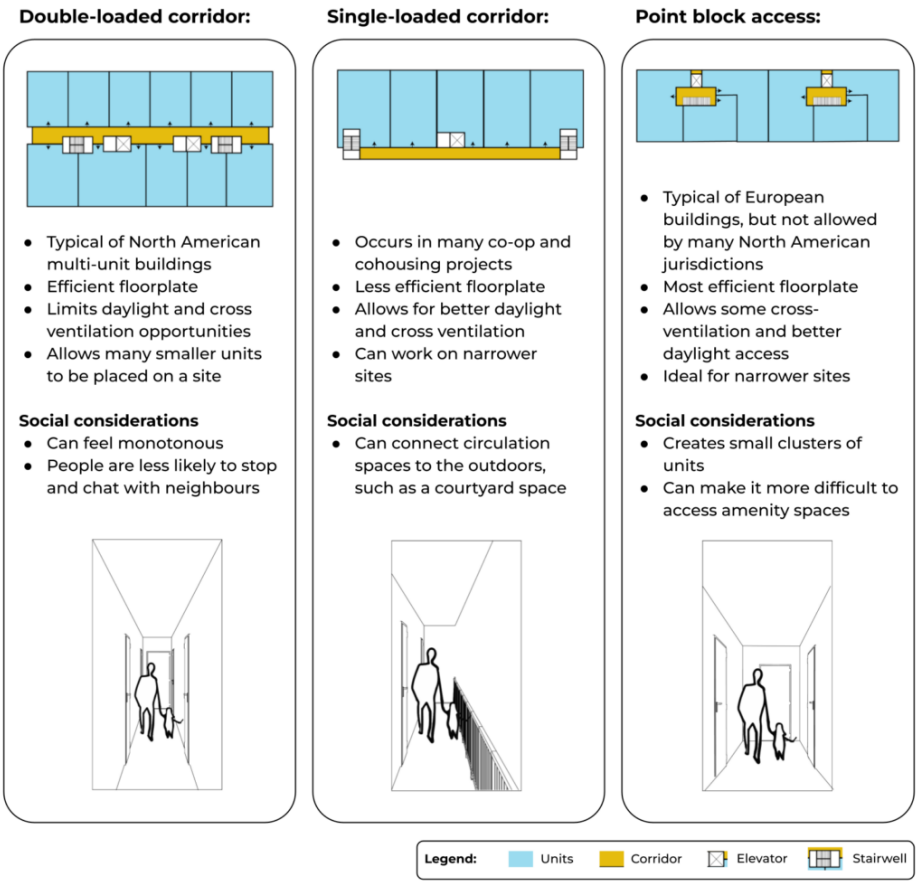

Figure 2: Horizontal Circulation (Social Corridor)

Source (Happy Cities, 2022)

2.7. Spatial transformation of communal circulation spaces

Spatial transformation of communal circulation spaces, both vertical and horizontal, in condominiums is a significant aspect of modern architectural design. It aims to enhance functionality, aesthetics, and user experience within these shared areas (Malla, Karanjit et al. 2019).

Emphasizing natural light: The spatial design of communal circulation spaces plays a crucial role in creating an inviting and comfortable environment. One way to enhance these spaces is by emphasizing natural light. Incorporating ample natural light into

circulation spaces can create a welcoming and vibrant atmosphere. This can be achieved by integrating large windows, skylights, or light wells throughout the vertical and horizontal circulation areas (Siagian and Sitorus 2020). Natural light not only brings warmth and brightness into the area but also transforms the overall atmosphere. By strategically positioning windows and skylights, designers can maximize the amount of daylight that enters the space (Li, Lam et al. 2003).

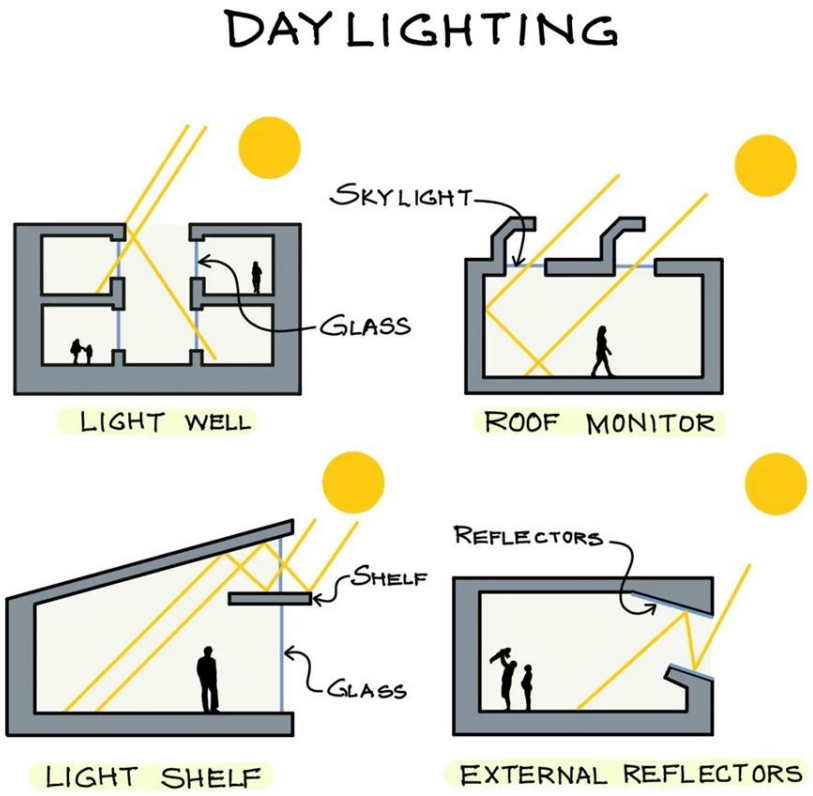

Figure 3: Day Lighting at communal and circulation spaces

Source (Arch20, 2023)

Multi-functional spaces: The transformation of communal circulation spaces into multi-functional spaces is a key aspect in optimizing the utilization of architectural designs. By reimagining these spaces, architects have the opportunity to create environments that serve multiple purposes and cater to different needs. To optimize the use of communal circulation areas, designers can incorporate flexible furniture arrangements, such as seating nooks, study corners, or workspace areas (Botero 2013) (Ingwani, Gondo et al. 2010, Keller and Mukudi-Omwami 2017, TEREFE 2022). This allows residents to utilize

these spaces for various activities, promoting social interaction with neighbors on the same floor.

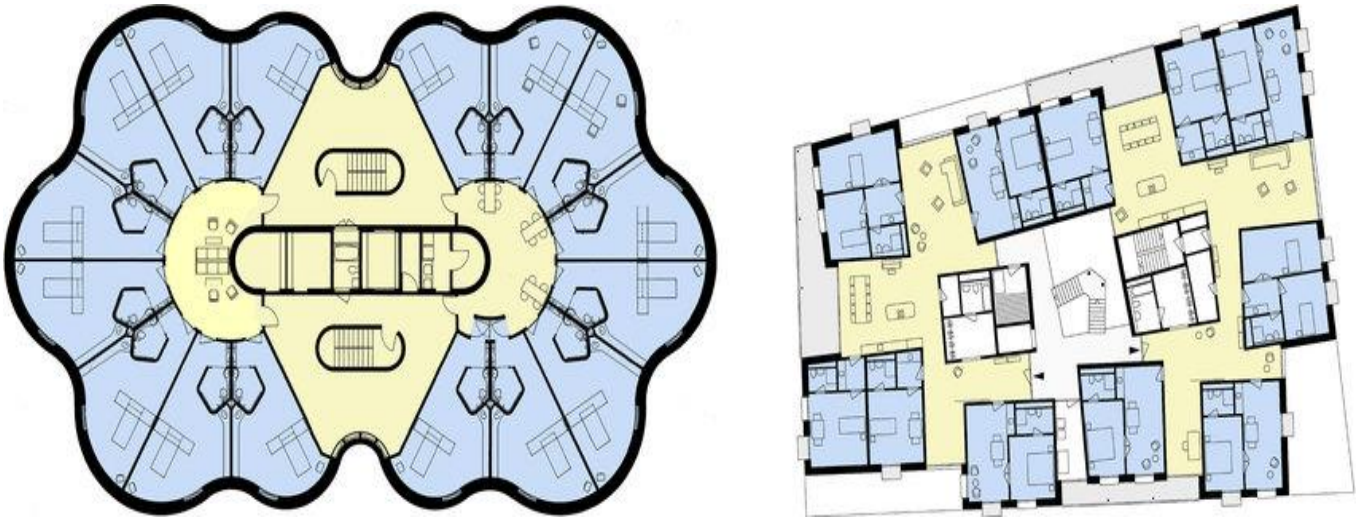

Figure 4: Multi-functional spaces for Co-living concepts

Source (Simonovic Alfirevic, 2020)

Gone are the days when communal circulation spaces were solely for the purpose of moving from one area to another; now, they can be transformed into areas for collaboration, or even relaxation, this paradigm shift not only enhances the functionality of the space but also promotes a sense of community and engagement among the users.

Artistic and interactive elements: Introducing art installations, paintings, or interactive features like digital screens, touch displays, or interactive projections can transform circulation spaces into visually engaging and interactive experiences. These elements can serve as focal points, fostering a sense of identity and creativity within the condominium environment (Wu, Ge et al. 2020).

2.8. Advantages of communal space

Communal circulation spaces, both vertical and horizontal, in condominiums offer several advantages that contribute to the overall functionality and appeal of the living environment. Communal circulation spaces in condominiums play a vital role in creating a functional, enjoyable, and cohesive living environment for residents (Setyowati and Sara 2020).

2.8.1. Enhanced Safety and Security

Communal circulation spaces, both vertical and horizontal, can enhance safety and security in condominiums in several ways: Well-designed communal circulation spaces contribute to the overall safety and security of the condominium. Adequate lighting, clear way finding signage, and surveillance systems can help deter potential risks and provide a sense of comfort for residents. There will be clear visibility on the condominium building by proper design and lighting in communal circulation spaces ensure clear visibility, reducing the risk of accidents, unauthorized access, or suspicious activities (Crouch, Shaftoe et al. 2014). Adequate lighting helps residents feel safe and allows for effective surveillance, deterring potential criminals. On the other hand if there are access control measures implemented such as key cards, electronic locks, or intercom systems in communal circulation spaces can restrict unauthorized entry into the condominium. This helps prevent unwanted visitors from accessing residential floors or common areas(Newman, Johnston et al. 2006).

Communal circulation spaces will play a vital role during emergency communication: Communal circulation spaces can serve as communication zones during emergencies. Incorporating evacuation routes having properly designed communal circulation spaces provide clear and well-marked evacuation routes in case of emergencies such as fires or natural disasters. These routes help residents navigate safely to designated assembly points, minimizing panic and ensuring a swift evacuation. Emergency Lighting: In the event of a power outage or emergency situation, communal circulation spaces should be equipped with emergency lighting systems. This ensures that residents can safely navigate the space and find their way to exits or emergency equipment. These measures provide residents with peace of mind and contribute to a secure living environment (Levitt 2012).

2.8.2. Improved Connectivity

Communal circulation spaces provide a means of connecting different parts of a condominium, allowing residents to easily navigate between floors, units, and common areas. This connectivity promotes a sense of community and encourages interaction among residents (Russell and Gossweiler 2001, Setyowati and Sara 2020).

2.8.3. Social Interaction and Community Building

Communal circulation spaces serve as gathering points and meeting areas where residents can interact, socialize, and build relationships. These spaces create opportunities for casual encounters, conversations, and the development of a sense of belonging within the community.

2.8.4. Promote Active Lifestyles

Communal circulation spaces, particularly staircases and corridors, can encourage physical activity and promote a healthy lifestyle. Encouraging the use of stairs instead of elevators and incorporating walking or jogging paths within these spaces can contribute to residents' fitness and well-being (Kleeman, Giles-Corti et al. 2023).

2.8.5. Increased Natural Light and Ventilation

Properly designed communal circulation spaces can maximize the use of natural light and ventilation (Li, Lam et al. 2003). This not only reduces reliance on artificial lighting and HVAC systems but also creates a more pleasant and energy-efficient environment for residents.

2.8.6. Aesthetically Pleasing Design

Well-designed communal circulation spaces enhance the overall aesthetic appeal of the condominium. Incorporating elements like art installations, covering, and attractive finishes can create a visually appealing environment that residents can enjoy as they move through these spaces (Bly and Minneman 1990, Hadi, Heath et al. 2018).

2.8.7. Ease of Maintenance

Efficient design and material selection in communal circulation spaces can contribute to easier maintenance and cleaning. Durable flooring, low-maintenance finishes, and

carefully planned accessibility for maintenance staff can help keep these areas clean and well-maintained (Rim and Choi 2011).

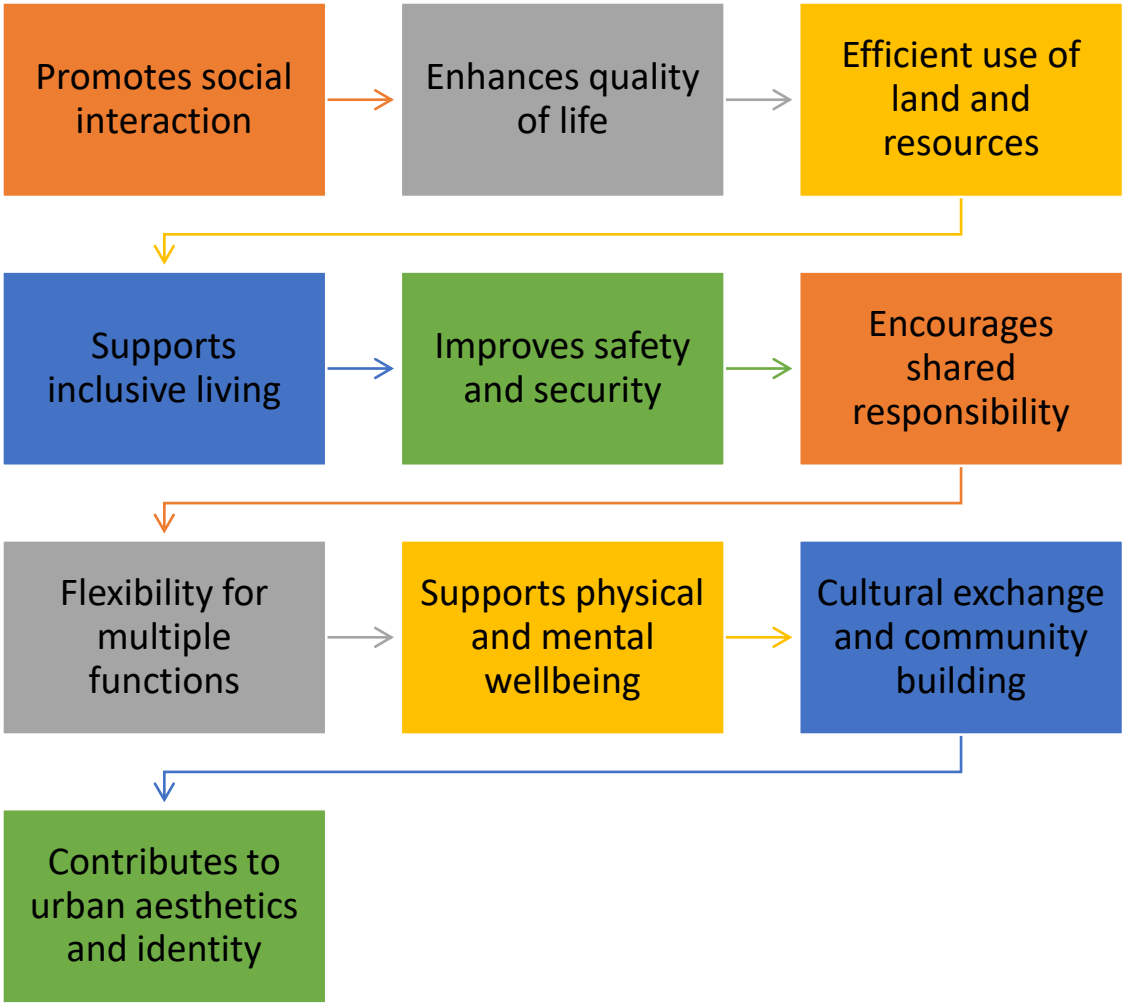

Figure 6: Advantages of communal space

2.9. Factors contributing to spatial change

Condominiums have undergone significant spatial transformations in their communal circulation spaces, both vertically and horizontally. These changes have been influenced by various factors that have shaped the way these spaces are utilized and perceived.

Increasing demand for urban living: One contributing factor is the increasing demand for urban living, which has led to the construction of high-rise condominiums with multiple floors and shared amenities. Another factor is the desire for more inclusive and interconnected living environments, prompting developers to create communal spaces that foster social interaction and a sense of community (Kleeman, Giles-Corti et al. 2023).

Safety and Accessibility: The primary concern when transforming these spaces is ensuring the safety and accessibility of residents. Factors such as proper lighting, clear signage, slip-resistant materials, handrails, and barrier-free design are incorporated to enhance safety and improve accessibility for all residents, including those with disabilities or mobility challenges (O'MALLEY, Innes et al. 2018, Rahimi, Ansari et al. 2020).

Efficient Space Utilization: Condominiums often have limited space, necessitating the efficient use of every square foot. Spatial transformations focus on optimizing the layout of corridors, stairs, and lifts to maximize efficiency and minimize wasted space (Russell and Gossweiler 2001, Tony 2020, Ribbe Kelso, Stockton et al. 2022).

Improved Flow and Circulation: The spatial transformations aim to enhance the flow and circulation within these areas. Corridors are widened to accommodate increased foot traffic, staircases are designed to minimize congestion, and lifts are strategically placed to ensure smooth movement between floors (Chambers, Bafna et al. 2018).

Aesthetics and Visual Appeal: The visual appeal of these spaces is given importance to create a pleasant and inviting atmosphere (Mahdavinejad, Mashayekhi et al. 2012, Bagheri and Sahroudi 2015). Design elements such as attractive flooring, wall finishes, lighting fixtures, and artwork are incorporated to transform corridors, stairs, and lifts into visually appealing areas.

Integration of Technology: Technological advancements play a role in the transformation of these spaces. Features such as controls, smart lighting systems, energy-efficient elevators, and digital signage are integrated to enhance convenience, efficiency, and user experience (Newman, Johnston et al. 2006, Mahdavinejad, Mashayekhi et al. 2012, Hasriyanti, Zulestari et al. 2018).

Sustainability and Green Design: The focus on sustainability extends to corridors, stairs, and lifts. Energy-efficient lighting, eco-friendly materials, and sustainable design principles are employed to minimize environmental impact and promote energy conservation within these spaces (Levitt 2012, Wu, Ge et al. 2020)

2.10. Conceptual framework

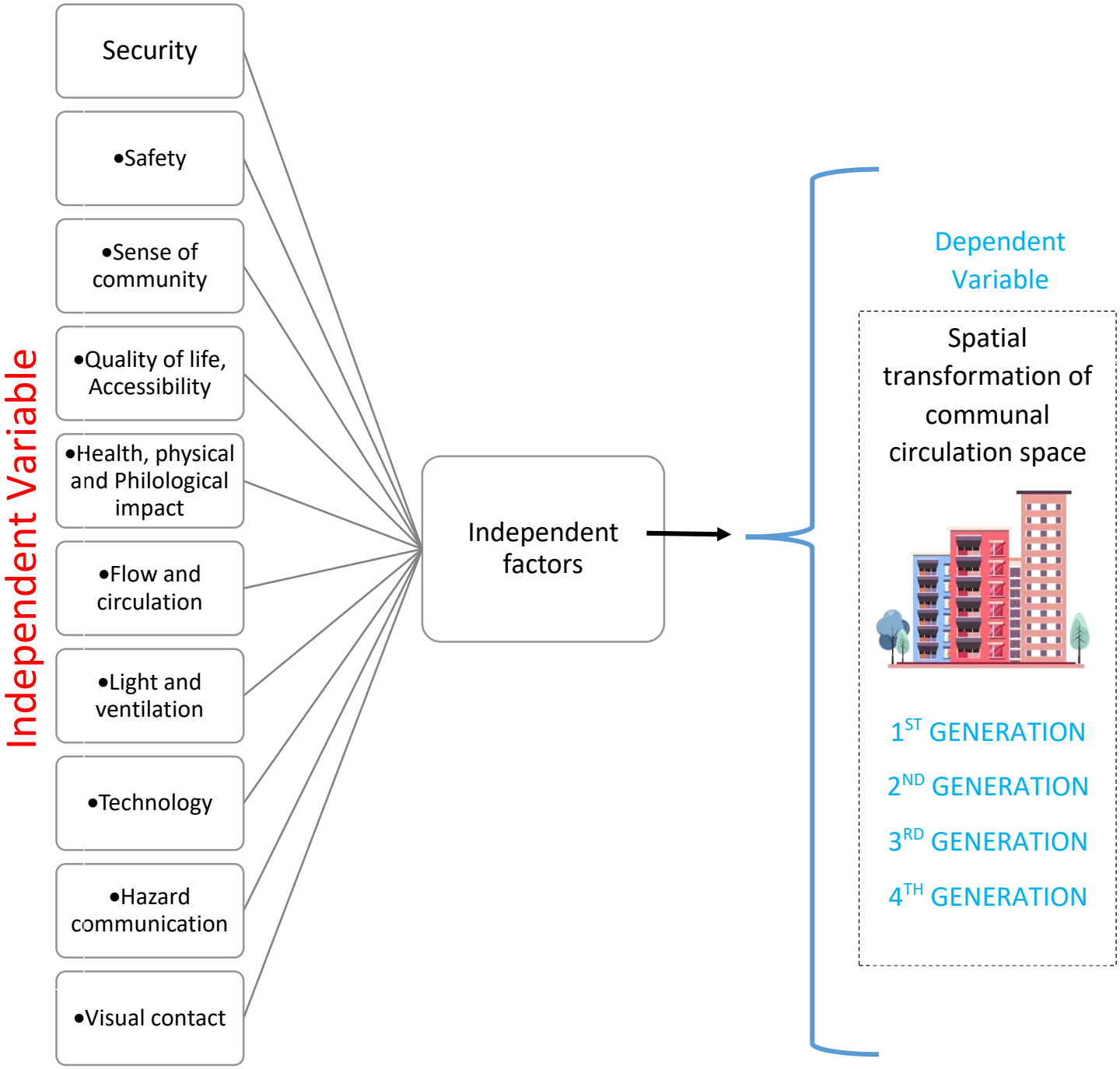

Figure 7: Conceptual Framework

2.11. Terminologies

Condominium: A residential building in a complex or multi-unit building, in which each unit is owned separately by an individual but shared facilities such as hallways, elevators, parking spaces, and recreational spaces are jointly owned and managed by a condominium association or collective agreement.

Generations: Generations are successive phases of condo development, typically categorized as such: First Generation, Second Generation, Third Generation, and Fourth Generation, each with step-by-step enhancements in design, construction, and functionality over the years.

Topology: The spatial relationship and positioning of building units within a condominium property is referred to as topology in architecture. It includes the manner by which buildings are oriented, placed, and positioned with respect to pathways, open spaces, roads, and other site features so that they become functional and livable environments.

Typology: Typology is the typification of condominium buildings based on shared characteristics like form, height, structure, and generation. They may consist of typologies like high-rise, low-rise, linear blocks, courtyard type, or generational type that facilitate understanding of the logic of design and use of various condominium types.

CHAPTER THREE

RESEARCH METHODOLOGY

The following methodologies were employed to address the research questions and achieve the objectives, ensuring a systematic and evidence-based approach throughout the study

3.1. Study population and study area

This study will focus on analyzing and investigating the spatial transformation of communal circulation space design at the integrated housing development program condominium houses in Addis Ababa. All the sites available in the city will be under study by clustering the blocks into generations. After all design transformation factors, effect, will be assed and investigated by taking sample size from each site and generation type.

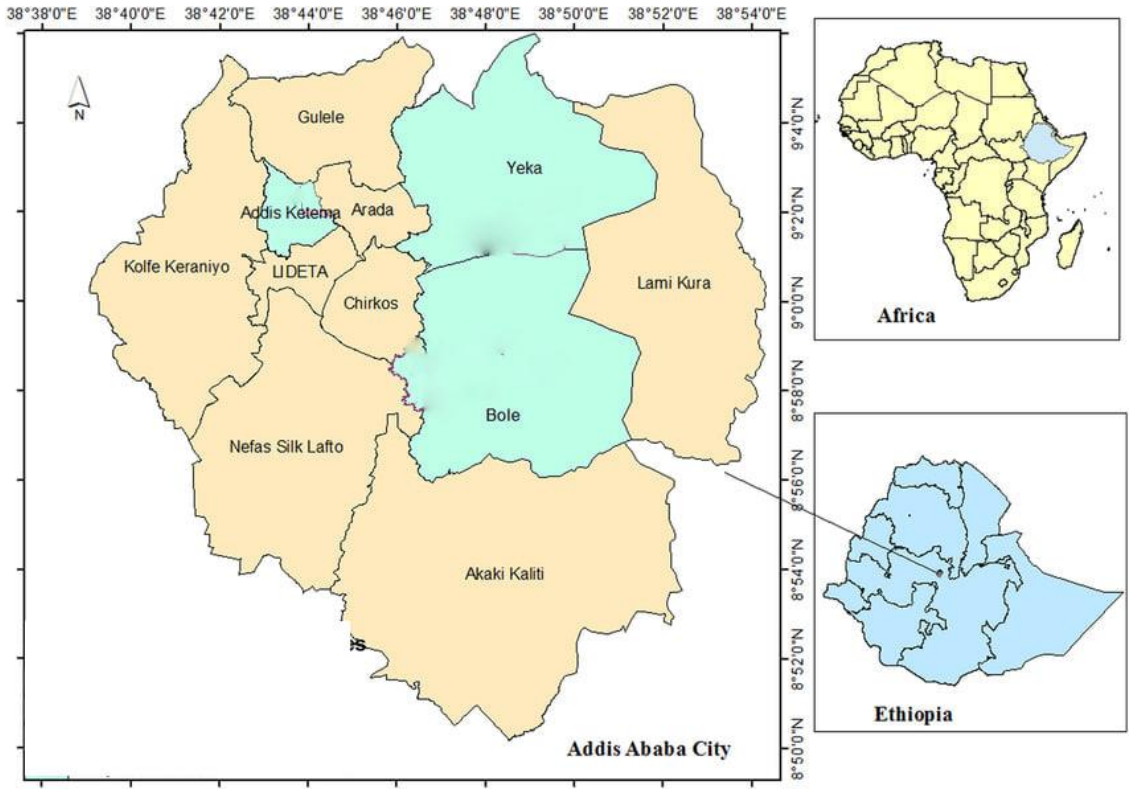

Figure 8: Study area topography

Source (Kalkidan, 2024)

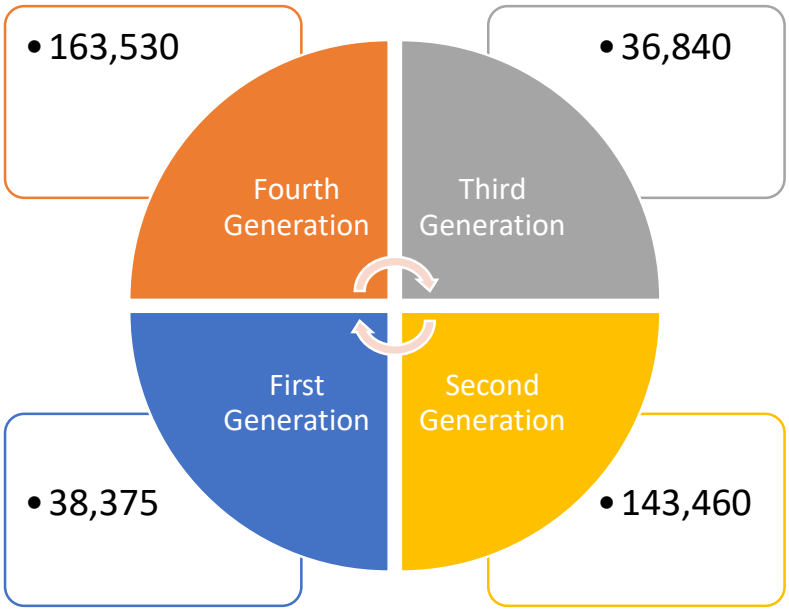

Figure 9: Type of Generation Vs Number of Residents

3.2. Sample size determination

Given that this study needs a longitudinal survey, the method suggested by (Viechtbauer, Smits et al. 2015) would be the most suited for determining the sample size. The following factors should be changed before estimating the sample size: In this scenario, 50% would be the prevalence of the condition receiving a positive response, represented by (p), making p=0.05. The likelihood of receiving a negative response, (q), in this instance would be 50%, making q=0.05. The estimation's accuracy. This might be the relative accuracy, represented by the symbol (e), which is about equivalent to 2.718. From the probability tables, the value of z. 95% of the values will fall within two standard errors of the mean if the numbers are regularly distributed. This corresponds to a value of z of 1.96 (from the conventional normal variety tables). The sample size (n) will be determined using the following Equation (1) below based on the aforementioned parameters:

$$n = \frac{(1.96^2 xpxq)}{e^2} \ldots\ldots\ldots\ldots\ldots Equation\ 1 \text{ (For population >100,000)}$$

$$n = \frac{(1.96^2 x0.05x0.05)}{2.718^2} = 384.6\ approximatley\ 385\ up\ to\ 400$$

The total number of residential owners or dwellers considered as respondents were around 400. Those 385 resources will be selected using proportional sampling based on the total number of residents and the type generation from each site as follows:

Table 1: Proportional Sample for the four generation

For 400 sample respondents the proportion will be computed taking 400 as 100%		
Type of generating	**Number of residents**	**Proportional sample**
4th	163530	171.1438 approximately 171
3rd	36840	38.55523 approximately 39
2nd	143460	150.1393 approximately150
1st	38375	40.16169 approximately 41

3.3. Type of research design and data analysis

To address the research questions regarding the spatial transformation of communal circulation space design and the determinant factor, this study used variety of research designs. Quantitative analyses was utilized to describe means, percentages, frequencies, coefficients of variation, and standard deviations using both descriptive and inferential statistical approaches. To make comparisons, arguments, and interpretations, the qualitative analyses were utilized. Dwellers or residents as the responders of the self-administrative questionnaires in a longitudinal study design utilizing a deductive technique. On a Likert scale with five possible responses, the questioner (Appendix A) will receive an answer.

3.4. Method of data collection and data analysis

After self-administered questioner having three sections to be answered by respondents using five (5) scale agreement Likert scale, each responded using scale to show their agreement.

Specific objective One: To assess Historical evolution of typologies and their circulation system

Research Question One: How have the communal circulation spaces (vertical and horizontal) within the building typologies of a mass housing project (condominiums) in Addis Ababa transformed over time?

Specific objective Two: To investigate the current spatial configurations of circulation space.

Research Question Two: What are the current spatial configurations of circulation space look like.

In order to achieve the first and second specific objectives, the types of design typologies were counted. The circulation space design was further categorized into generations. The current spatial configurations of circulation spaces were analyzed based on design features related to vertical and horizontal circulation. The historical evolution of typologies and their circulation systems was reviewed from valid literature and compared with the currently transformed spatial designs.

3.5. Reliability checking

In order to ensure that the results can be relied on, the validity of the data is first determined by determining the internal consistency of the data set and the credibility of the questionnaire survey. The reliability of a survey questionnaire was assessed using Cronbach's Alpha Coefficient. If the Cronbach's Alpha Coefficient is 0.70 or higher (Heo, Kim et al. 2015), which means that all the points are dependable and the test is internally consistent, that would be even better.

3.6. Correlation analysis

The purpose of correlation is to measure and express the extent of independent variable to dependent variable. Considering the eleven (11) variables, one dependent variable which (Generation one, Generation two, Generation three and Generation four), on the other hand there were eleven independent variables namely Security, Safety, Sense of community, Quality of life, Accessibility, Health, physical and Philological impact, Flow and circulation, Light and ventilation, Technology, Hazard Communication, and Visual contact, are linearly related or not. Correlation coefficients (r) provide information about the direction of the relationship (positive or negative) as well as the intensity of the relationship (-1.0 to +1.0). Furthermore, correlation tests revealed whether the correlation is statistically significant. Correlation coefficients range between -1.0 and +1.0. The direction of the relationship is represented by the sign of the coefficient.

3.7. Univariate analysis (Spatial transformation of design vs daily life of residential lives)

Specific objective Three: To assess the effect of spatial transformation based on residents' preferences.

Research Question Three: What are the effects of these spatial transformations based on the resident's preference?

To assess the effect of the spatial transformation on residential lives of dwellers, univariate analysis of variance (one way ANOVA) will be performed. The Spatial transformation of design is clustered into design into generations. First, second, third and fourth generation types of spatial design transformations will be regarded as dependent variables While eleven (11) independent variable categories explicitly security, safety, sense of community, quality of life, accessibility, health physical and philological impact , flow and circulation, light and ventilation, technology, hazard communication, and visual contact. . The effect of the spatial transformation in communal circulation design in terms of the after mentioned categories will be investigated on SPSS version 32, the univariate analysis will be performed

3.8. Data analysis tool and data presentation

The result data will be presented using qualitative description, quantitative analysis by charts, tables, and figures. The descriptive and inferential statistics were computed on as statistical tool which is called Statistical Package for the Social Sciences (SPSS) version 32.and Confirmatory Factor Analysis techniques will be computed using AMOS Plugin. For drafting of topologies Adobe Illustrator version 20.1 and REVIT software for plan and 3D were used.

3.9. Ethical considerations

The foundation of human relations and dignity is ethics. The ethical principles will address the special difficulties and issues that researchers frequently encounter while carrying out research. Respondents in this study will be informed of its objectives. To the respondents, confidentiality and name protection are promised. Additionally, it was made clear that the data will only be utilized for this investigation. The researcher won't employ any shady methods to get data for this study.

3.10. Method summary

Specific Objective and research question	Summarized Method
Specific objective One: To assess Historical evolution of typologies and their circulation system **Research Question One:** How have the communal circulation spaces (vertical and horizontal) within the building typologies of a mass housing project (condominiums) in Addis Ababa transformed over time?	• Literature review • Referring the topological design • Discussion
Specific objective Two To investigate the current spatial configurations of circulation space. **Research Question Two:** What is the current spatial configurations of circulation space look like.	• Literature review • Referring the topological design • Discussion
Specific objective Three To correlate the factors that affect residents' preference due to spatial transformations. **Research Question Three** Does the factors that affect residents' preference due to spatial transformations correlate with the generation types.	• Self-administered Questioner • Survey • Observation • Correlation analysis • ANOVA • Hypothesis testing
Specific objective Four To assess the effect of the spatial transformation based on residents' preferences. **Research Question Four:** What are effects these spatial transformations based on the resident's preference?	• Self-administered Questioner • Survey • Observation • Univariate analysis • ANOVA Hypothesis testing

CHAPTER FOUR

RESULTS

After adopting the above-mentioned method, the following results were obtained. The result was analyzed and discussed in detail. From basic descriptive analysis to the statistical application with literature justification as follows:

4.1. Assessment of historical evolution of typologies and their circulation system

4.1.1. First Generation Condominiums: Site Assessment

The first-generation condominium housing schemes are a key initial effort in the Ethiopian urban housing program, formulated to address growing urbanization and widening demand for affordable residential infrastructure. The findings of the assessment are that 102 separate sites are envisaged under the first-generation condominium schemes. The projects are located in 11 sub-cities, an apparent deliberate effort at achieving balanced spatial coverage and accessibility in Addis Ababa.

The inventory revealed that the sites contain a total of 1,535 residential structures with a total land area of approximately 3,674,253 square meters (or 367.4 hectares). The scale reflects the government's huge investment in urban housing during the early stages of the condominium program. There was also a total of 470 communal areas found to be playing a significant role of making the sites more habitable. These common areas include shared green spaces, recreational spaces, and open courtyards that are designed to enhance social interaction, community engagement, and a more desirable urban way of life.

The results revealed that while there are examples of well-integrated residential and communal planning at some sites, such as GELAN II and MIKELEY LAND, others vary in terms of density and public space provision, indicating the need for more regularized design standards in future phases.

The discrepancy in the size of areas and communal provision is indicative of both the problems and potential faced in implementation.

4.1.2. First Generation Typology: Communal and Circular Space Assessment

In generation one, even though they all have common features in general there are about 18 different building designs, each will be described below.

Type A:- Both Type A G+2 and Type A G+3 are the only two designs that are currently available. Type A G+2 is comprised of two stacked building blocks and has a front stairs that is shared by both of structures. Additionally, there is one studio apartment, one apartment with one bedroom, and one apartment with two bedrooms in each and every block. Private balconies are available to each and every family. The open circulation area at the entry allows for maximum access to the units as well as circulation throughout the place.

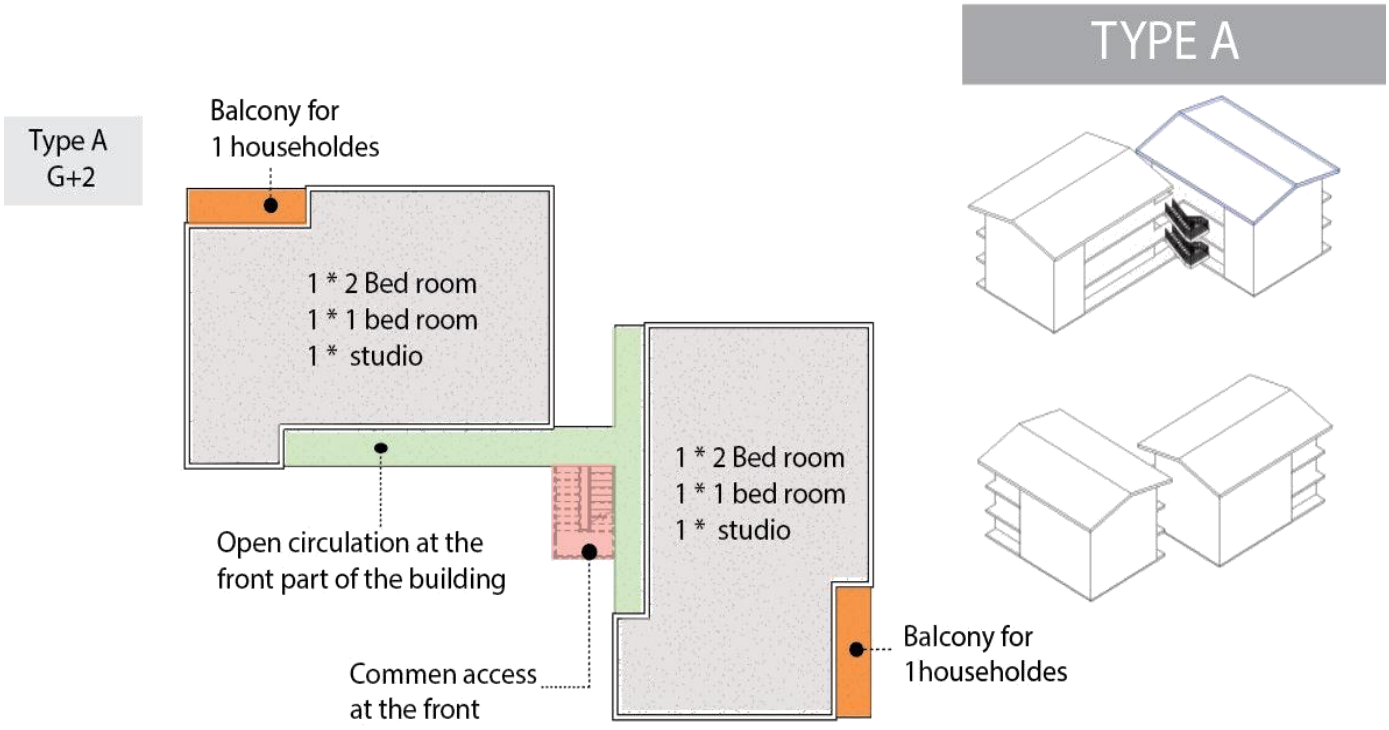

Figure 10: First Generation Type A G+2

Source (Author ,2025)

The other type was found out to be Type A G+3 building, which has the identical layout as the Type A G+2 building but adds an additional floor level, contains four flats with two bedrooms and one studio apartment per block. In this layout, a balcony is shared by three different households. Both places an emphasis on cost-effective construction, functional design, and easy access to one another, while at the same time ensuring that each neighborhood maintains a certain degree of privacy for its residents.

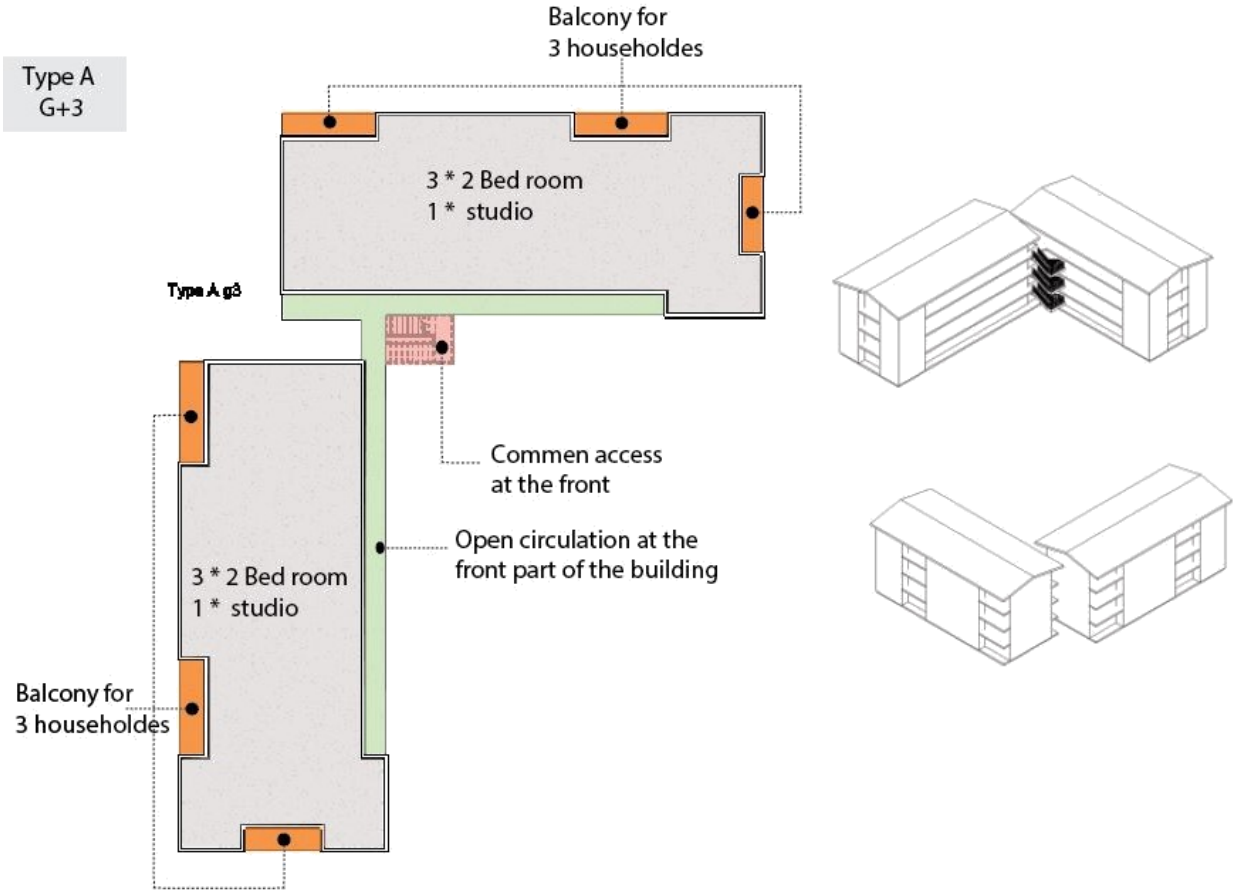

Figure 11: First Generation Type A G+3

Source (Author ,2025)

Type B: - Type B contains 3 different types which include Type B G+2, Type B G+3 with mezzanine floor and Type B G+2. All types contain L shaped Building connection and share common front vertical circulation. goes up to G+4 with only 1 bedroom excluding 2 bedrooms and studios.

Type B G+2 building has two blocks with each having three 1 bed rooms and have three balcony per each 3 household. The front stair is the same as type A G+2 shared for both blocks. It also has an open circulation at the front part of the building.

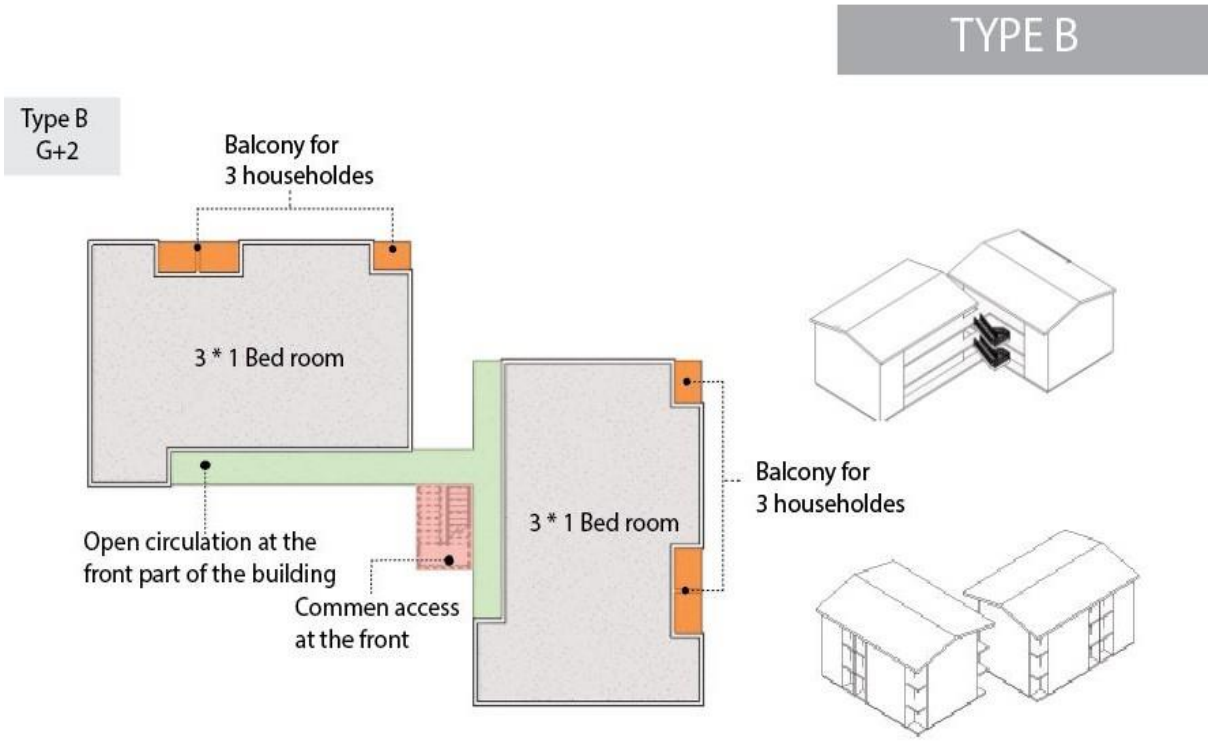

Figure 12: First Generation Type B G+2

Source (Author ,2025)

Type B G+3 has special feature which is a mezzanine floor this makes it unique from all other design types.it contains two blocks each having five 1 bedrooms but the for the block which contain the mezzanine the last floor have 2 bedroom unites. Each blocks have three balcony and have common access at the front Similar to type A. Type B G+4 is similar to type B G+3 in design, but number of house access is increased.

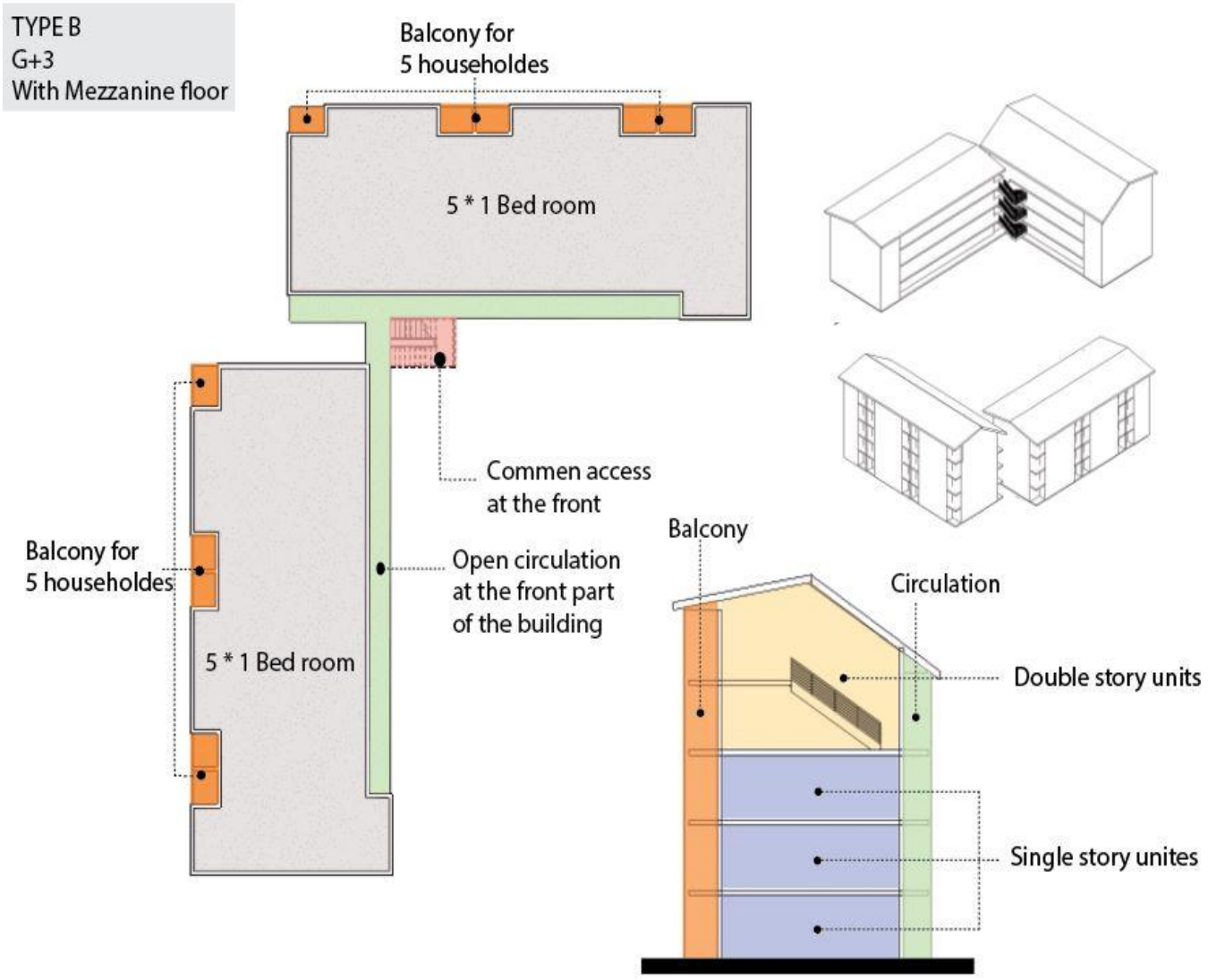

Figure 13: First Generation Type B G+3

Source (Author ,2025)

Type B G+4 also contains two blocks with each having five 1 bedroom's housing units and each block has five balconies for each household. The front stair is the same as other B type and shared for both blocks. It also has an open circulation at the front part of the building. It has a common access area at the front and an open circulation area at the front of the building.

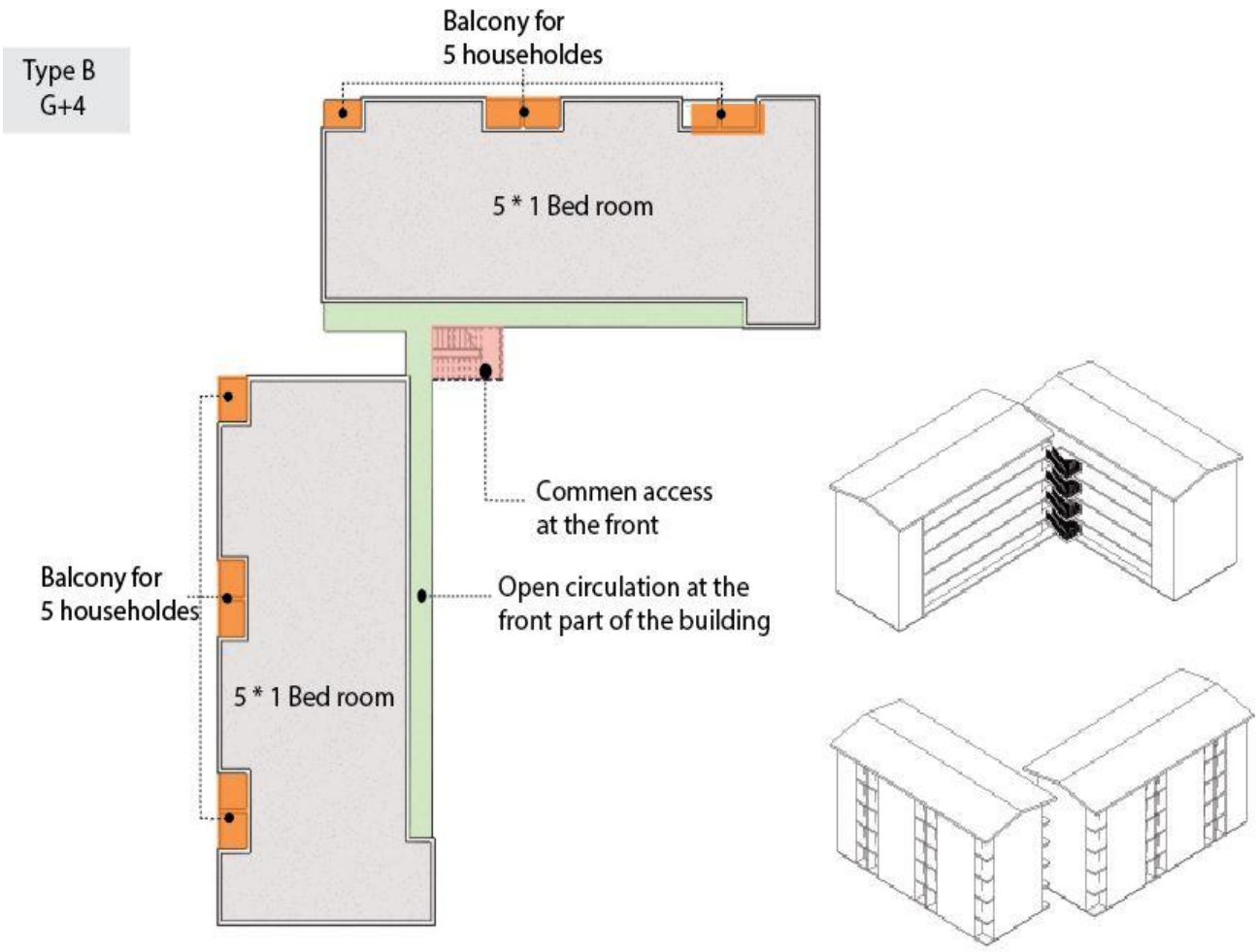

Figure 14: First Generation Type B G+4

Source (Author ,2025)

Type C :- Unlike type A and type B, it has only one block with common vertical circulation at the front central part of the building and in some types studio type housing unites were provided for commercial purposes. In this type we have about 7 subtypes but throughout this research period data related to Type C3 weren't found.

Type C G+2 have a single building block with two 1 bedrooms and studios. It has a long open circulation part at the front. There is also two balconies for two households.

For all houses, access to the stairs is at the front of the building.

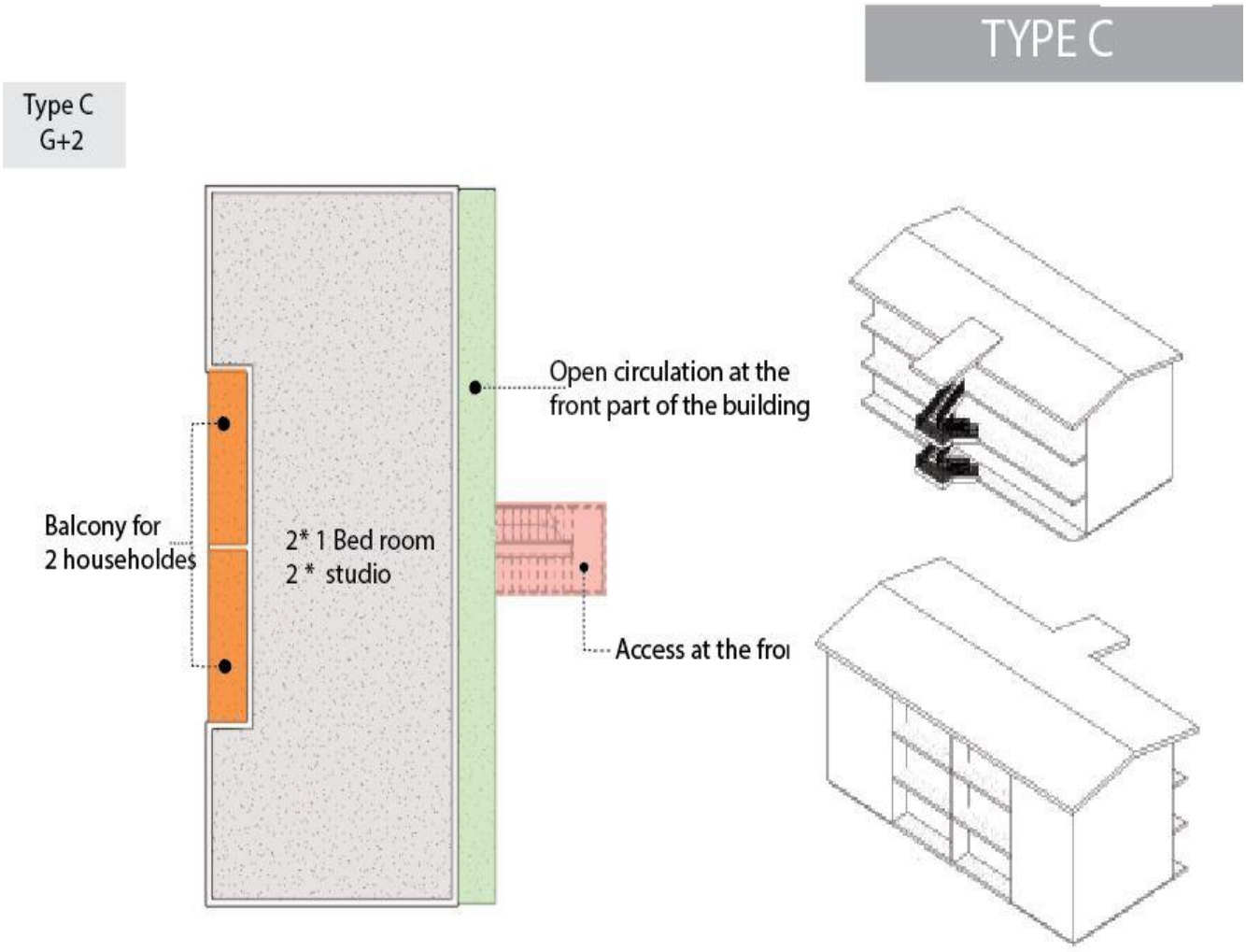

Figure 15: First Generation Type C G+2

Source (Author ,2025)

Type C1 G+3 have single building block with two 2 bedrooms, two 1 bed rooms and two studios. There are two balconies for two households. The stairs and open circulation are provided at the front part of the building. In this type six studio houses were added for shop purposes at the ground level of the building.

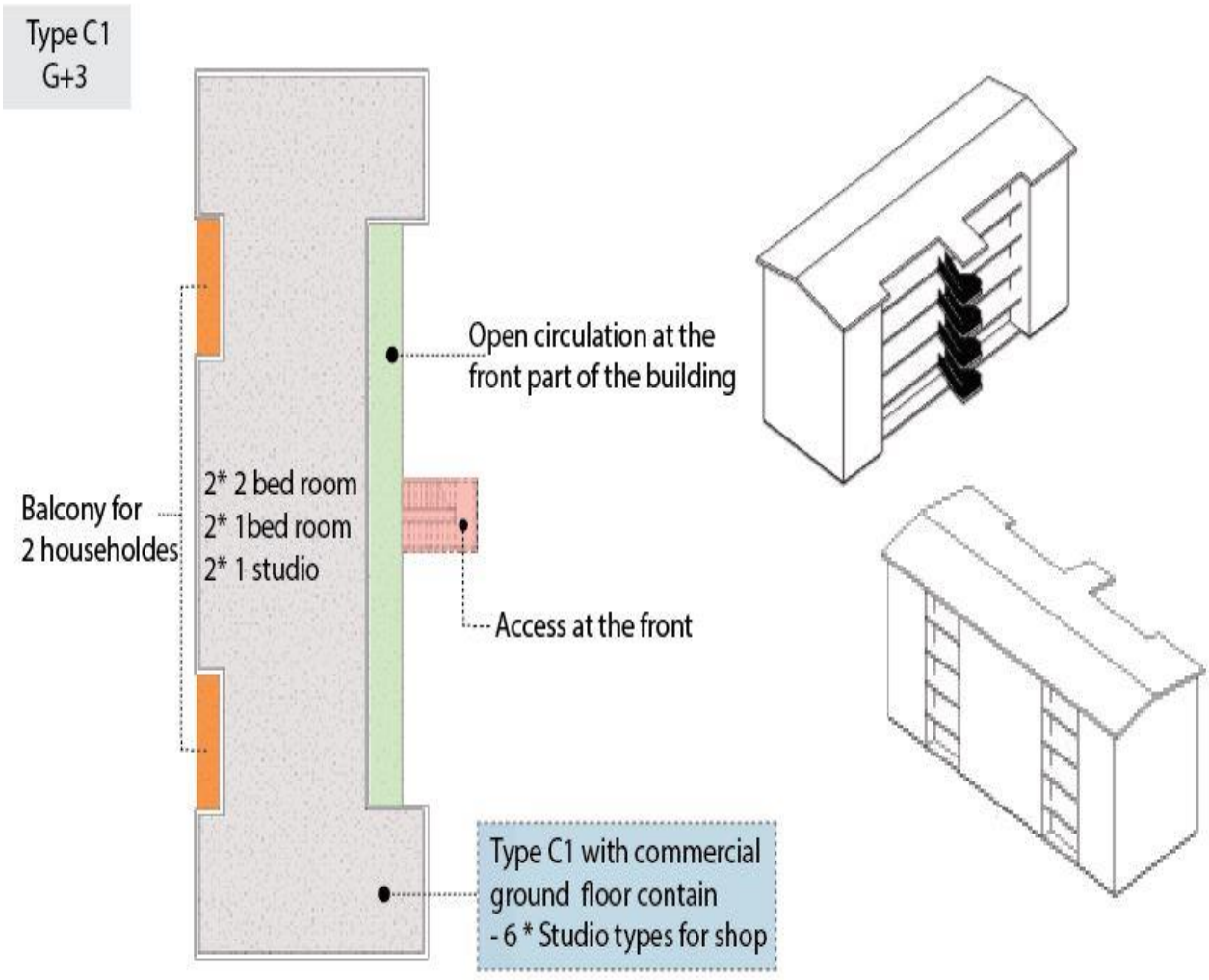

Figure 16: First Generation Type C G+3

Source (Author ,2025)

Type C2 G+2,G+3, G+4 this type contains 3 buildings with height difference but similar housing contain per floor. All fo theme have single building block with two 2 bedrooms and four 1 bedrooms and six studio houses were added for shop purposes at the ground level of the building. Both vertical and horizontal circulation systems are similar with other c type building units.

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Type C4 G+4 building have six 2 bedrooms with no balcony for the households. Open circulation and stairs is common for the houses at the front of the building.

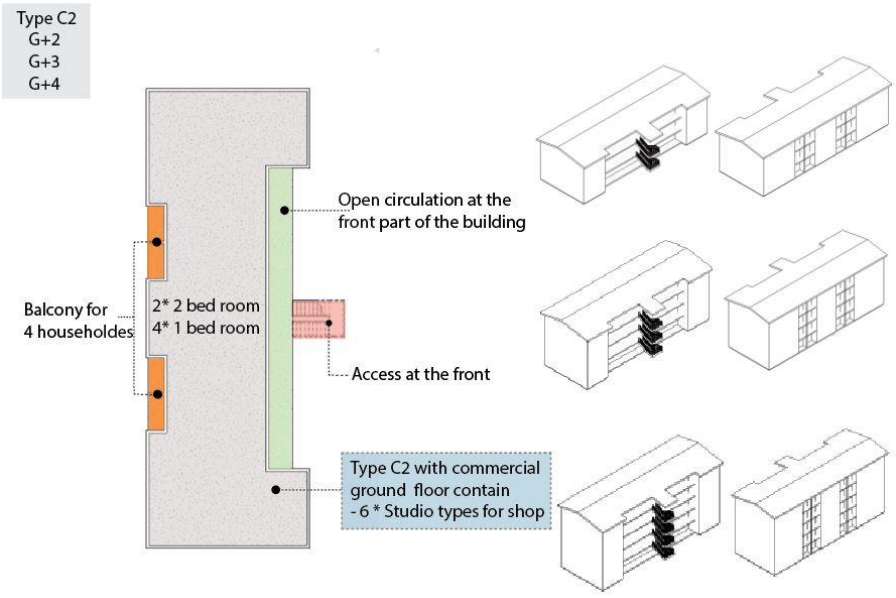

Figure 17: First Generation Type C2 G+2,G+3, G+4

Source (Author,2025)

Type C5 G+4 building comprises four 2 bedrooms, two 1 bedrooms and two studios. It have Recessed and narrow circulation Additional to open circulation at the front of the building.

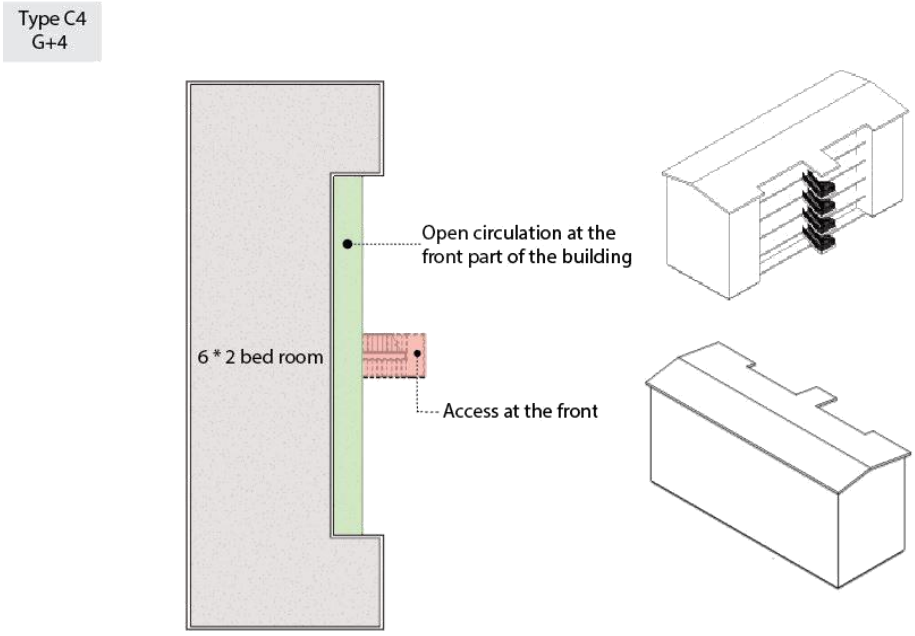

Figure 18: First Generation Type C4 G+4

Source (Author ,2025)

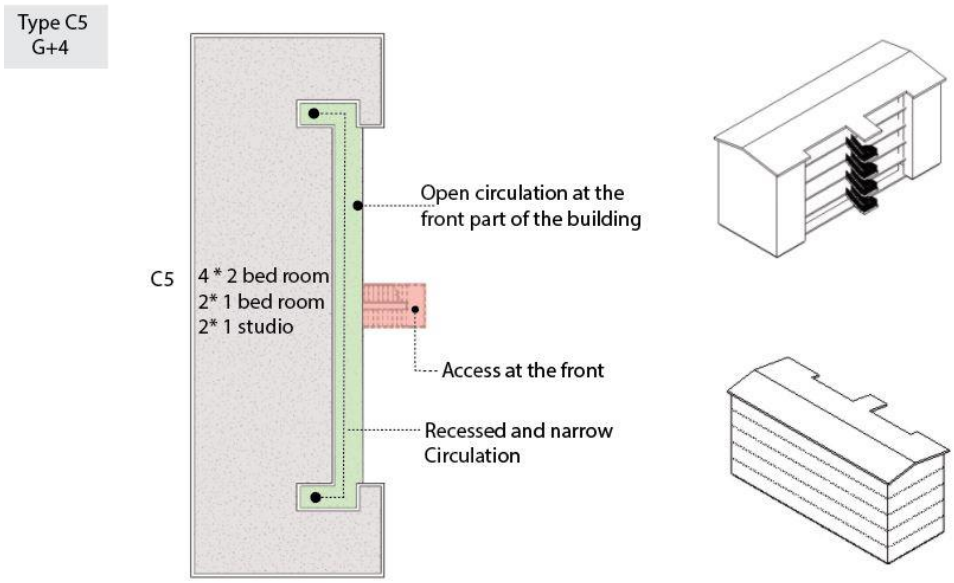

Figure 19:First Generation Type C4 G+5

Source (Author ,2025)

Type C6 G+4 buildings have five 2 bedrooms, one 1 bedroom and one studio. It also have Recessed narrow circulation similar to type C5. The stairs is common for all at the front of the building.

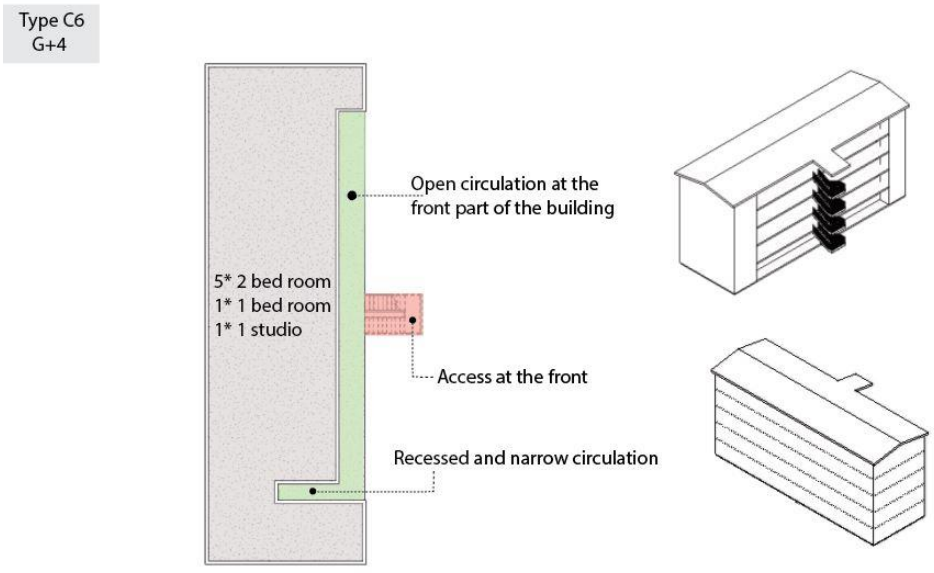

Figure 20: First Generation Type C6 G+4

Source (Author ,2025)

Type D :- single block type like type c and and contain only one sub type. Type D G+2 building is one block with two 2 bedrooms and two 1 bedrooms. There are balcony's for two households. Stairs and open circulation is at the front of the building.

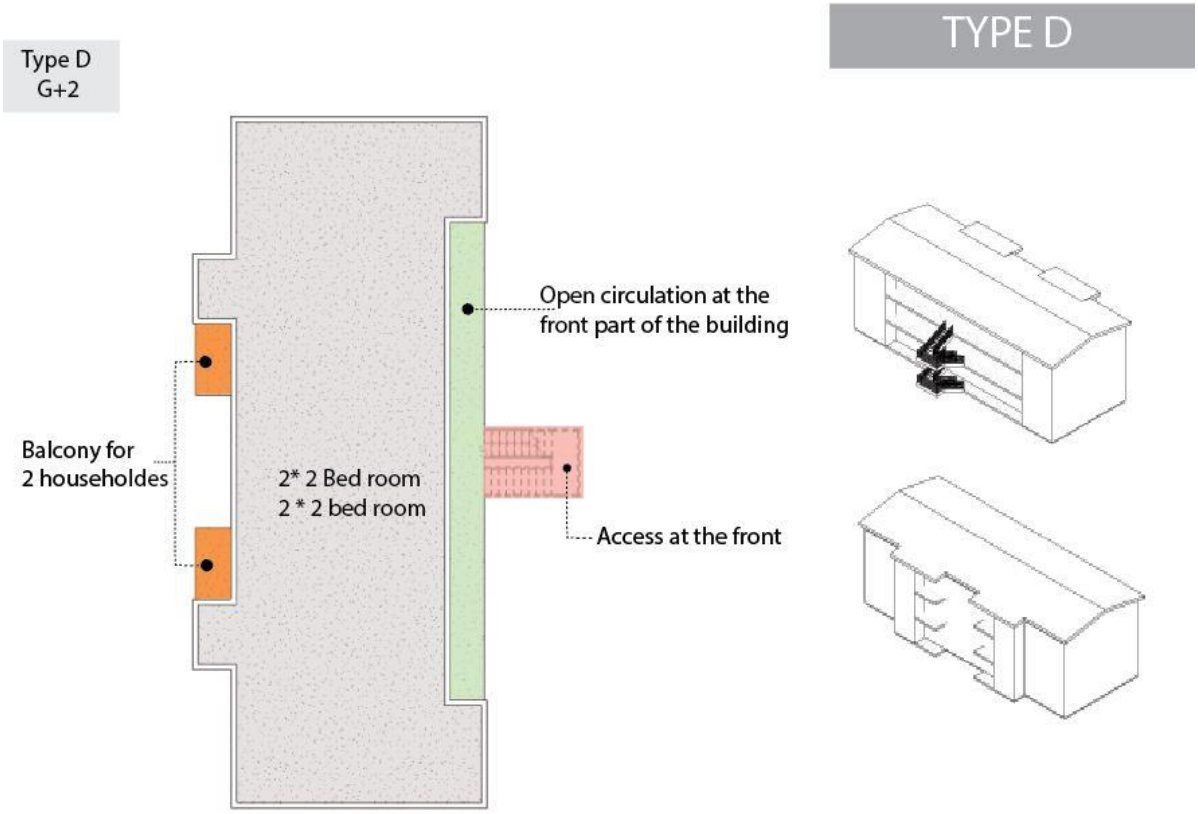

Figure 21: First Generation Type D G+2

Source (Author ,2025)

All the above types in generation one contain common vertical circulation at the front part of the building unites and in all types the stair(vertical circulation) is constructed by steal and it has separated foundation system from the main building. Because of its specific design there is a gap between the razer and trade and for the trade part concrete is poured on to the flat steel plate which is welded in cubic form. The whole structure is bolted on to the buildings structural system (beam) for further support. But in the remaining generation one types the vertical circulation(stair) constructed by concreate as part of the main building system.

Type T4 G+4 :- is one block building with no balcony. This type have two 2 bedrooms and three 1 bedrooms. Both the circulation and the access at the front

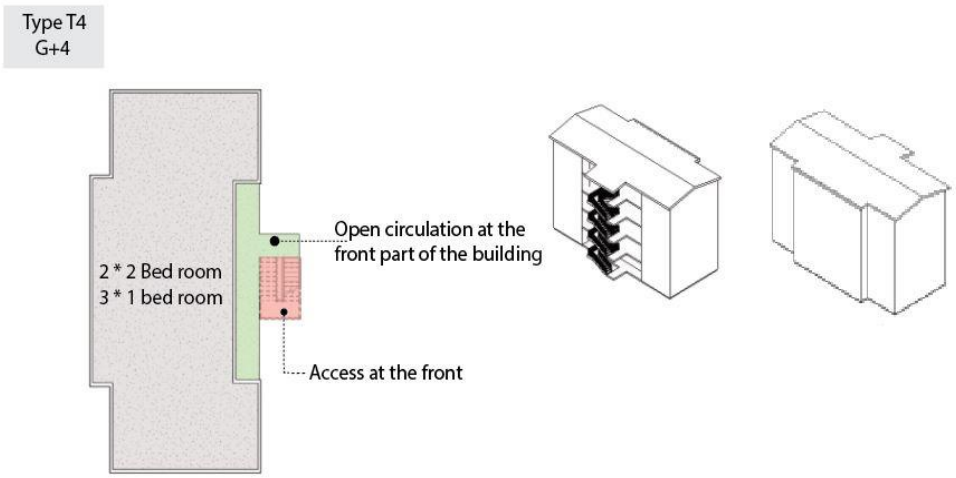

Figure 22: First Generation Type T G+4

Source (Author ,2025)

Type T16 G+2,G+3,G+4 :- building have one block with two 2 bedrooms,two 1 bedrooms and four studios. Only one balcony is for two households. this type recessed and narrow circulation Additional to open circulation at the front of the building.

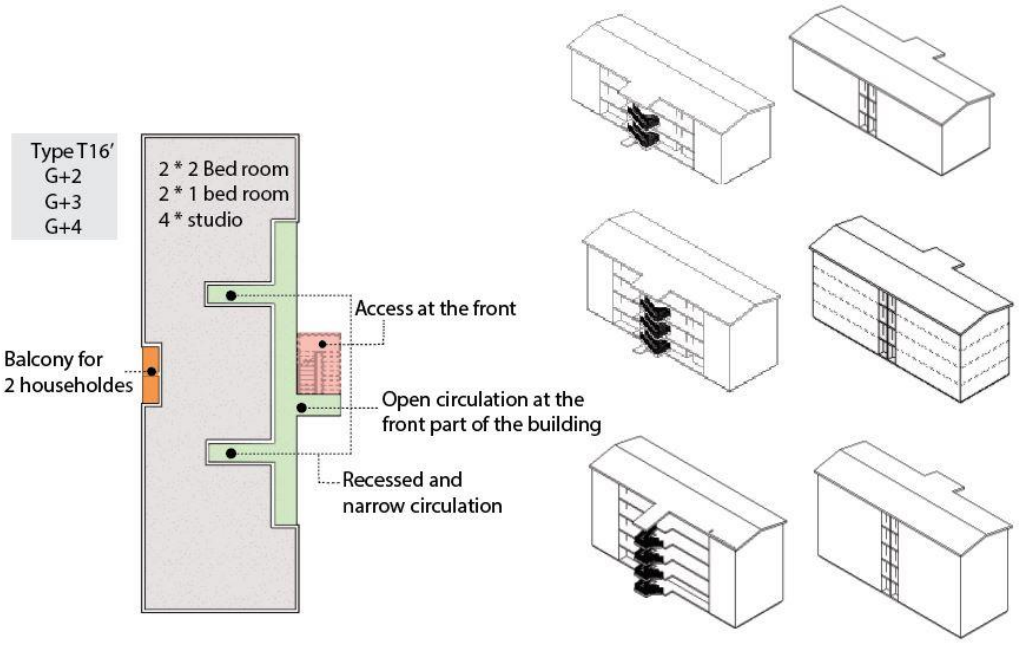

Figure 23: First Generation Type T16' G+2,G+3, G+4

Source (Author ,2025)

Type T16 G+4 :- buildings have two 3 bedrooms, two 1 bedrooms and two studios. Also have six studios for shop purposes. This type doesn't have balcony open circulation and stairs is accessible for all at the front of the building.

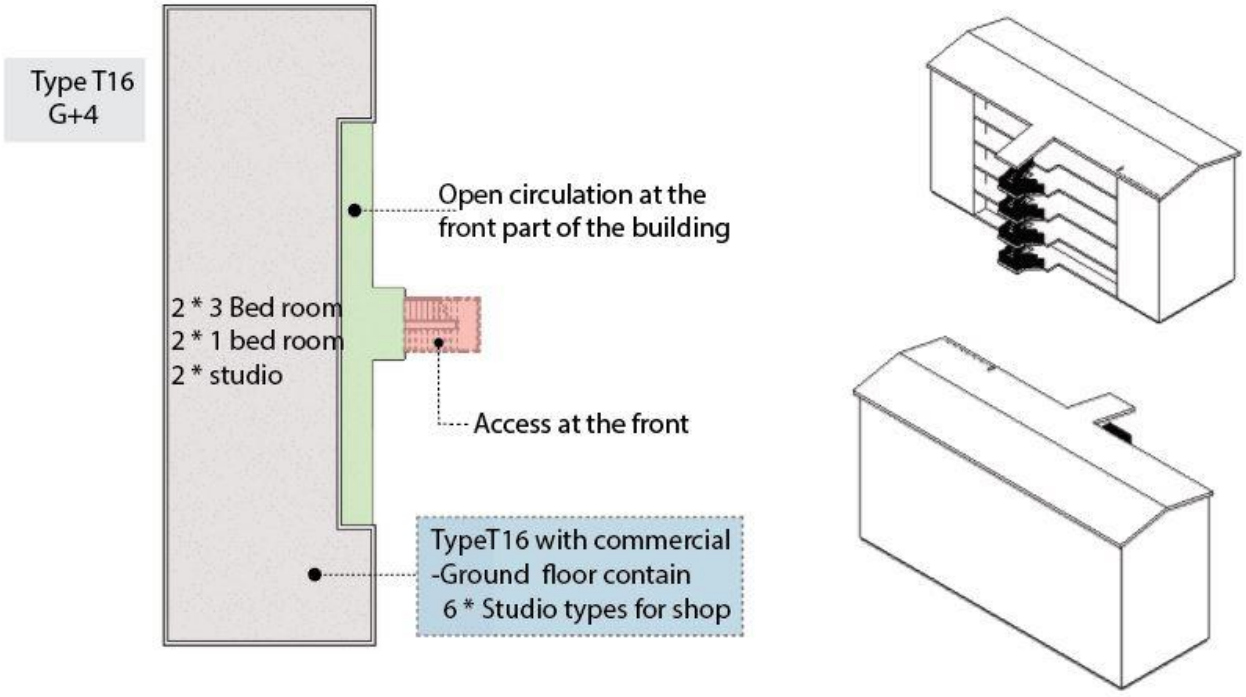

Figure 24: First Generation Type T16 G+4

Source (Author ,2025)

Type T18 G+2,G+3,G+4 :- buildings have two 2 bedrooms and four 1 bedrooms. Four households have their own balcony. Open circulation and stairs is common for the houses at the front of the building.

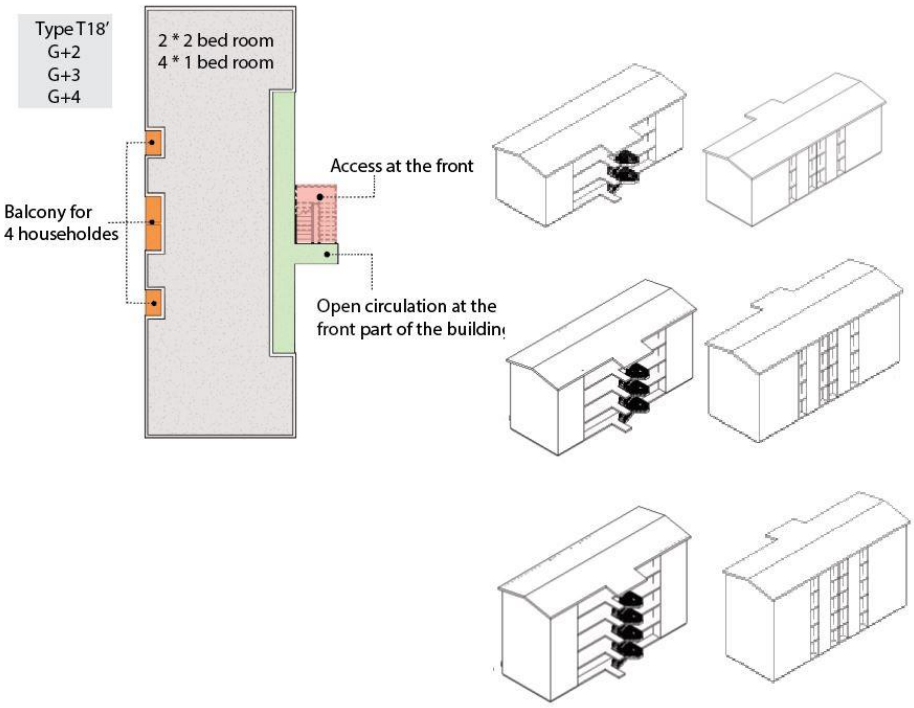

Figure 25: First Generation Type T18 G+2, G+3, G+4

Source (Author ,2025)

Type 18 G+4 :- The building is one block with two 2 bedrooms and four 1 bedrooms. Semi-closed circulation and stairs is accessible for the houses. The commercial ground contains six studios.

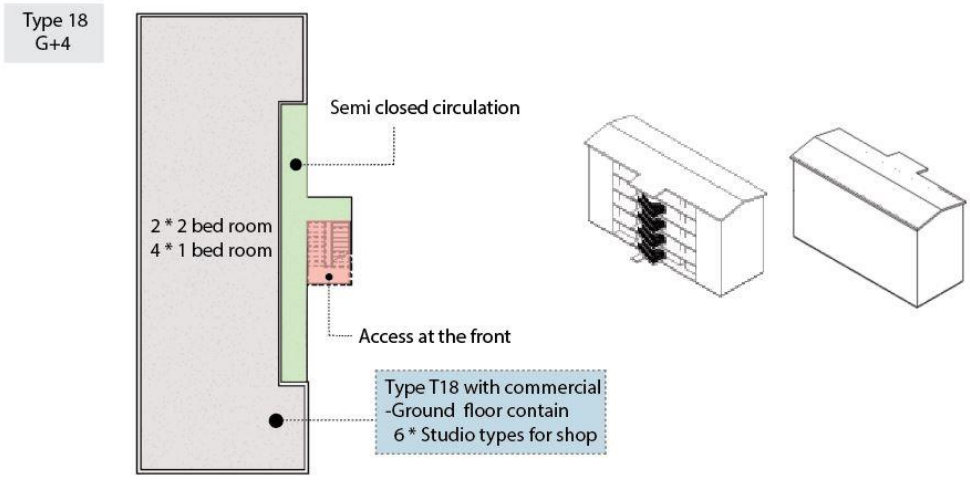

Figure 26: First Generation Type T18 G+4

Source (Author ,2025)

UM G+4 :- this type is different front the other it contains 3 building blocks and their combination form u shaped arrangement and common stairs for all. It also contains a semi closed courtyard common in the middle of all blocks. It have Recessed and narrow circulation Additional to open circulation.

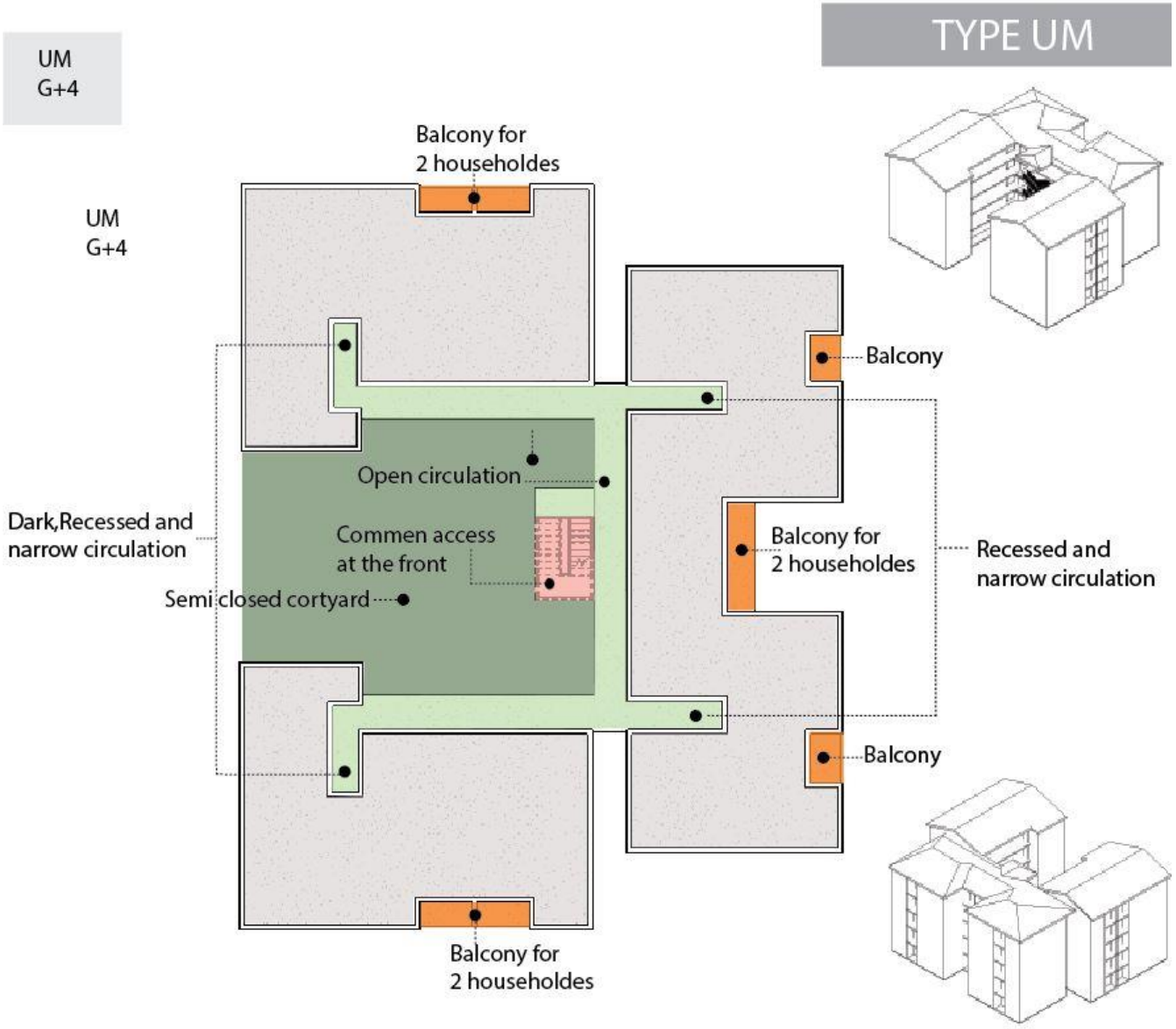

Figure 27: First Generation Type UM G+4

Source (Author ,2025)

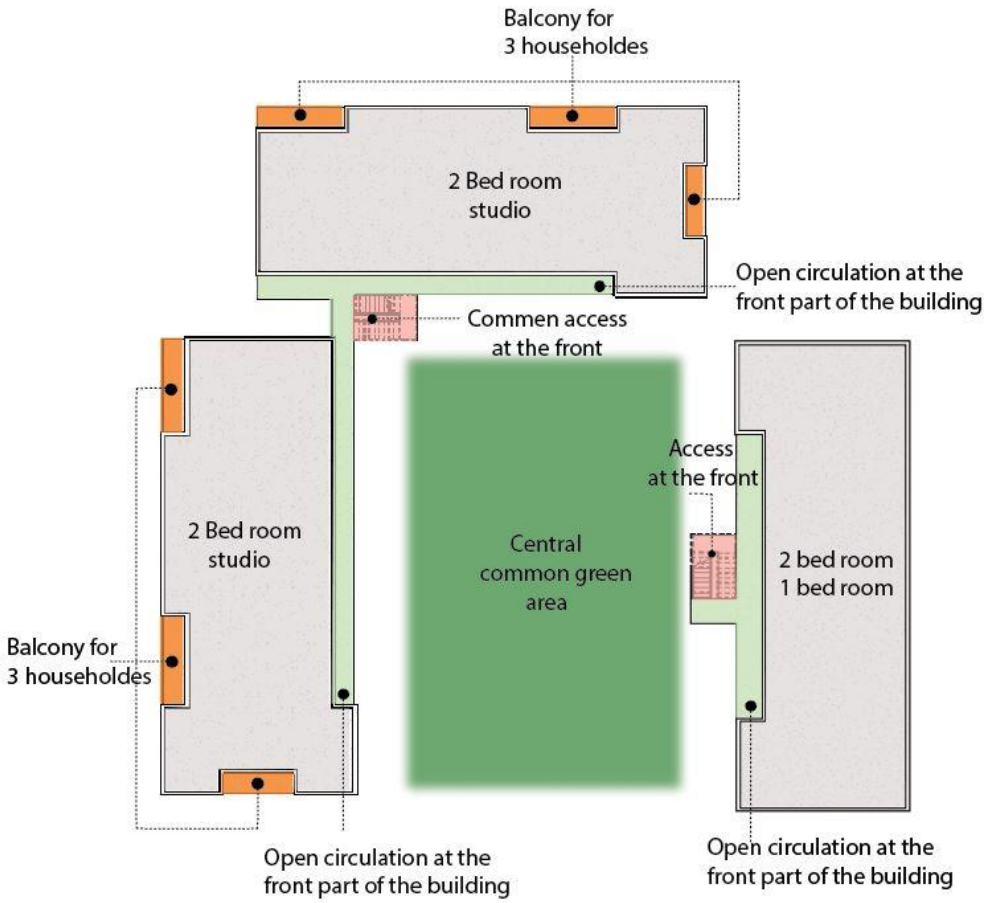

Figure 28: Building Block Arrangement for First Generation

Source (Author ,2025)

In first generation types its open design nature makes it easier to design common green areas in the center of 2 or more building blocks. The central green area protected by those 2 or more blocks and any suspicious activities were supervised by all the dwellers located in the surrounding blocks. Since it is visible from the corridors of the surrounding block it creates better social interaction and improves quality of life.

4.1.3. Second Generation Condominiums: Site Assessment

The second-generation condominiums are found in five strategically located subcities of Kolfe Keranio, Nefas Silk Lafto, Yeka, Bole, and Akaki Kaliti. These take up a vast 11,811,835 square meters space, and include a total of 4,782 buildings, and therefore this generation is the largest in terms of size. The discovery of the assessment highlighted the wide spatial extent and the substantial investment in the residential infrastructure of different zones of the city. 534 community facilities were incorporated, and it reflects a keen commitment to encouraging interaction between communities and the quality of city life. Places like Jemo and Hana Mariam are unique in size and accessibility, and places like Bole Bulbula focus on accessibility and integration into transport corridors.

4.1.4. Second Generation Typology: Communal and Circular Space Assessment

The outcome of the assessment was that shared and circular spaces in second-generation condominium compounds varied in their design, ranging from well-designed accessible spaces to irregular or fragmented shapes. This variation had a significant effect on the quality of interaction among residents, space utilization, and general functionality of the shared spaces across different locations.

Type T3 G+4: A 5-story building comprising a ground floor plus four upper floors (G+4). Unit Distribution per Floor includes Total 4 units per floor such as 2 × 2-bedroom units, 1 × 1-bedroom unit, 1 × studio unit. If we assume it is uniform layout across all floors (5 floors) × 4 units = 20 units (combination of 2-bedroom, 1-bedroom, and studio types).

Open circulation at the front part of the building, likely indicating open corridors or communal spaces for ventilation and accessibility.

This configuration emphasizes efficient space utilization with mixed unit sizes and open-front circulation for enhanced communal interaction and airflow. Commercial unites provides in the ground floor of this design type and nine (9) studio were provide.

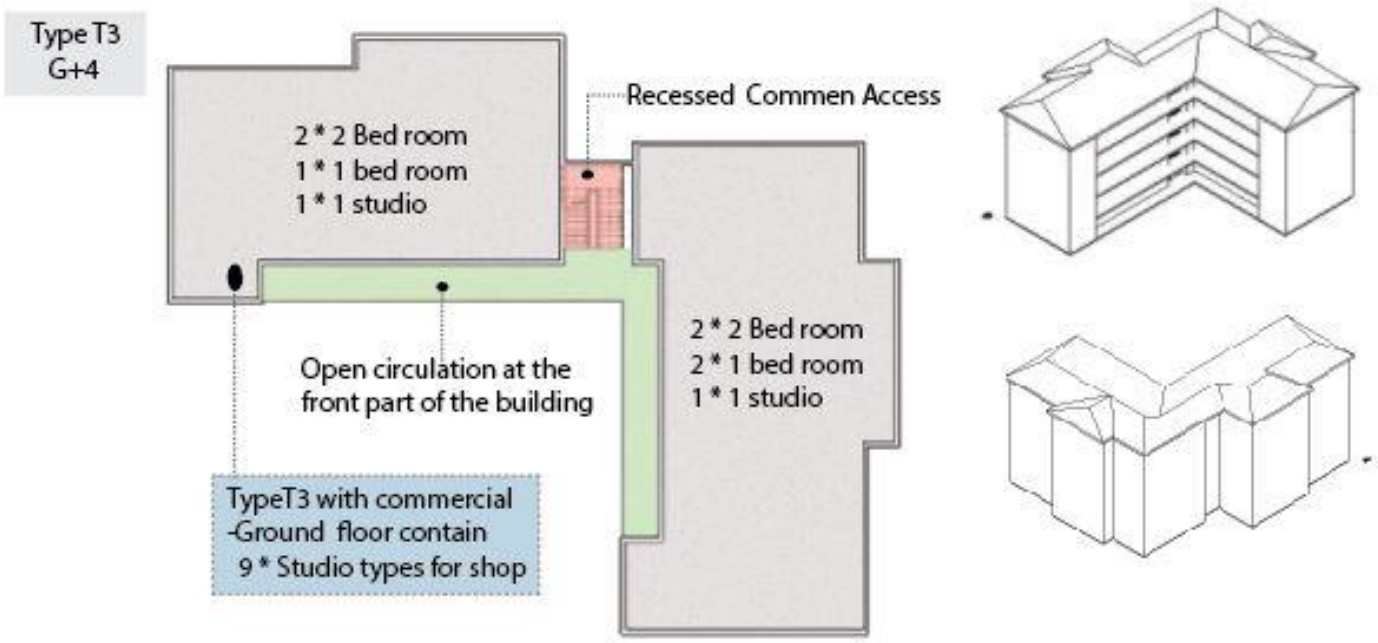

Figure 29: Second Generation Type T3 G+4

Source (Author ,2025)

Type X1 G+4: The design is A 5-story building (Ground floor + 4 upper floors). Unit Distribution per Floor contain a Total of variable units per floor including, 2-bedroom units, 1 bedroom and studio. This layout emphasizes flexible living arrangements with a balance of larger family units (2-bedroom) and compact hybrid units (1-bedroom+studio), complemented by functional shared spaces.

Open circulation at the front part of the building (likely open corridors or communal spaces for airflow and accessibility) and Recessed Common Access (shared entryways or pathways set back from the building facade).

The next two images are exemplary images which could be taken as example to show designs in generation one were slightly altered with recessed circulation and converted to generation two typology.

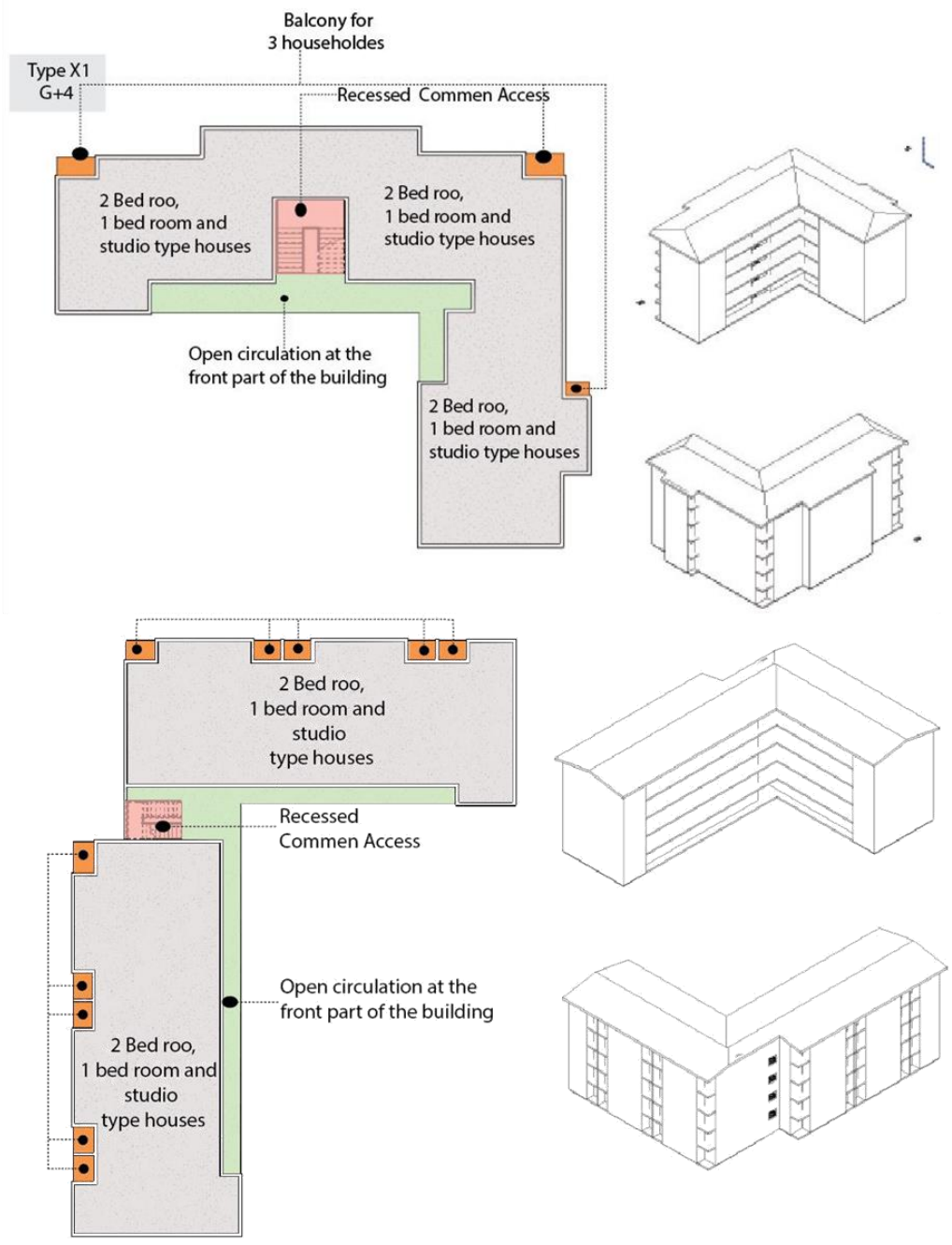

Figure 30: Second Generation Type X1 G+4

Source (Author ,2025)

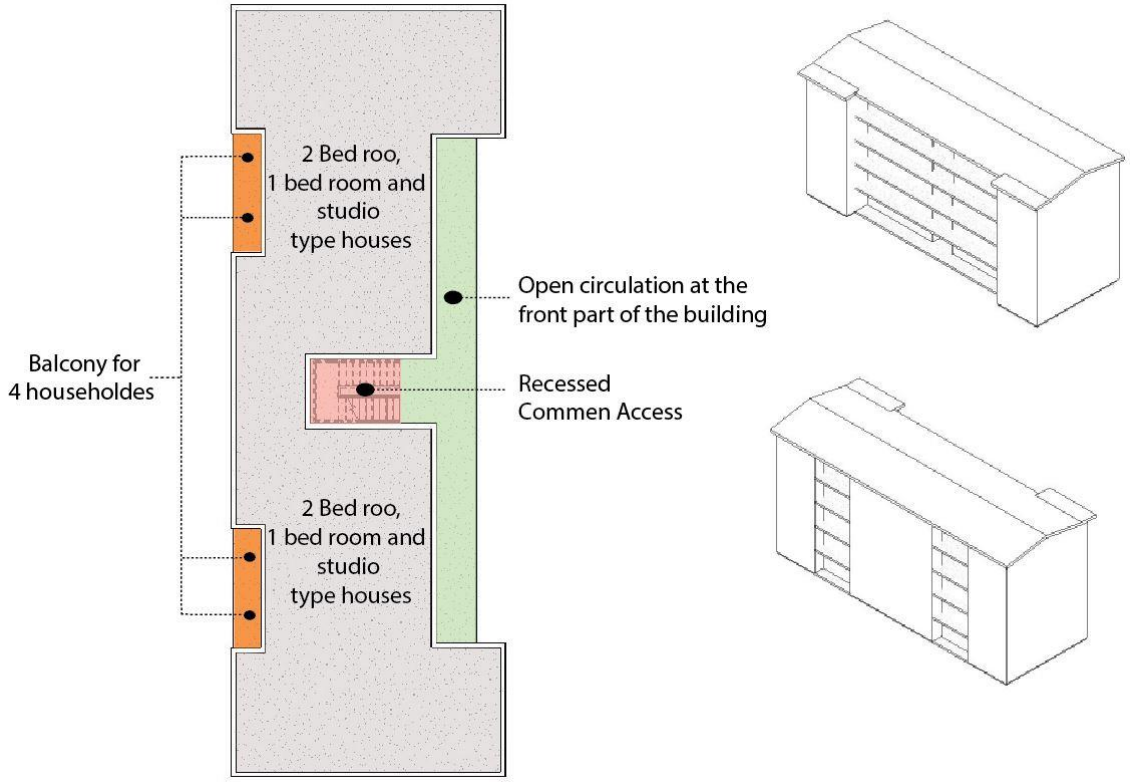

Figure 31: Second Generation Type I1 G+4

Source (Author ,2025)

UK combination of G+3 and G+4: The UK Combination integrates two building heights within a single design. The UK Combination of G+3 and G+4 is a flexible, mixed-height residential design that balances density with livability. By integrating varied unit sizes, shared amenities, and adaptable circulation, it caters to diverse urban needs while maintaining architectural coherence.

This hybrid design creates a staggered or terraced appearance, likely to adapt to site constraints or urban zoning requirements while maximizing housing density. Modular layouts with repeated 3-bed and 2-bed units suggest cost-efficient, standardized construction. Accommodates varying household sizes (families, couples, and singles) through diverse unit types.

Communal pathways or corridors designed for airflow and accessibility, particularly at the front of the building. A shared outdoor space partially enclosed by the building, fostering community interaction while maintaining privacy. Entryways or staircases set back from the building faced to streamline the exterior design and provide sheltered access.

Community Spaces, balconies and a semi-closed courtyard encourage social interaction. Urban Efficiency Combines vertical density with functional design to optimize land use in constrained urban environments.

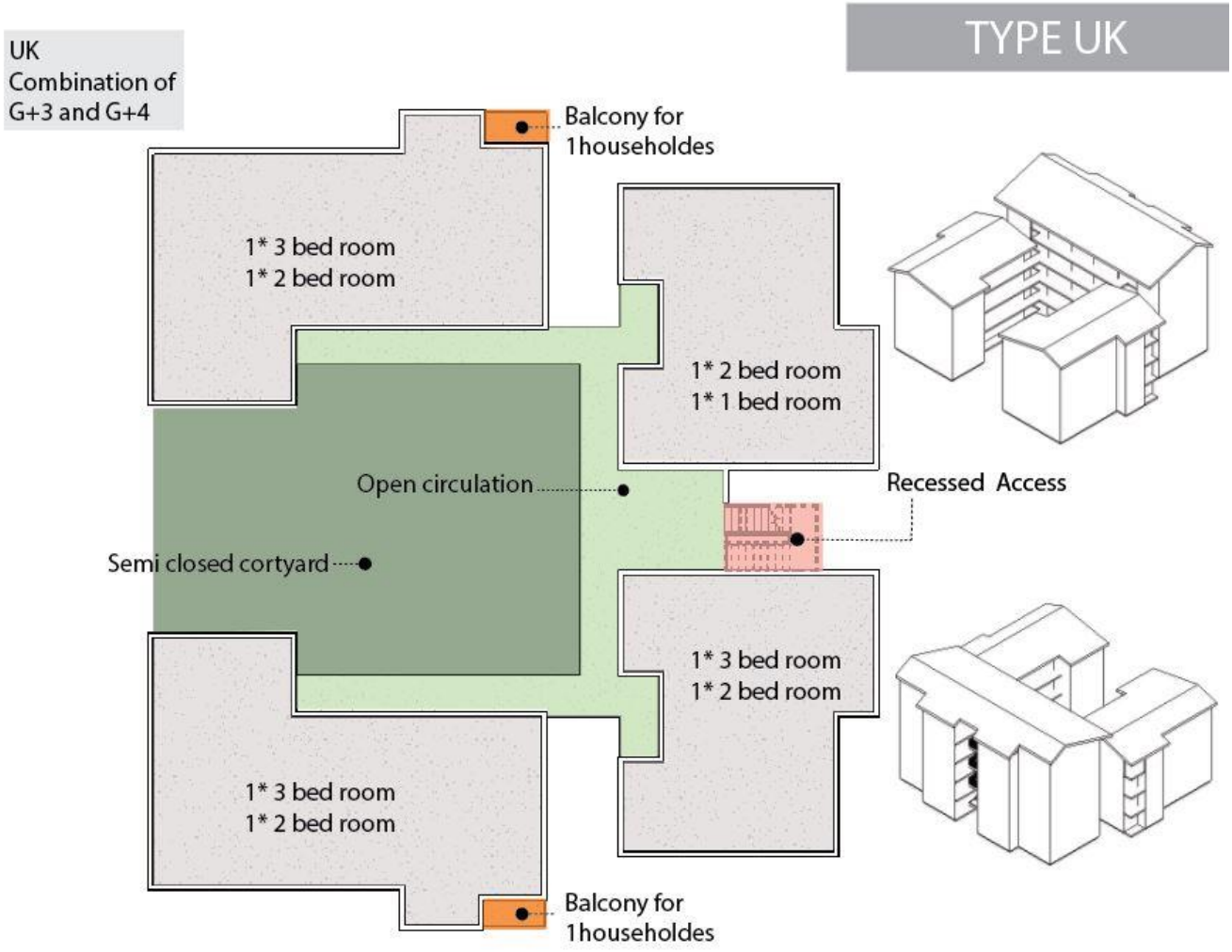

Figure 32: Second Generation Type UK G+3, G+4

Source (Author ,2025)

Type D2 G+2: This specific project is designed for 10/90 program and contain only studio type typologies for low income dwellers.

Even though this design creates segregation within the community. After the construction of this site specifically in “Koye Feche” project site all registered individuals within 10/90 program receive there studio house without lottery. In addition to studio typology houses were canceled or replaced by other typologies.

Open circulation at the front is Shared corridors or communal spaces for accessibility. Front-facing communal spaces or corridors for natural light and ventilation. Recessed Common Access and Shared Entryways or staircases set back from the building faced for privacy and weather protection.

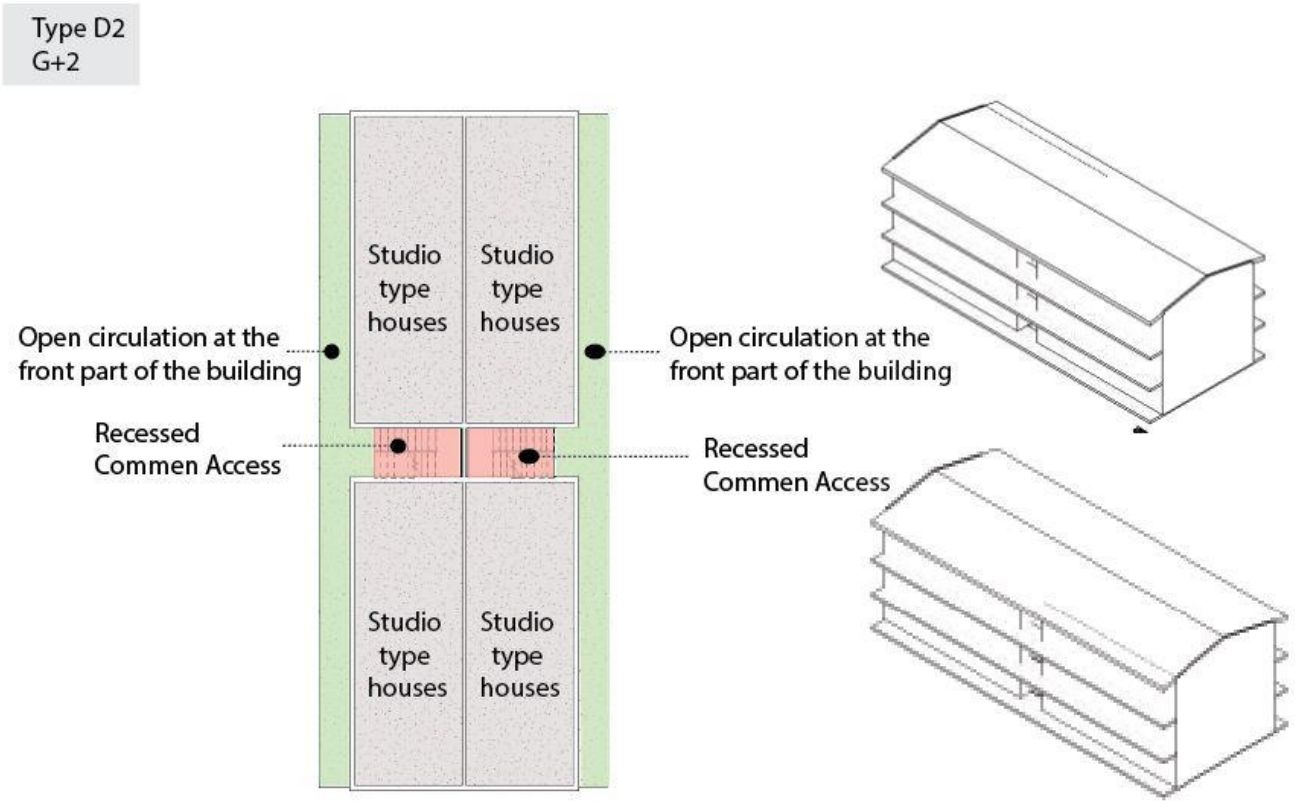

Figure 33: Second Generation Type D2 G+4

Source (Author ,2025)

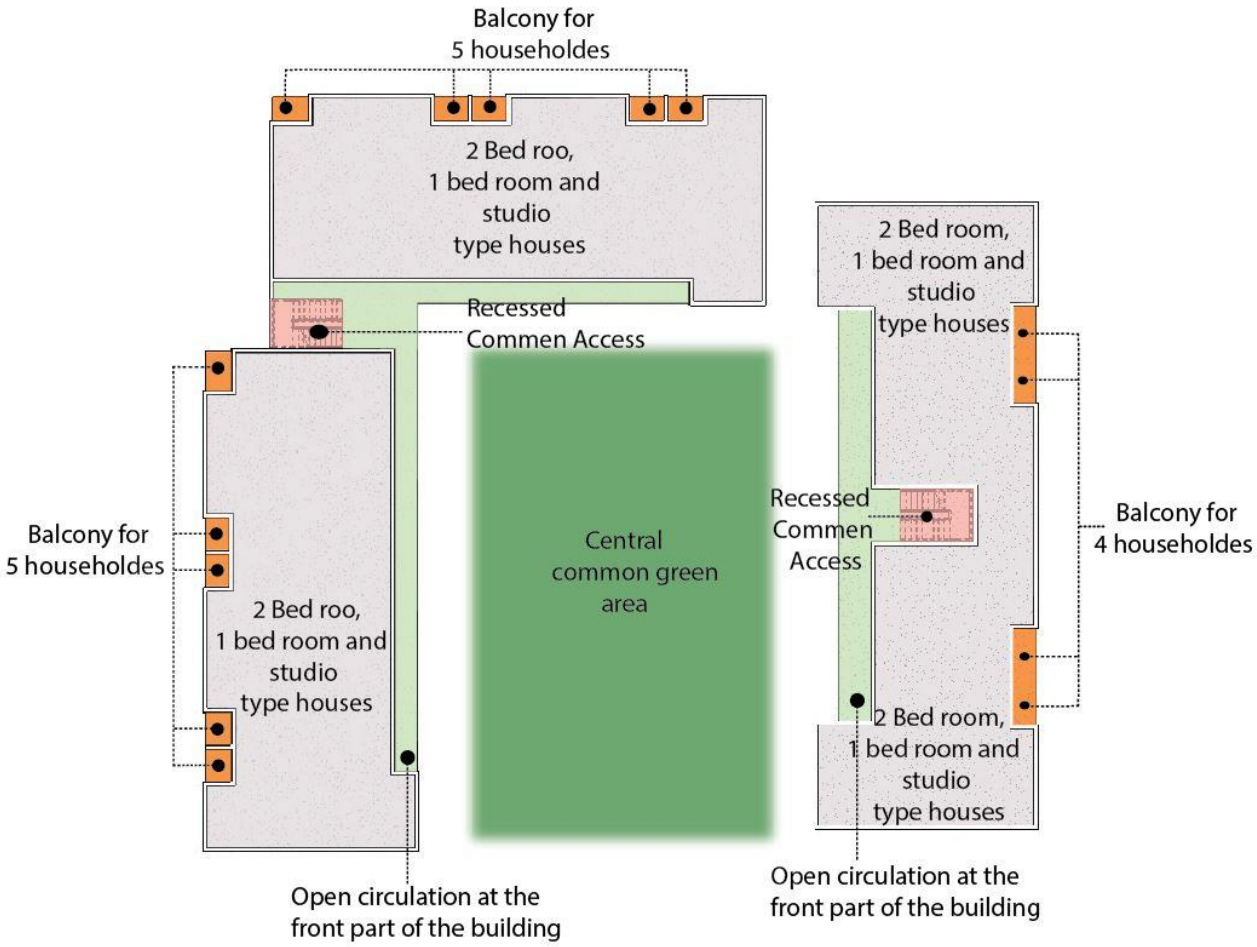

Figure 34: Building Block Arrangement for Second Generation

Source (Author, 2025)

In generation 2, most designs allow to create the central green area but since the position of the stairs is far from the public eye it hard for the dwellers to navigate what is happening in the stairs from the common space and from the adjacent blocks.

4.1.5. Third Generation Condominiums: Site Assessment

More densely and centrally concentrated, third-generation condominiums are found in three subcities, Ledeta, Arada, and Bole. Covering a small 130,139 square meters, this generation consists of 921 buildings. The effects of the assessment were greater emphasis, with growth being focused in infill lots and highly sought-after urban areas. Growth only covered 2 community areas, suggesting a more limited supply for common facilities, possibly due to spatial constraints. The locations, although smaller in number, are well-positioned like Arada and Ledeta utilizing under-developed plots within aging neighborhoods to support increased housing supply where the demand is particularly significant.

4.1.6. Third Generation Typology: Communal and Circular Space Assessment

This assessment analyzes the configuration and accessibility of communal and circular spaces in third-generation condominium buildings, focusing on how the spaces were configured, differences in their configuration, and the roles they are intended to play in daily community life.

Type M1 G+4: A 5-story building comprising a ground floor plus four upper floors (G+4). Unit Distribution per Floor includes Total 4 units per floor such as 2-bedroom units, 1-bedroom unit, and studio unit. Semi Open circulation at the front part of the building, and the two blocks connect together since they connected back-to-back it is difficult to form shared open space. The Commercial unites provides in the ground floor of this design type and Six (6) studio type shops were provide. Compact, urban-friendly design for mixed-use (commercial + residential) Emphasis on shared spaces (recessed access) to optimize density.

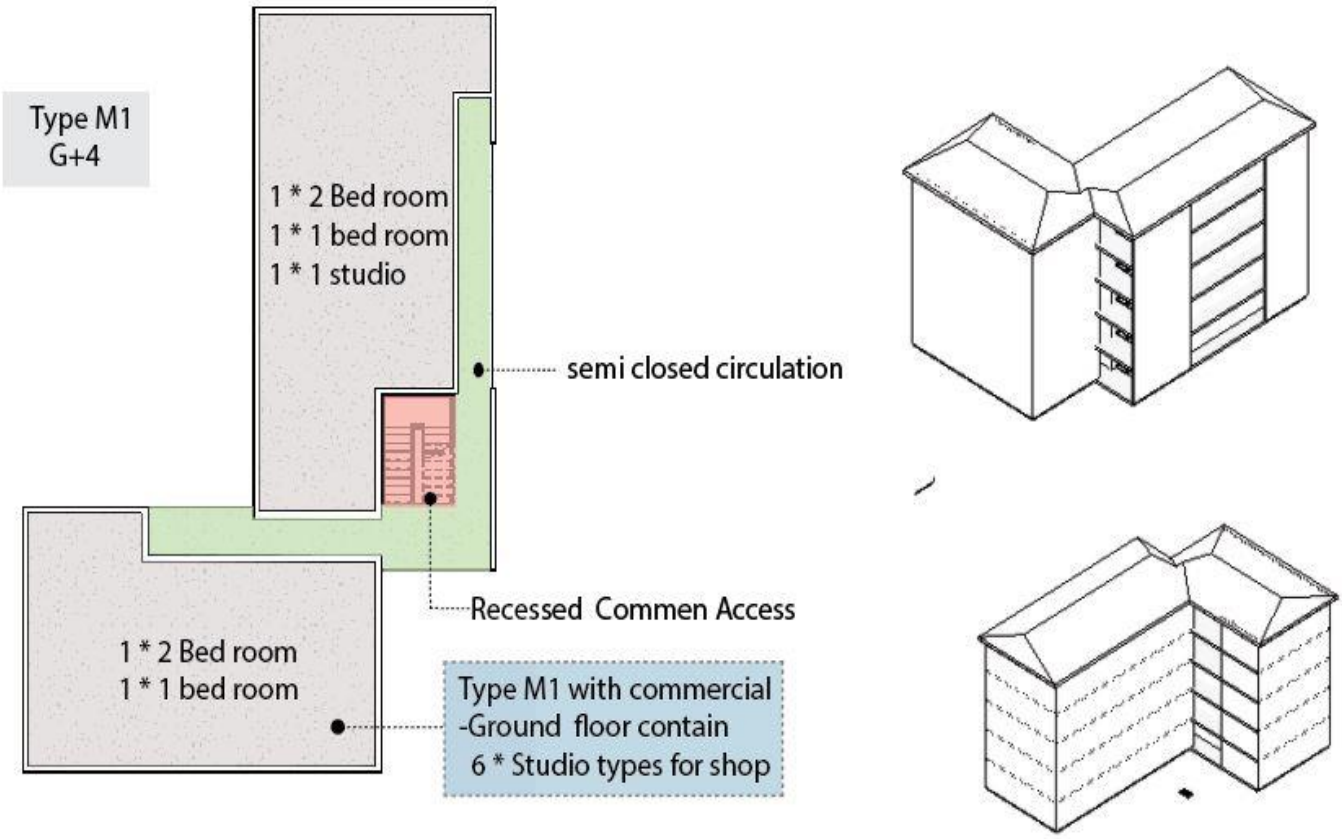

Figure 35: Third Generation Type M1 G+4

Source (Author ,2025)

Type M2 G+4: Residential-only, Semi-Closed Circulation is partially enclosed staircases or corridors with limited openness for ventilation/light. Recessed Common Access is shared entry points set back from the building façade, creating sheltered pathways.

The implementation of double loaded corridor starts on this typology because of this building Units arranged around central or offset staircases to optimize space. Semi-closed corridors/staircases connect units while maintaining airflow. Urban, density-optimized design with vertical stacking. Minimalist facade, possibly with recessed balconies or shared outdoor spaces.

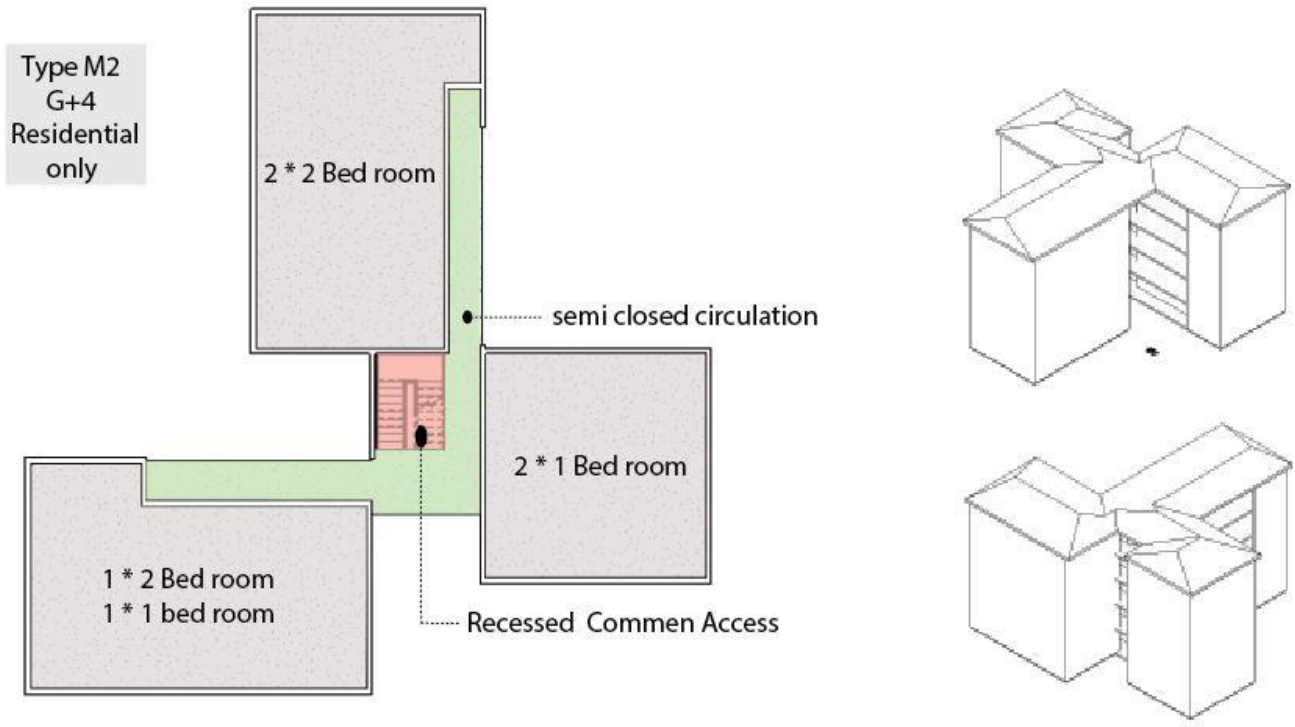

Figure 36: Third Generation Type TypeM2 G+4 Residential only

Source (Author ,2025)

TypeM2 G+4 Commercial & Residential: A 5-story building comprising a ground floor plus four upper floors (G+4). Unit Distribution per Floor includes Total 4 units per floor such as 2-bedroom units, 1-bedroom unit, and a studio unit.

Commercial Ground Floor Contains 5 studio-type shops (3 studios + 2 studios, likely arranged linearly along the street). Units arranged around a central staircase or offset corridor. Semi-Closed Circulation Partially enclosed staircases or corridors (openings for light/ventilation).Recessed Common Access is shared residential entry points recessed from the building's façade. Building Units arranged around a central staircase or offset corridor. Vertical Zoning Clear separation between commercial (ground) and residential (upper floors). Urban Density Design Compact units, shared amenities (e.g., recessed access) to maximize space.

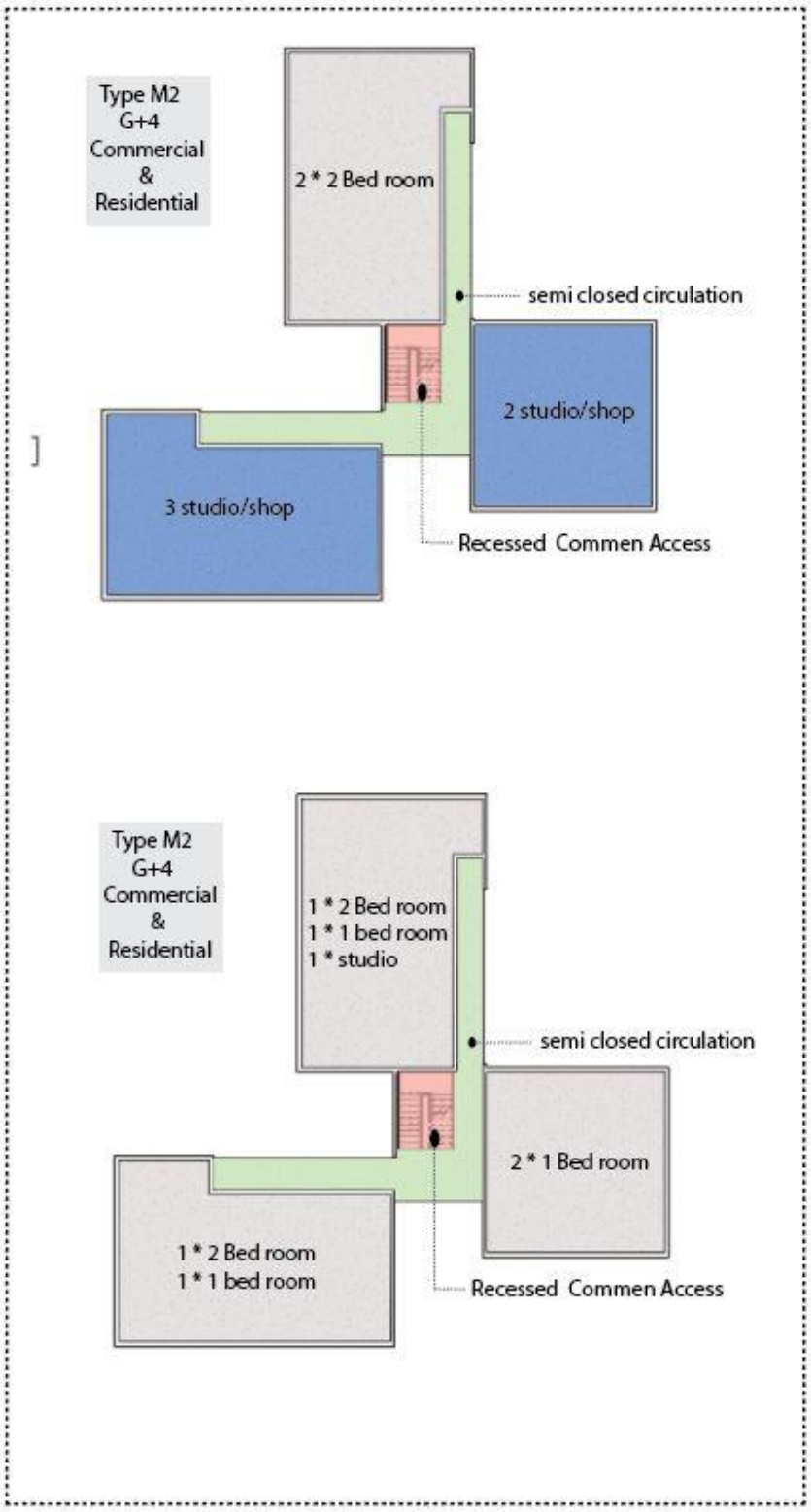

Figure 37: Third Generation Type M2 G+4 Commercial & Residential

Source (Author ,2025)

Type L1: In the ground floor large entry way created in order to give axes for the vertical circulation. Recessed Common Access is Similar to Types M1/M2, entryways are set back from the building facade, possibly to enhance privacy or streamline circulation Enclosed or relatively darker pathways for movement within the building, differing from "semi-closed" systems in other types.4 balconies provided for 4 households.

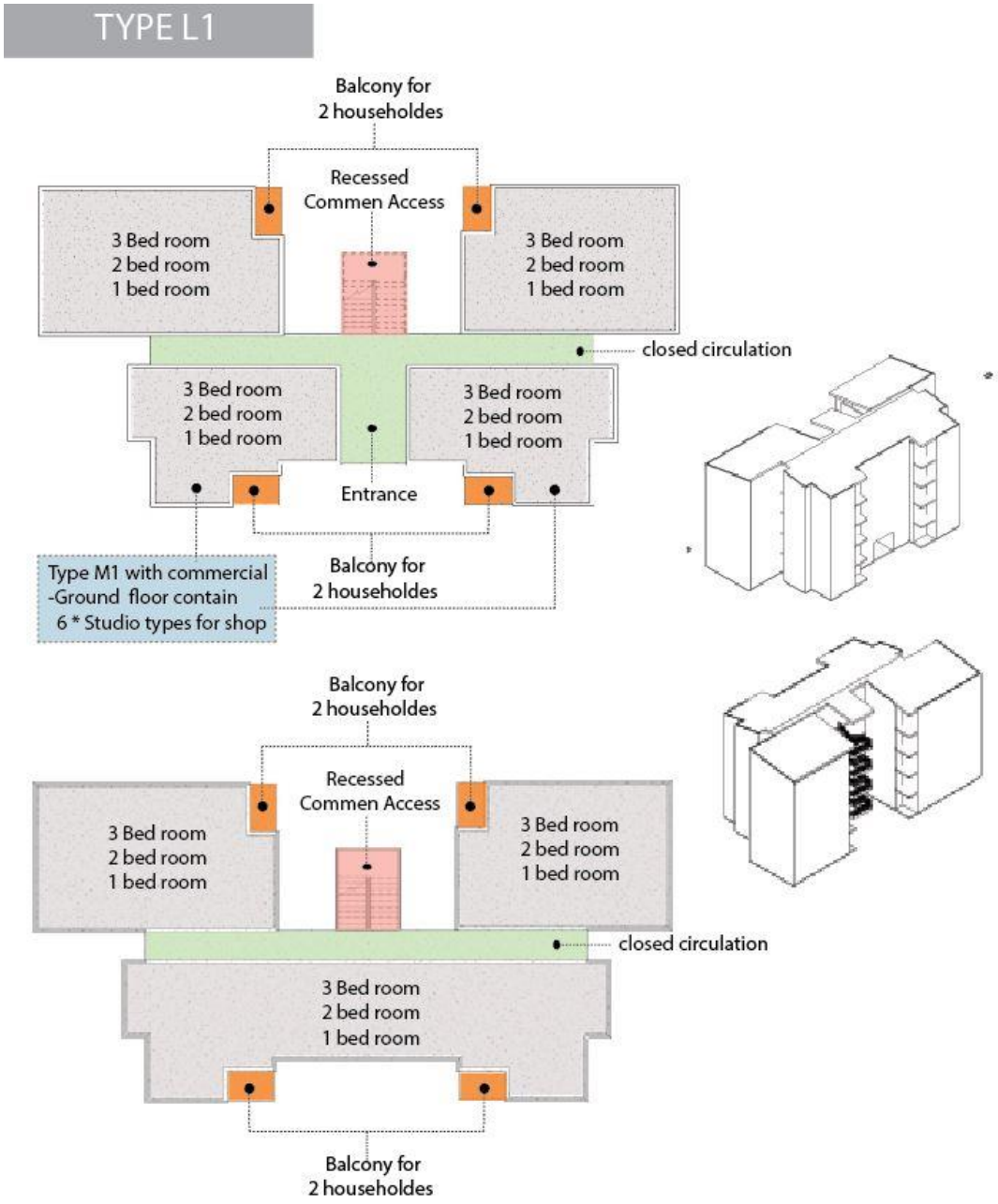

Figure 38: Third Generation Type L1 G+4

Source (Author ,2025)

The corridors found in the middle of the housing unites because of these are darker and no or minimum contact to the surrounding environment or with the other building block. Dwellers in this typology's completely separated from their surroundings. The form and the arrangement of the housing units in the generation three didn't allow the housing block to interact with its surroundings. In summary, Type L1 appears tailored for residential use with shared balconies and recessed access

Type L2: The entrance or primary access points are positioned at the front of the building, emphasizing a centralized or traditional entry system. This contrasts with "Recessed Common Access" in Types M1/M2.

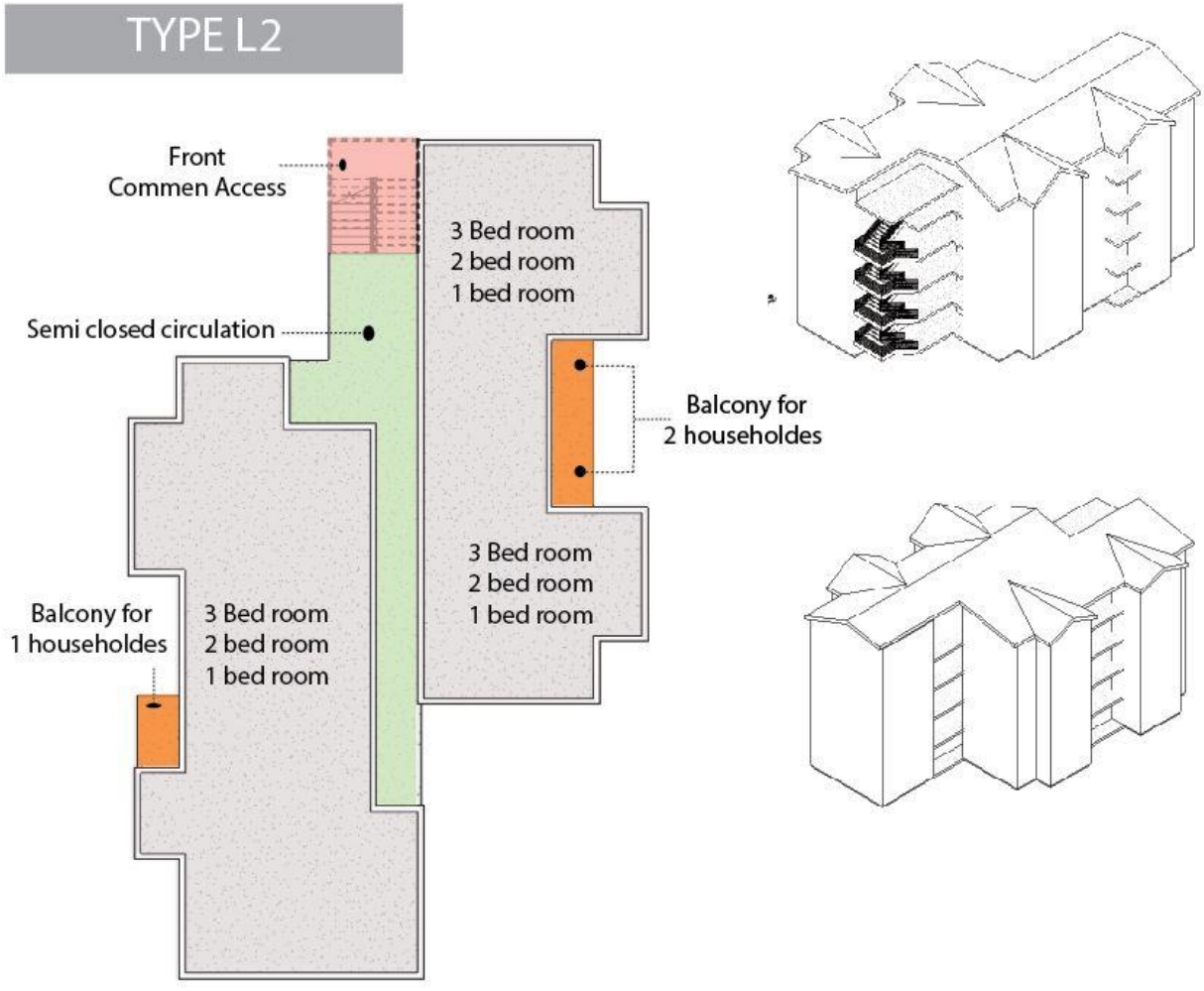

Figure 39: Third Generation Type L2 G+4

Source (Author ,2025)

Semi-Closed Circulation refers to partially enclosed pathways (e.g., corridors, staircases) that blend open and enclosed spaces, similar to other types like M1/M2. 4 balconies provided for 4 households.

The corridors found in the middle of the housing units and because of these there are relatively dark and minimum contact to the surrounding environment or with the other building block. Dwellers in this typology's completely separated from their surroundings.

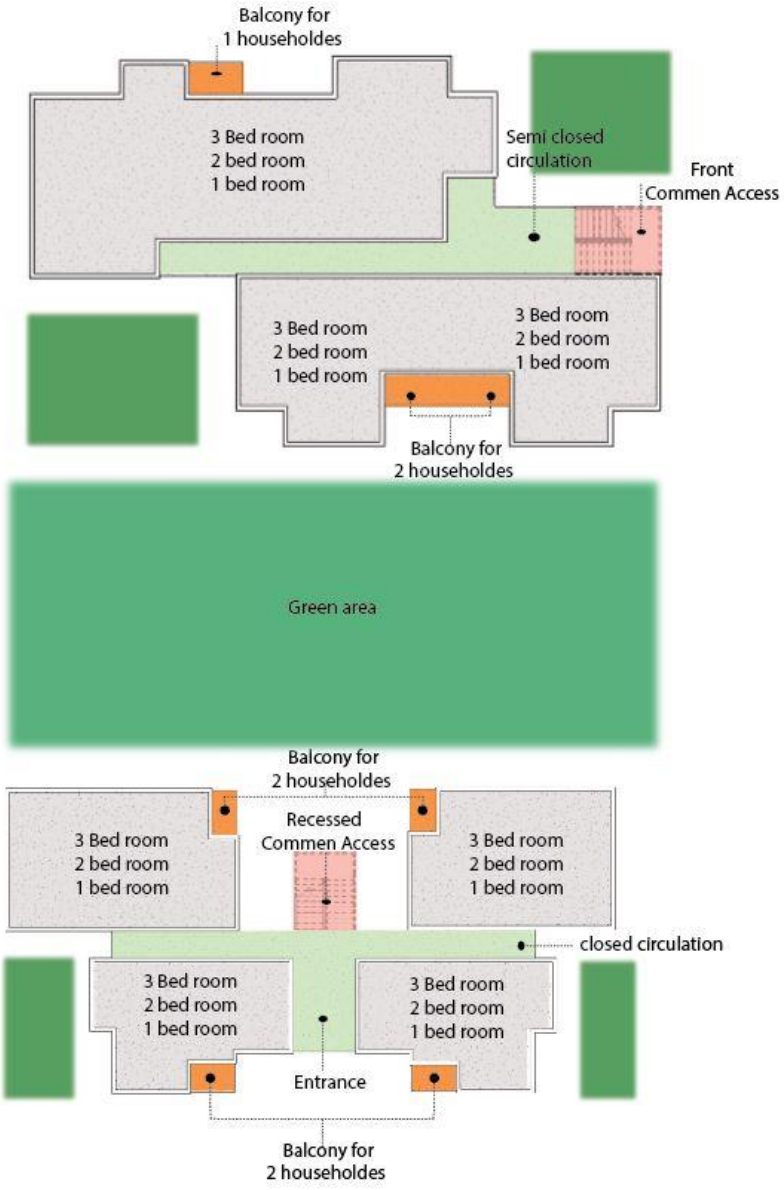

Figure 40: Building Block Arrangement for Third Generation

Source (Author, 2025)

The form and the arrangement of the housing units in generation three didn't allow the housing block to interact with its surroundings. Dwellers in this typology's completely separated from their surroundings. Green area were provided in between blocks but since the residents can't supervise any activates in the green area it is difficult to create a sense of belongings.

4.1.7. Fourth Generation Condominiums: Site Assessment

The fourth-generation development is dispersed over five sub cities: Kolfe Keranio (K.K), Nefas Silk Lafto (N.L), Yeka, Bole, and Akaki Kaliti. Developed over a total of 6,092,677 square meters with 1,817 buildings, this phase is a continuation of high-density, large-scale development. Spatial efficiency and communal support infrastructure were identified as the prime focus, and a total of 462 communal spaces were built to accommodate social and recreational uses. The developments include key sites such as Jemo Gara and parts of Bole Arabsa, which were defined by possessing a well-designed pattern and proximity to public amenities. This generation demonstrates a developing urban design approach with integration of housing within communal as well as infrastructural planning.

4.1.8. Fourth Generation Typology: Communal and Circular Space Assessment

This assessment looks at how well the communal and circular areas in fourth-generation condominium buildings are laid out and how easy they are to get to. The main point of this study is to look at how the spaces were set up, how they were set up differently, and what they are meant to do in the daily lives of the people that live there.

Type BL G+2, G+3, G+4 building is two blocks with vertical circulation, stair access and closed courtyard in common. Each block has balcony for two households. Also, both blocks have open circulation.

Type T9 (G+4) : Building contains five Floors which is Ground + 4 floors. The ground floor have 4 studio units for commercial shops. The Two blocks contain different combination of 1-bedroom, 2-bedroom, and 3-bedroom housing units.

Semi-closed circulation (partially enclosed common pathways), Recessed common access points, Balconies shared by 2 households and Closed courtyard design are Features of this type.

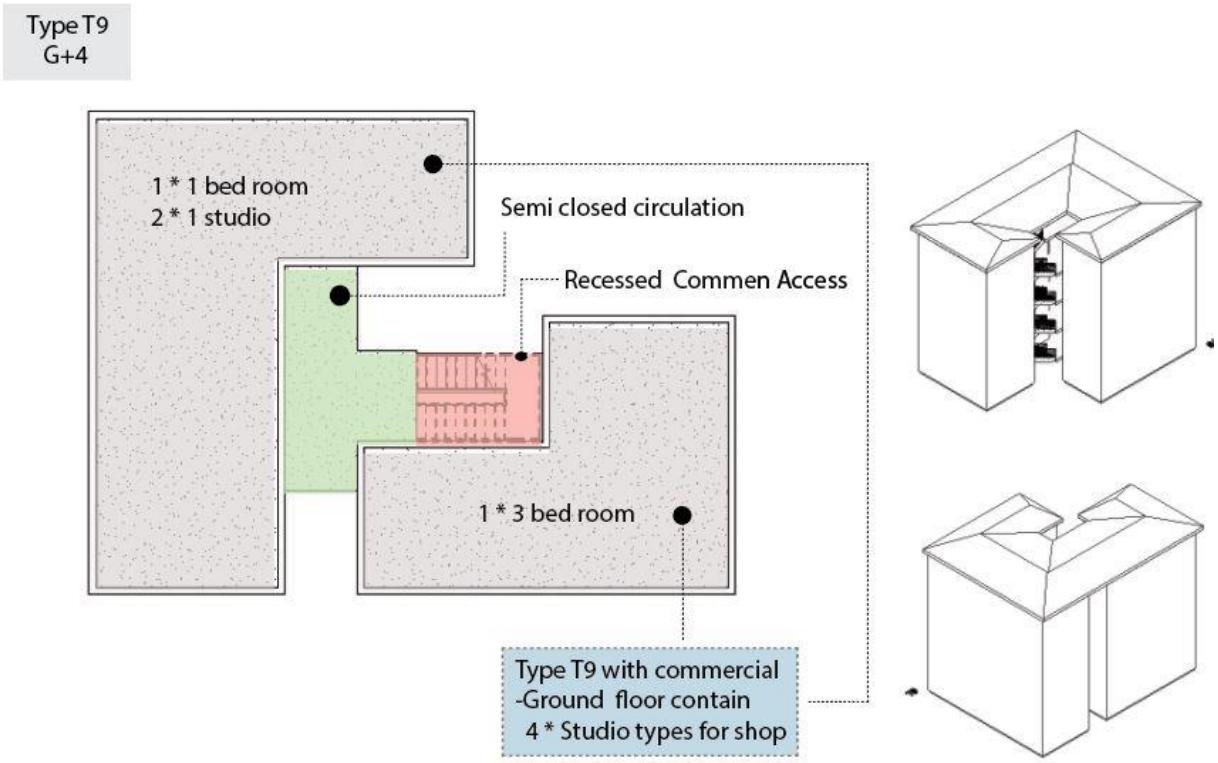

Figure 41: Fourth Generation Type T9 G+4

Source (Author ,2025)

Type L: is a building that have four blocks with shared open Circulation and main stair access at the middle. Balconies are shared by 3 households. Repeated sequence of 3-bed, 2-bed, and 1-bed units across floors.

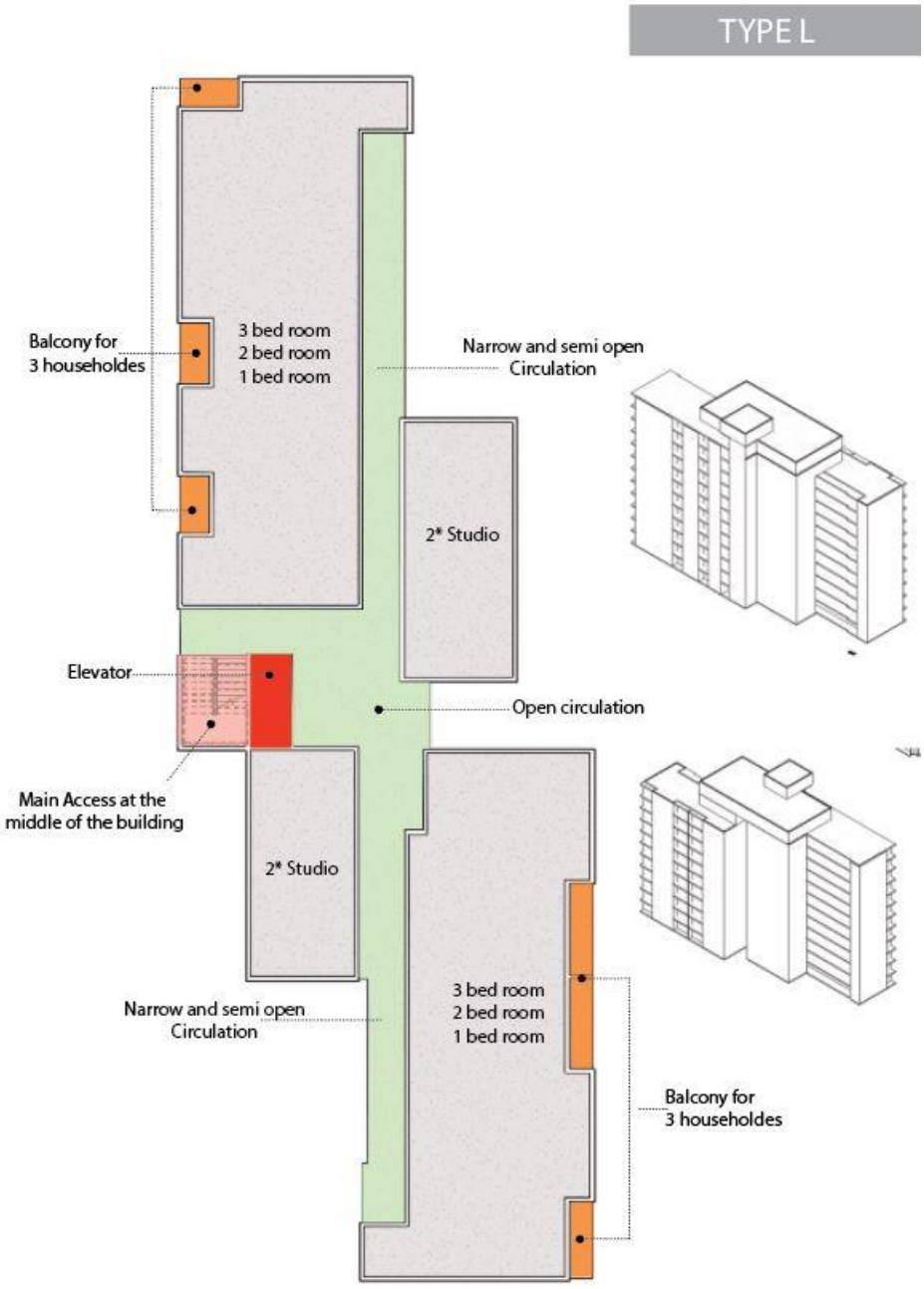

Figure 42: Fourth Generation Type L G+4

Source (Author ,2025)

EDGE L: The building features a repetitive vertical arrangement of apartments, with floors containing 3-bedroom, 2-bedroom, and 1-bedroom units stacked in sequence. Circulation spaces are split between open corridors and narrow, or dark corridors. Balconies are allocated unevenly: one large balcony serves 4 households, while smaller balconies cater

to 1 household each, indicating varied apartment sizes or shared amenities. The main access is centrally located in the middle of the building, streamlining entry and exit for residents. Two emergency exits are positioned at opposite ends of the structure for safety compliance. The design emphasizes density, with repetitive floor plans and minimalistic circulation systems. This layout likely prioritizes urban efficiency, balancing private living spaces with communal infrastructure like shared balconies and centralized access points.

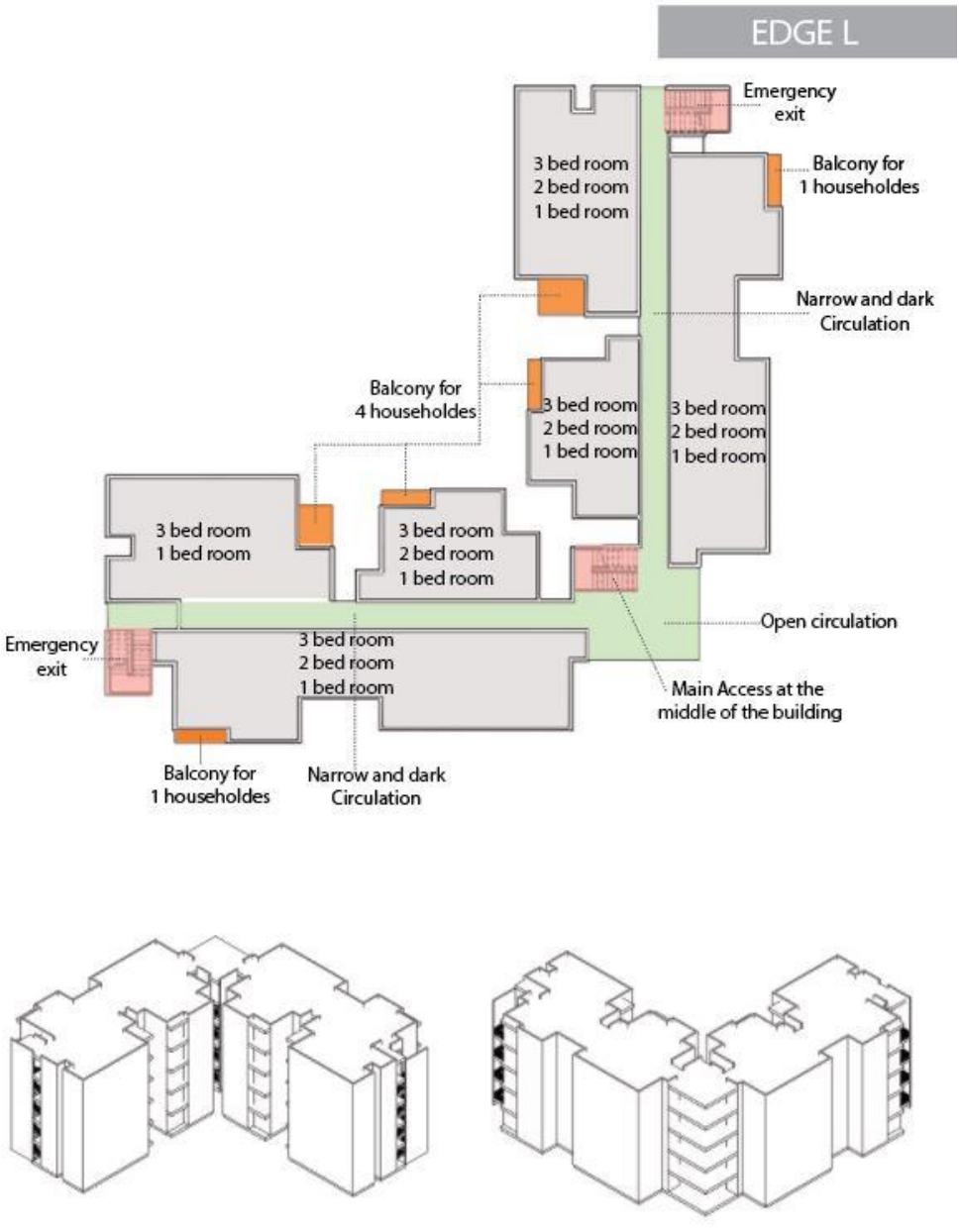

Figure 43: Fourth Generation Type EDGE L G+4

Source (Author ,2025)

EDGE St: The building repeats a vertical pattern of 3-bedroom, 2-bedroom, and 1-bedroom units across multiple floors, emphasizing standardized living spaces. Circulation is dominated by narrow, dark corridors, creating constrained pathways that prioritize space efficiency over natural light. A central main access point at the middle of the building provides entry, flanked by two emergency exits for safety compliance.

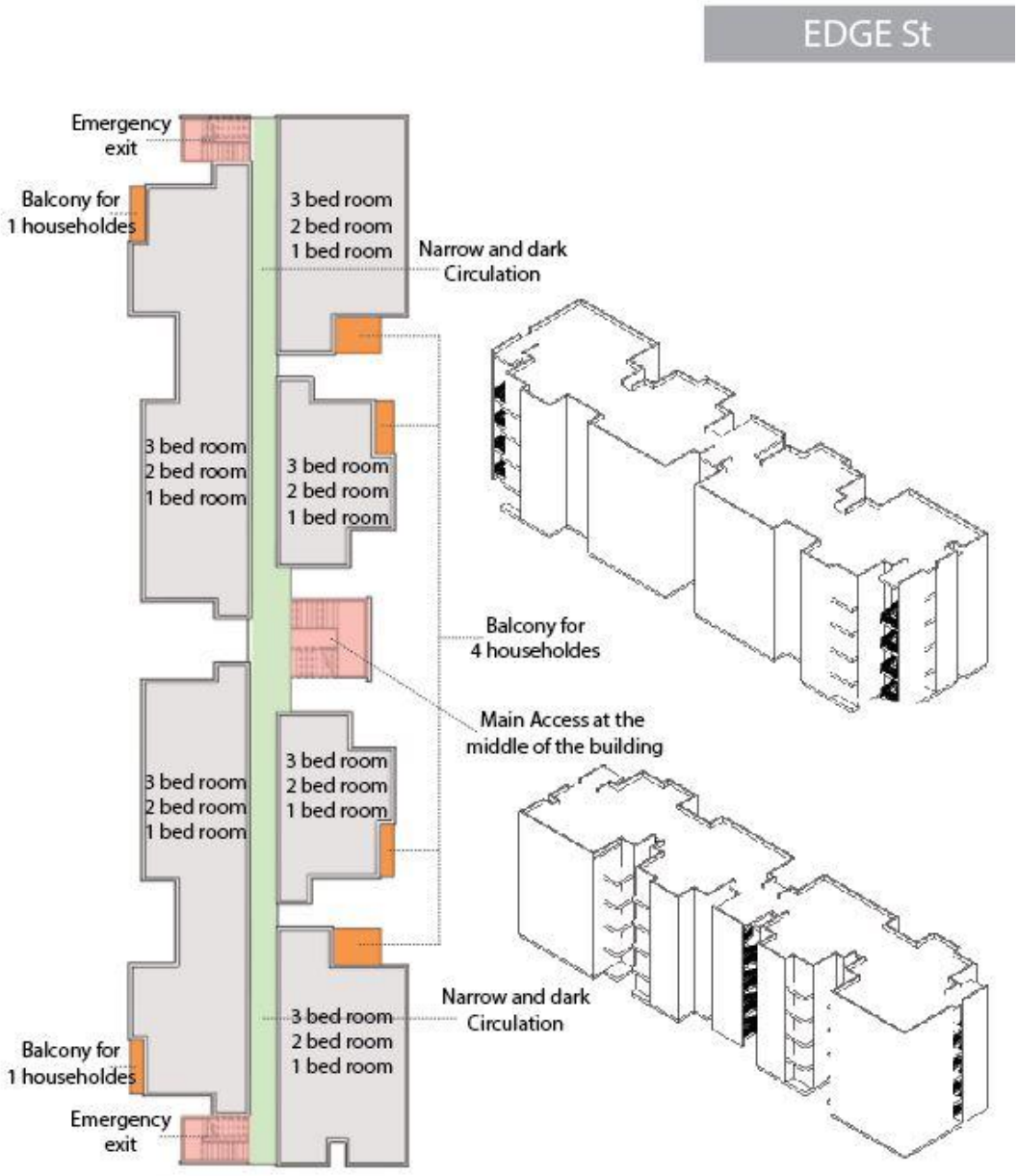

Figure 44: Fourth Generation Type EDGE st G+4

Source (Author ,2025)

Balconies are unevenly distributed along one side of the building block and 4 large balcony serves 4 households while smaller balconies cater to 1 household each, suggesting a mix of private and semi-shared outdoor areas. The design focuses on urban density, with repetitive floor plans and minimalistic circulation systems. Emergency exits are strategically placed at both ends of the structure, ensuring compliance with safety regulations without compromising the compact layout. This layout balances high-density living with functional infrastructure, targeting urban environments where space optimization and cost-effective construction are critical.

Type I: The core design features vertically stacked units repeated across floors, each containing a 3-bedroom, 2-bedroom, and 1-bedroom apartment.

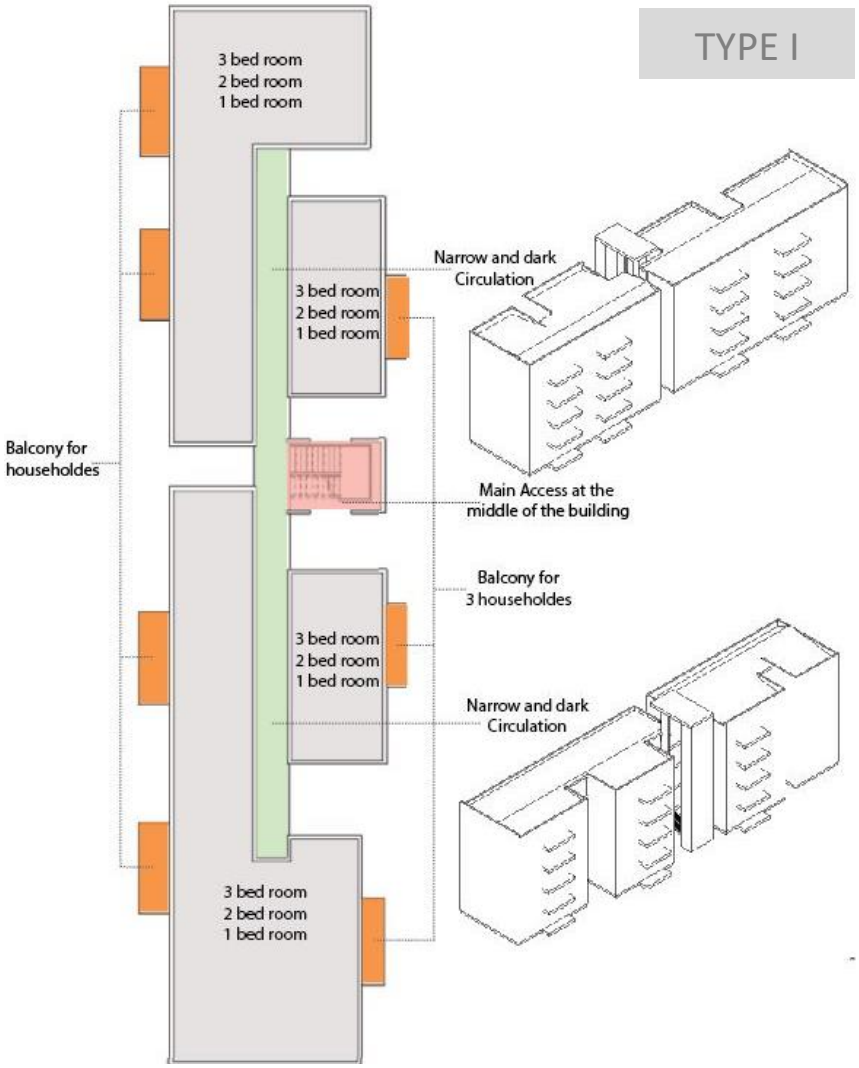

Figure 45: Fourth Generation Type I G+4

Source (Author ,2025)

Circulation is dominated by narrow, dark corridors, emphasizing space efficiency over natural light. A central main access point at the middle of the building connects residents by stairs, without emergency exits at both ends. Balconies are distributed ferly in both longitudinal direction of the building creating private outdoor spaces. The layout prioritizes uniformity, with identical unit sequences (3/2/1-bed) on every floor.

Type I L-Shape: This variant adopts an L-shaped footprint, altering the corridor layout while retaining the repeated 3/2/1-bed unit sequence. Balconies are distributed ferly in adjustments for corner units of the building creating private outdoor spaces. Circulation remains narrow and dark, but the L-shape introduces angled pathways, potentially creating light wells or internal courtyards. The central elevator and absence of emergency exits are retained.

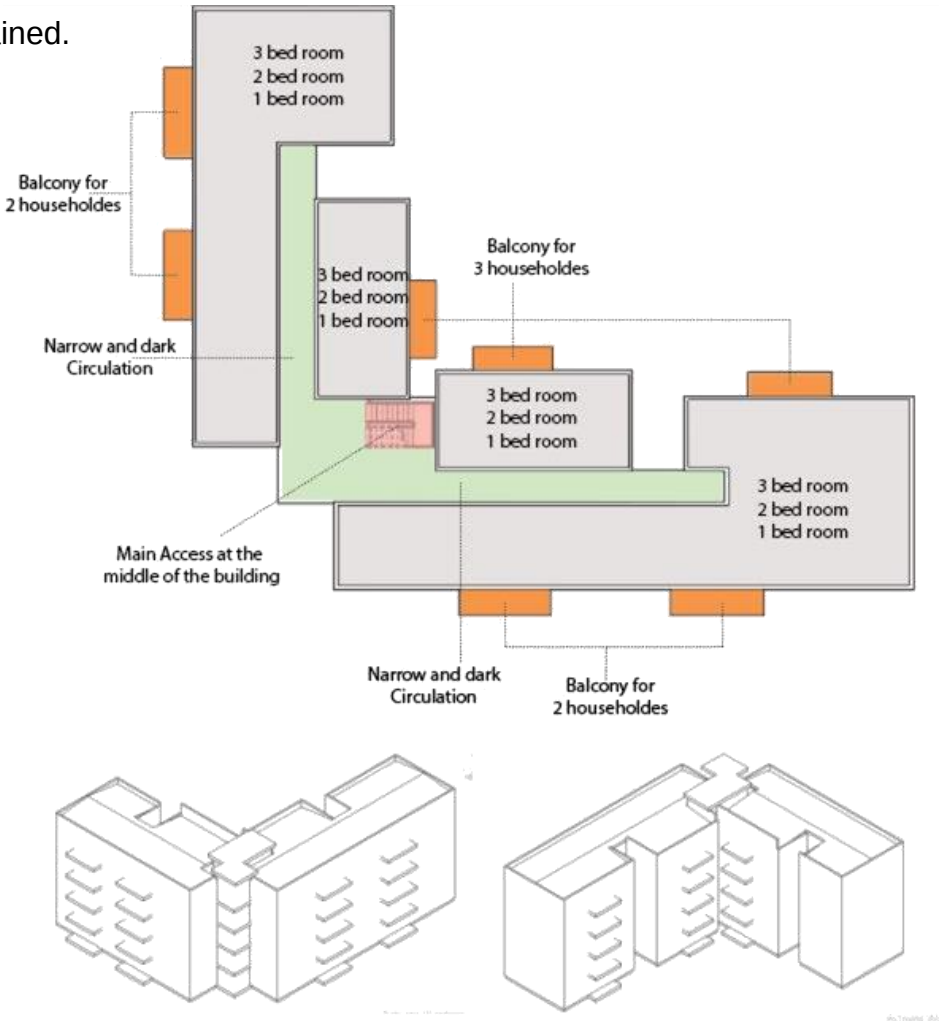

Figure 46: Fourth Generation Type I L-Shape G+4

Source (Author ,2025)

Type I 3: This design is similar to the design of type I, the core design features vertically stacked units repeated across floors, each containing a 3-bedroom, 2-bedroom, and 1-bedroom apartment. Circulation is dominated by narrow, dark corridors, emphasizing space efficiency over natural light. A central main access point at the middle of the building connects residents to elevators and stairs, while emergency exits are positioned at both ends.

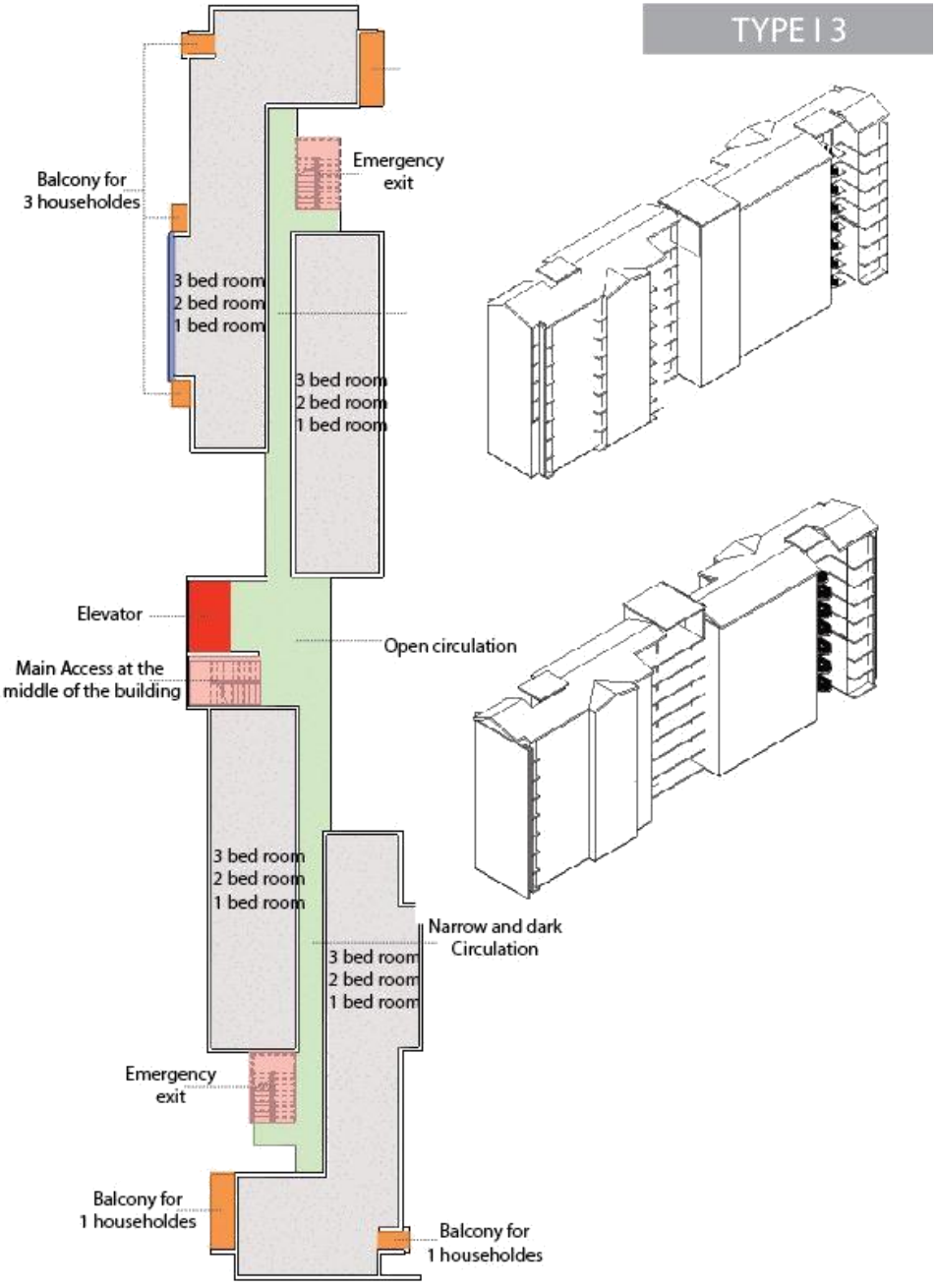

Figure 47: Fourth Generation Type I 3 G+4

Source (Author ,2025)

Balconies didn't distributed ferly in both longitudinal direction of the building which creating uneven private outdoor spaces. The layout prioritizes uniformity, with identical unit sequences (3/2/1-bed) on every floor. For Safety purposes Symmetrical emergency exits and centralized staircases ensure compliance.

Type I 3 Shape (Commercial): A hybrid design integrating ground-floor commercial studios (e.g., shops) with residential units above.

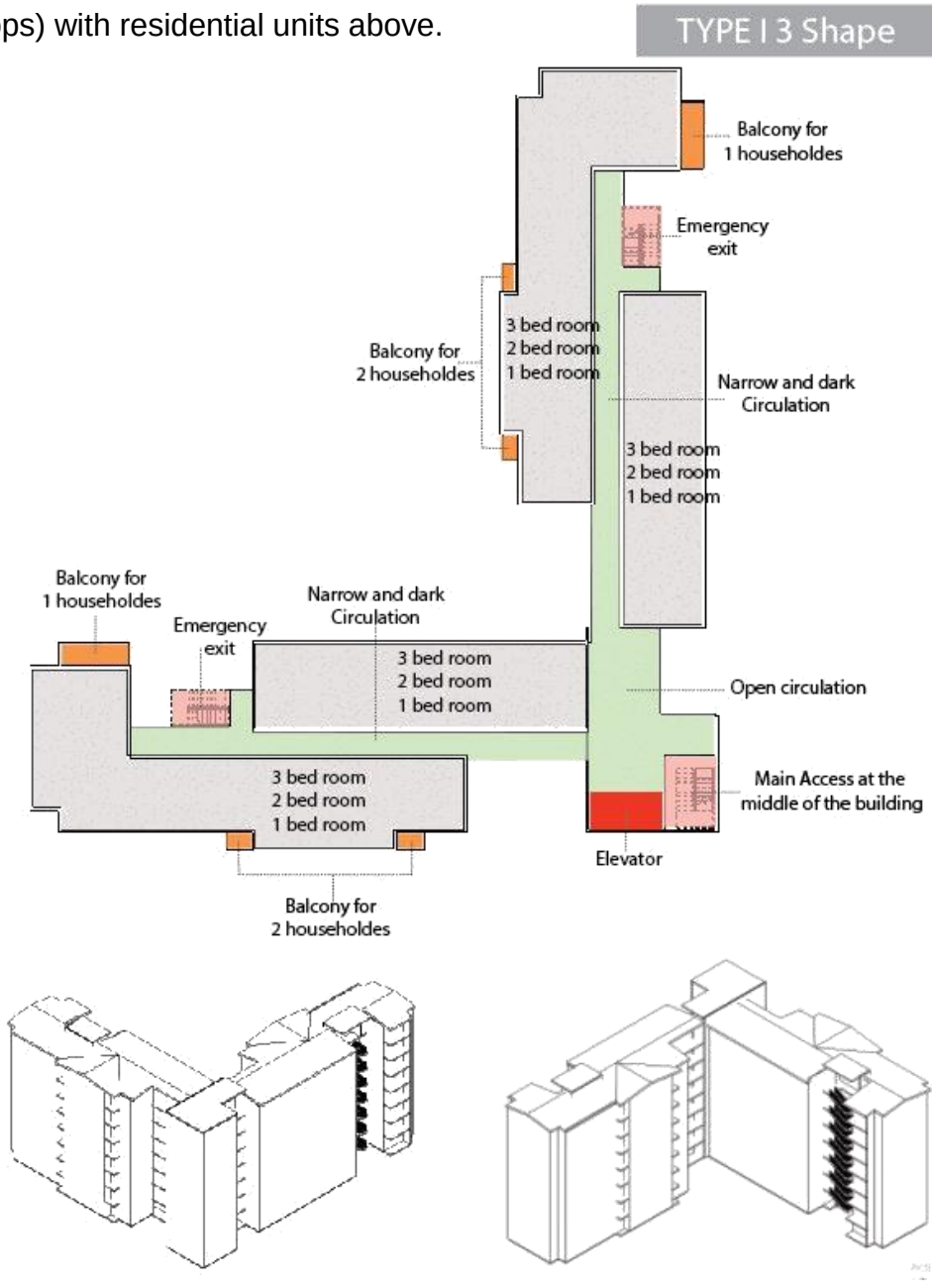

Figure 48: Fourth Generation Type I 3 L Shape G+4

Source (Author ,2025)

The upper floors follow the standard 3/2/1-bed repetition, while the ground floor features open circulation to accommodate retail traffic. Emergency exits are emphasized near commercial zones, and elevators remain centrally located. These variant balances public accessibility (for shops) with private residential needs.

Type I exemplifies modular urban housing, prioritizing density and cost-efficiency through repetition, while variations (L-shape, commercial integration) adapt to site constraints or mixed-use demands

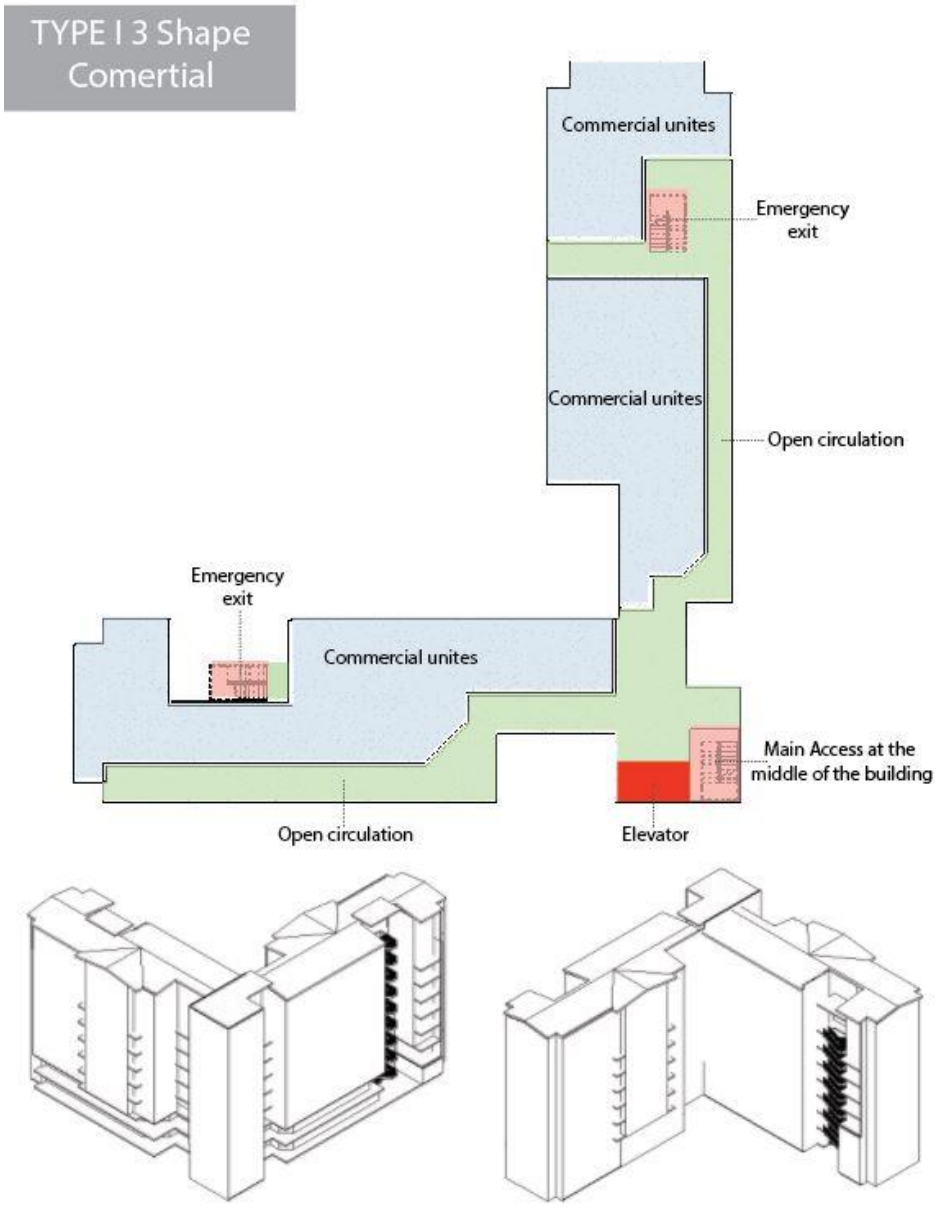

Figure 49: Fourth Generation Type I 3 L Shape Commercial G+4

Source (Author ,2025)

OTT G+4: The building follows a linear or L-shaped layout (implied by "OTT L Shape" references), with narrow, dark corridors dominating circulation pathways. Each floor contains repetitive sequences of 3-bedroom, 2-bedroom, and 1-bedroom apartments, emphasizing standardized living spaces for urban density. Upper Floors are Vertical repetition of 3/2/1-bed units, connected by narrow corridors For Space Efficiency Narrow, dark corridors prioritize function over aesthetics. A central main entrance streamline movement, without Emergency exits positioned at strategic points.

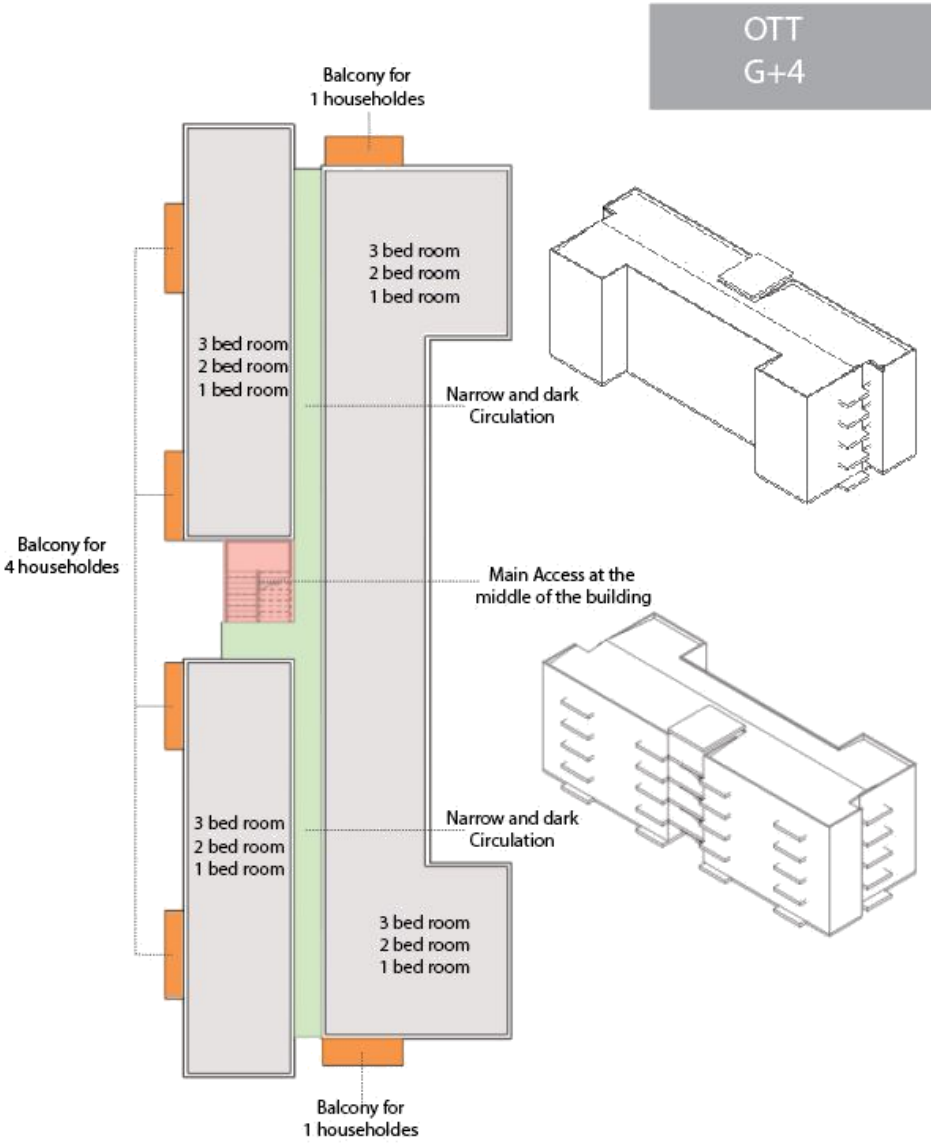

Figure 50: Fourth Generation Type OTT G+4

Source (Author ,2025)

Balconies didn't Allocated ferly in both longitudinal direction of the building which creating visually uneven private outdoor spaces. This design targets high-density urban environments, balancing affordability, safety, and modular construction. While OTT G+7 adds two more floors and explicit commercial units, the G+4 variant focuses on a smaller footprint with similar principles.

OTT L Shape: This five-story building (Ground + 4 floors) adopts an L-shaped footprint creating two perpendicular wings that likely enclose a courtyard or light well. Floors repeat a standardized sequence of 3-bedroom, 2-bedroom, and 1-bedroom apartments, emphasizing modular design for cost and space efficiency. Balconies are unevenly allocated and smaller balconies for 1 household 4 larger balconies for 4 households.

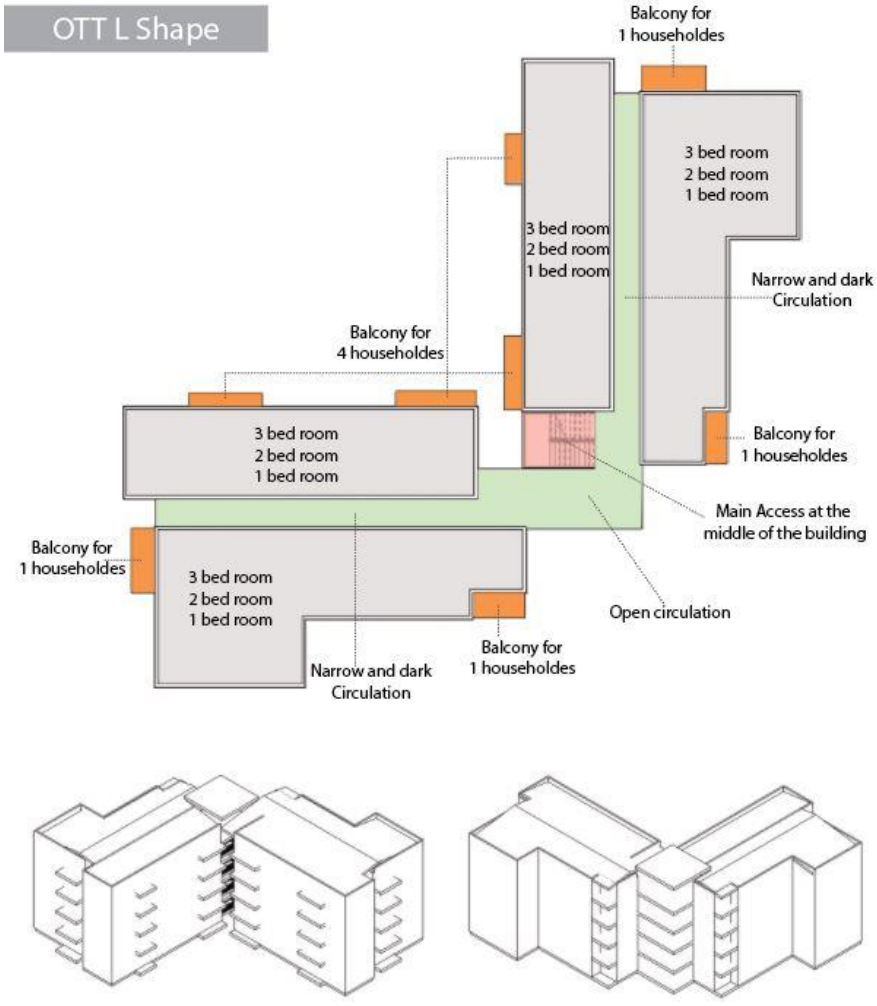

Figure 51: Fourth Generation Type OTT L-Shape G+4

Source (Author ,2025)

This design caters to high-density urban environments, blending modular construction with pragmatic spatial solutions. Narrow, dark corridors dominate internal pathways, prioritizing space efficiency over natural light. Open circulation zones appear near central access points, contrasting with the constrained hallways additionally repetitive floor plans ensure uniformity and maximize residential capacity, while the angled design may improve natural light penetration into some units.

OTT G+7: (Ground + 7 floors) describes an eight-story residential high-rise designed for high-density urban living. The building features repetitive vertical sequences of 3-bedroom, 2-bedroom, and 1-bedroom apartments across its floors, emphasizing modular efficiency. Circulation is dominated by narrow, dark corridors tight, the pathways prioritize space optimization over natural light. A central main access point at the middle of the building houses the elevator and primary staircase, streamlining vertical movement for residents.

Emergency exits are strategically placed at both ends of the structure, ensuring compliance with safety regulations without disrupting the compact layout. Balconies didn't Allocated ferly in both longitudinal direction of the building which creating visually uneven private outdoor spaces. Key priorities include urban density (via repetitive, space-efficient units), safety (symmetrical emergency exits), and centralized accessibility (elevator and mid-building access). The OTT G+7 exemplifies pragmatic high-rise living, tailored for cost-effective construction in space-constrained urban environments.

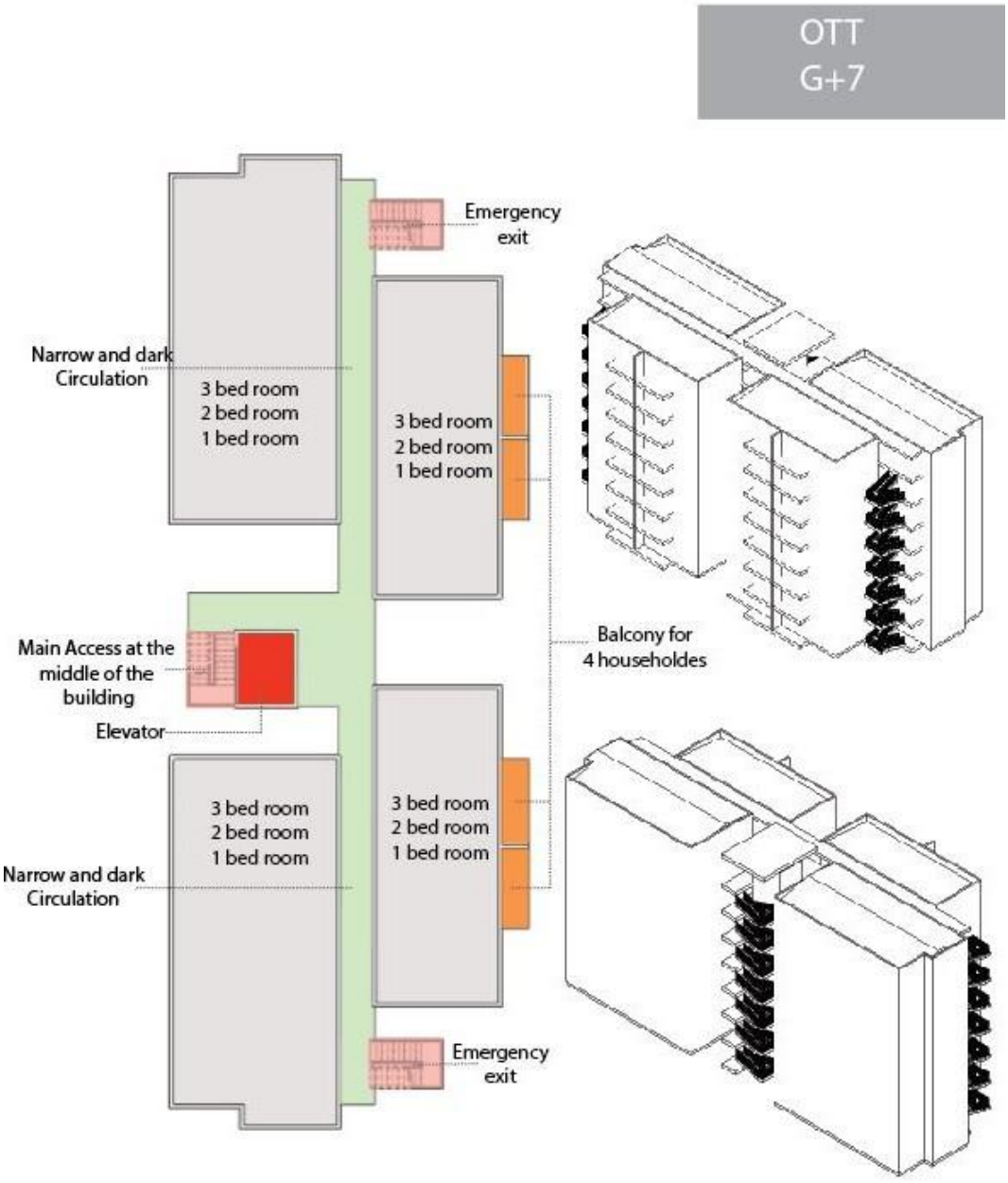

Figure 52: Fourth Generation Type OTT G+4

Source (Author ,2025)

OTT L-Shape G+7: L-shaped building with G+7 floors (Ground floor plus 7 upper floors). Residential Units are repeated configurations of 3-bedroom, 2-bedroom, and 1-bedroom units across floors. Balconies are allocated for 2 households and 2 households in different sections. Circulation are Narrow and dark vertical/horizontal circulation pathways. Main

access is located at the middle of the building and an elevator is included for vertical movement and Emergency exits are integrated into the design. This type emphasizes compact living with repeated unit layouts, centralized access, and functional safety elements, tailored for medium-density residential use.

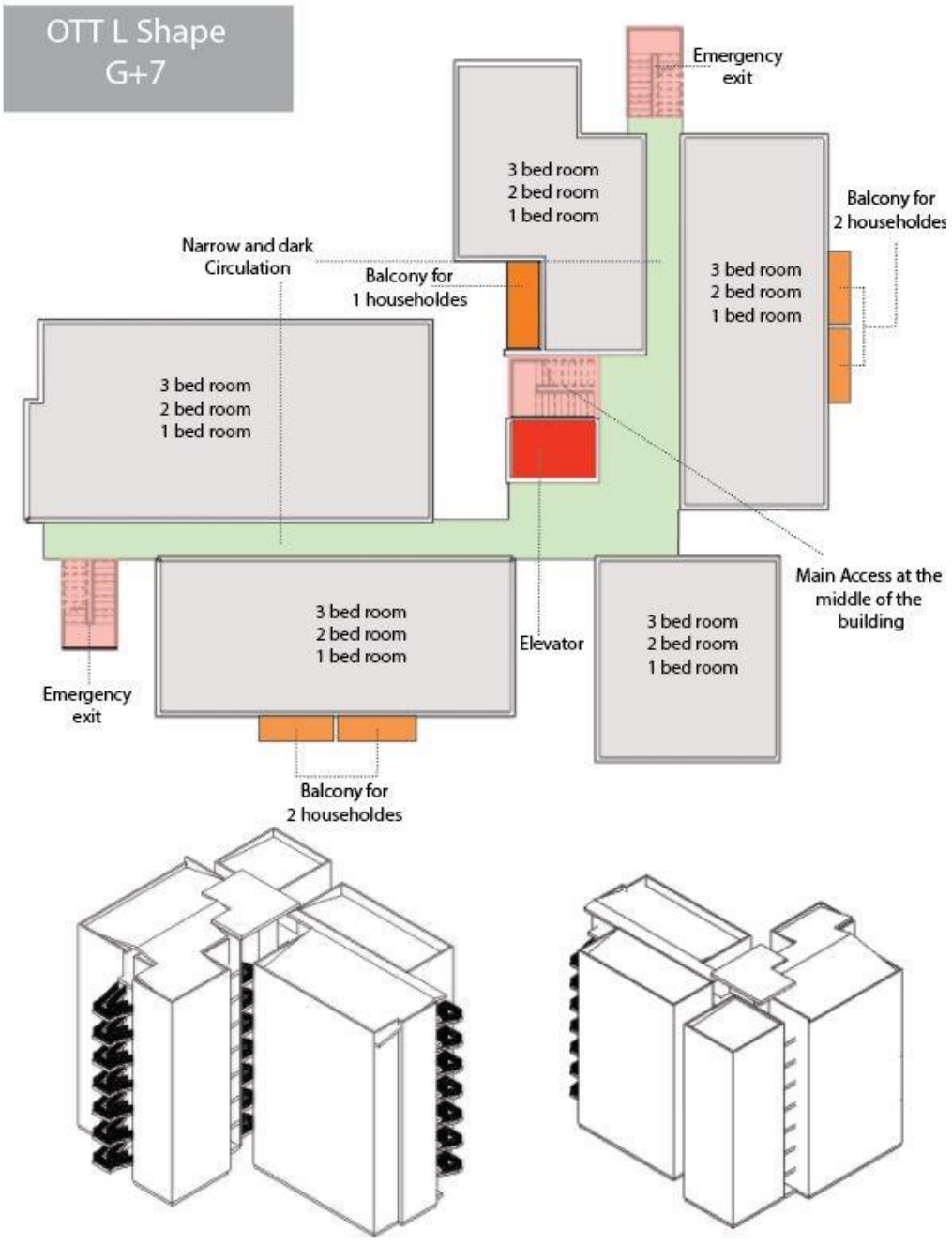

Figure 53: Fourth Generation Type OTT L-Shape G+7

Source (Author ,2025)

SIS: (Ground + 7 floors) describes an eight-story residential high-rise designed for high-density urban living. The building features repetitive configurations of 3-bedroom, 2-bedroom, and 1-bedroom units across floors. Multiple balconies allocated are for different households.

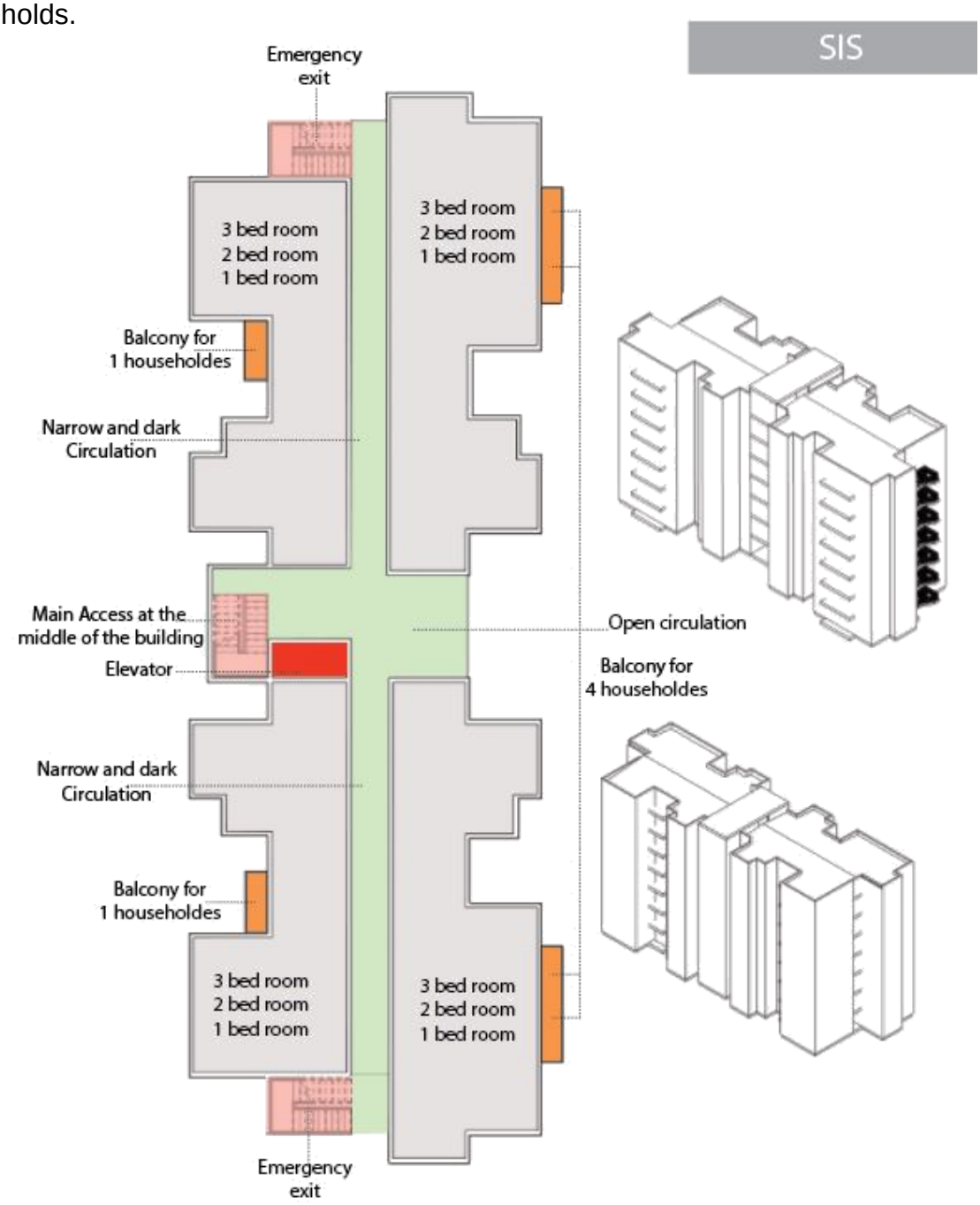

Figure 54: Fourth Generation Type SIS G+7

Source (Author ,2025)

Main access is centralized at the middle of the building. Includes an elevator for vertical movement and Emergency exits are integrated into the design. This type appears tailored for medium-density housing with a focus on repeated unit efficiency and centralized access.

SIS L-Shape: L-shaped residential building with repeated configurations of 3-bedroom, 2-bedroom, and 1-bedroom units across floors. Multiple balconies allocated are for different households.

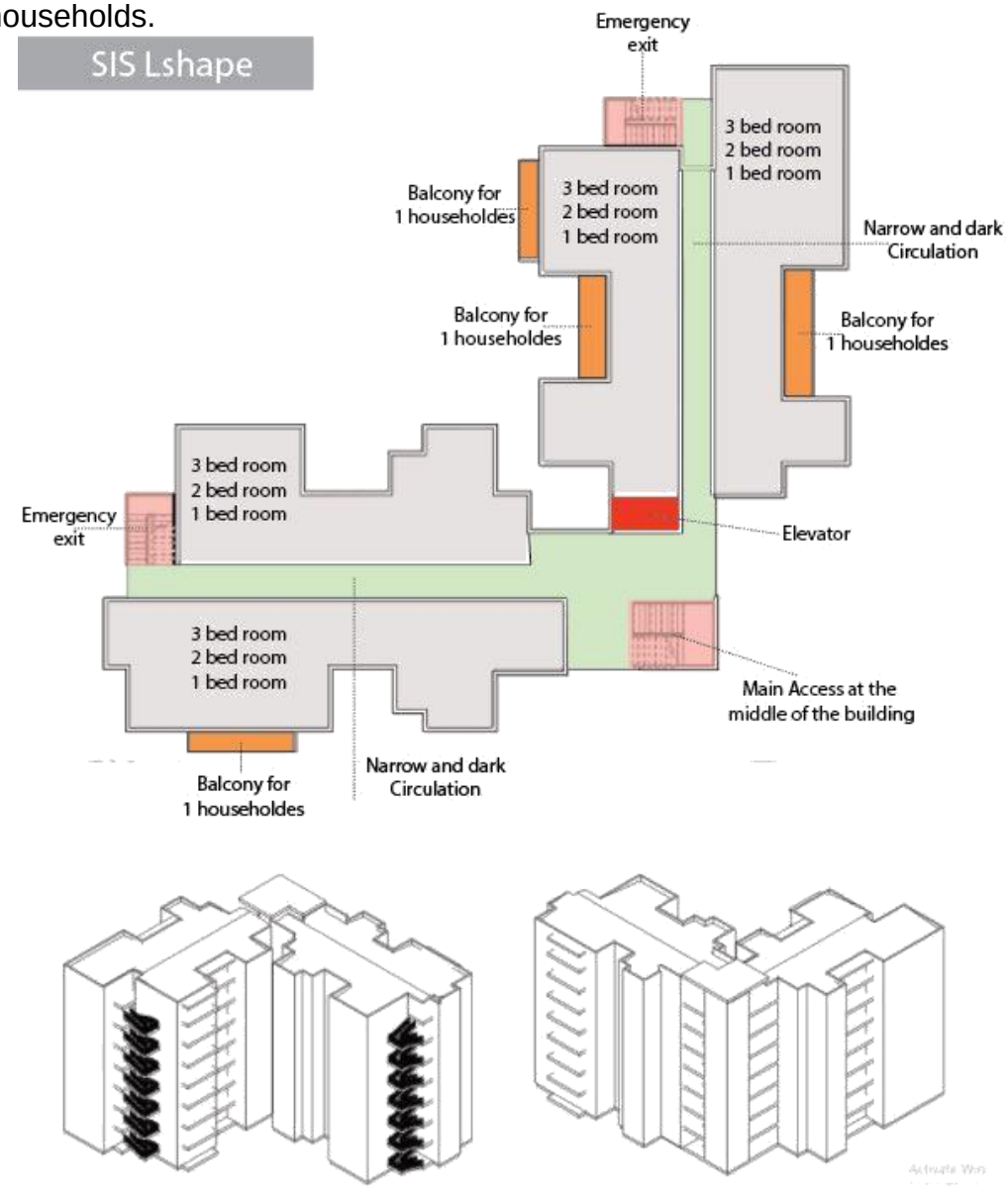

Figure 55: Fourth Generation Type SIS L-Shape G+7

Source (Author ,2025)

Main access is centralized at the middle of the building. Includes an elevator for vertical movement and Emergency exits are integrated into the design. This type appears tailored for medium-density housing with a focus on repeated unit efficiency and centralized access.

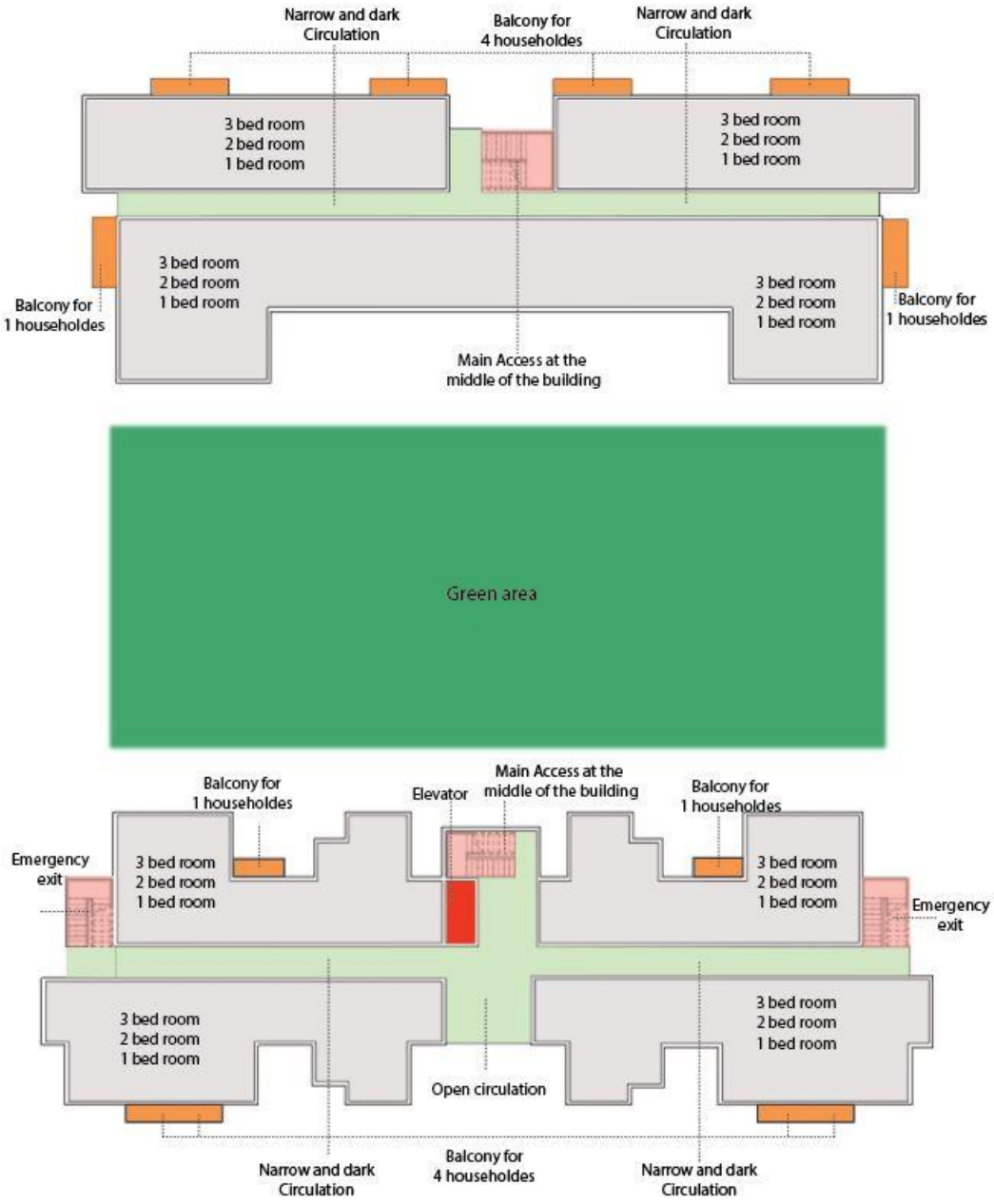

Figure 56: Building Block Arrangement for Fourth Generation

Source (Author, 2025)

In generation 4 large open spaces were provided in between building blocks to accommodate the existing dense population. The design of these building blocks are kind of closed off because of these the open green areas didn’t connect visually to either the vertical or horizontal circulation of the existing buildings.

Since chance of getting natural light sufficient for the eye is low with in the building blocks, dwellers use the provided open space to warm an infant or to perform other activities but since the open area lacks any connection with the building blocks it is difficult to create a sense of belongings and it hard for the dwellers to monitor and control any suspicious activities in the open area.

4.2. Respondent's questioner response rate

After disseminating the questioner (Appendix A) having eleven (11) sections for the total sample size of 385 respondents, however, 407 proportional responses were acquired. From all types of generations. This results in the response rate being 100% of respondents being able to fill in the questioner. Based on the 407 responses the following analysis was made.

4.3. Checking the reliability of data

The reliability of data was checked by Cronbach's Alpha Coefficient will be used to determine the reliability level of a survey questionnaire. Considering the eleven (11) items, one dependent variable which is customer loyalty type of generation (Generation one, Generation two, Generation three and Generation four), on the other hand there were eleven independent variables namely Security, Safety, Sense of community, Quality of life, Accessibility, Health, physical and Philological impact, Flow and circulation, Light and ventilation, Technology, Hazard communication, and Visual contact. The following table illustrates the reliability statistics.

Table 2: Reliability Statistics

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.836	0.836	11

The result exemplifies Cronbach's Alpha value of 0.836 in which greater than the 0.85 resulting in the internal consistency of the data to be excellent so each item describes similar construct or variable.

4.4. Correlation analysis

Correlation was measured and expressed to the extent to which independent variables (the eleven (11) factors, namely Security, Safety, Sense of community, Quality of life, Accessibility, Health, physical and Philological impact, Flow and circulation, Light and ventilation, Technology, Hazard communication, and Visual contact and the dependent variable (1^{st}, 2^{nd}, 3^{rd}, and 4^{th} generations) are linearly related or not. Correlation coefficients

(r) provide information about the direction of the relationship (positive or negative) as well as the intensity of the relationship (-1.0 to +1.0). Furthermore, correlation tests revealed whether the correlation is statistically significant. Correlation coefficients range between -1.0 and +1.0. The direction of the relationship is represented by the sign of the coefficient. The following table illustrates the correlation of dependent and independent variables. The result presented below was illustrated at **ANNEX (A)** and discussed as follows:

The statistical analysis between condominium generation types and user perceptions of communal and circulation spaces reveals multiple significant relationships. The analysis shows that residents in newer generation buildings have a positive and significant perception of security ($r = 0.174$, $p = 0.000 < \alpha = 0.05$) and safety ($r = 0.171$, $p = 0.001 < \alpha = 0.05$). The perception of circulation flow shows a weak but significant positive correlation with generation type ($r = 0.104$, $p = 0.036 < \alpha = 0.05$).

The analysis revealed multiple factors which demonstrated substantial negative relationships. The accessibility rating showed a negative relationship with generation type ($r = -0.181$, $p = 0.000 < \alpha = 0.05$) which indicated that modern buildings received lower accessibility scores. The health and physiological impact factor displayed a moderate negative correlation ($r = -0.238$, $p = 0.000 < \alpha = 0.05$) and lighting showed a slight negative correlation ($r = -0.111$, $p = 0.025 < \alpha = 0.05$). The strongest negative relationship occurred between technology integration and the study results ($r = -0.434$, $p = 0.000 < \alpha = 0.05$) which indicated that residents noticed a major reduction in technological features in newer generation buildings. The visual quality of communal spaces experienced a minor decrease from one generation to the next ($r = -0.138$, $p = 0.005 < \alpha = 0.05$).

The analysis revealed that several variables failed to establish statistical significance. The sense of belonging ($r = 0.017$, $p = 0.736 > \alpha = 0.05$) and hazard communication ($r = 0.052$, $p = 0.294 > \alpha = 0.05$) failed to show significant correlations which suggests these aspects remain stable between generations or are affected by different variables.

The analysis reveals that new condominium generations demonstrate minor safety and security improvements, yet residents view them unfavorably regarding accessibility and lighting and health effects and technology integration and visual quality. The conflicting

results demonstrate design evolution inconsistencies which require additional research for design improvement.

4.5. Effect of spatial transformation on residential lives

To check the effect of each eleven independent variable characteristics on the type of generation resident perception univariate analysis was used by considering Eleven (11) factors were selected as shown (section four of Appendix A) whether there is a significant difference in residential lives between the four generation types. This is a crucial factor to consider, as research has shown that different designs of communal circulation designs can inhibit different factors when having different topology. A One-way analysis of variance (ANOVA) was conducted to assess the impact of independent factors on the daily life of the residents living in four generations of condominium buildings. The result is was discussed as follows and the table can be found at **ANNEX (B).**

The result shows the Tests of Between-Subjects Effects of the eleven independent variables considering the four generation types of condominium designs. By testing two tailed analysis of variance ANOVA univariate test significant and non-significant factors were identified taking alpha value of 0.05.

4.5.1. Significant Factors at 95% Confidence Interval ($\alpha = 0.05$)

SECURITY: The F-value for security is 1.688 and p-value is 0.045. As $p = 0.045 < \alpha = 0.05$, the result is significant at the 95% confidence interval. This suggests that at least one generation of residents has a different perception of security which means elements such as entrance control or neighborhood safety differ among condominium generation types.

SAFETY: The Safety value has an F-value of 2.788 and p-value 0.000. Given $p = 0.000 < \alpha = 0.05$, it means the result is extremely significant at the 95% confidence interval. This indicates that at least one generation experiences different levels of physical safety such as looking at children on the playground form the communal and circulation space.

SENSE OF COMMUNITY (SSENSE): This factor represents an F-value of 1.714 and a p-value of 0.032. Thus, $p = 0.032 < \alpha = 0.05$ indicates the result is significant at the 95 percent confidence level. It means that the sense of community which includes

interaction, support, and neighborhood connectedness is different for at least one generation group.

QUALITY OF LIFE (QUALITY): As for Quality of Life, the F-value is 1.118 and the p-value is 0.037. The reason being $p = 0.037 < \alpha = 0.05$, this finding is within the threshold that would be considered significant at the 95% confidence interval. It shows that at least one group of residents perceives their overall life satisfaction and well-being in their living environment differently than the others.

HEALTH & PHYSIOLOGICAL WELL-BEING: This variable has F-value of 3.080 with a p-value of 0.000. Since $p = 0.000 < \alpha = 0.05$, so it is highly significant at the 95% confidence level. It is made clear that residents from at least one generation have different perceptions of health and comfort conditions (ventilation, noise, mental stress, etc.) under which they live.

FLOW & CIRCULATION: For Flow and Circulation the F-value is 3.704 with a p-value of 0.000. Since $p = 0.000 < \alpha = 0.05$, the result is highly significant at the 95% confidence interval which means that there is at least one generation who perceive the ease of movement within buildings differently due to the design and layout.

LIGHT: The F-value of this factor is 2.344 and its p-value is 0.003. This value is statistically significant where $p < 0.05$. Thus, the result is significant at the 95% confidence interval which states the null hypothesis can be rejected at that level. This indicates that the residents of at least one generation have different experiences with lighting (natural or artificial) because of design standards that are likely imposed during their lifetimes.

VISUAL CONTACT: For Visual Contact, F-value is 3.978 with p-value equal to 0.000. Because $p = 0.000 < \alpha = 0.05$, it strongly signifies a statistically significant finding at the 95% confidence level. This means that the level of visual interaction and social interaction in common areas is not the same for at least one generation.

4.5.2. Non-Significant Factors at 95% Confidence Interval ($\alpha = 0.05$)

These factors have also been assessed in the study, where no significant evidence was found at 95 percent confidence level confidence level $\alpha = 0.05$.

ACCESSIBILITY: This value accounts for F= 1.374 and p= 0.132. Because p = 0.132 > α = 0.05, the factor is not significant and consequently there is no statistically valid reason to accept the hypothesis. Due to lack of evidence, there are no valid reasons to claim that perceived accessibility changes among the generations.

TECHNOLOGY: Technology has a p-value of 0.299 and an F-value of 1.164. At the 95% confidence level, the result is not significant because p = 0.299 > α = 0.05. This indicates that all four generations of view technology access and implementation (such as the elevators and smart features) similarly.

Hazard communication has a p-value of 0.068 and an F-value of 1.701. Despite being relatively close, the 95% CI does not show statistical significance because p = 0.068 > α = 0.05. As a result, there is not enough variation in hazard-related communication (like emergency alerts or signage) to demonstrate a generational effect.

The results derived from the one-way ANOVA performed at 95% confidence (α = 0.05) reveal that the different independent variables play significant roles in contributing to the perception of residents in four different generational types of condominium buildings. The significant variables include Security, Safety, Sense of Community, Quality of Life, Health and Physiological Well-being, Flow and Circulation, Light, and Visual Contact. While the ANOVA result shows differences in the generational types regarding each of the above elements, it does not indicate the generational groups that show significant differences. For greater insights into the above point, an independent samples t-test was used, the details of whose result appear in (Table 5) below. The statistical test analyzed the difference in the mean values for each relevant factor among different generational types, hence making it easier to identify the specific differences in those areas. Through the comparison of the variation in the means using the t-test, the research managed to determine the distinctions in how each generation group views the identified factor. Such analysis provides better insight into the consequences of residential environmental changes in contributing to different aspects of life among generations, hence informing enhanced decision-making in residential policy and physical design improvement.

4.6. Multiple comparison from independent sample t-test

The multiple comparison results illustrated in **ANNEX (C)** shows the mean differences and significance values between generation types on each of the eleven independent criteria. These include Security, Safety, Sense of Community, Quality of Life, Accessibility, Health & Physiological Well-being, Flow & Circulation, Light, Technology, Hazard Communication, and Visual Contact. The table was computed using independent sample t-tests to examine spatial transformation's influence on the condominium residents of all four types of housing generations. By comparing each pair of generations (e.g., 1st and 2nd, 2nd and 4th, etc.), the table identifies the specific individual pairs of generations with statistically varying perceptions ($p < 0.05$) on every factor. This post hoc analysis offers greater insights than the initial ANOVA, providing not only if differences do exist, but between which generations differences occur, thus enabling a more focused understanding of the effects of changes in space on residents' experiences.

Security: - The independent t-test (Table 5) showed statistically significant differences in perceptions about security among different generations at the level of confidence 95%. It was interesting to note that the 1st generation perceived security as better than the 2nd generation as evidenced by the statistically significant positive difference in the means 0.0846, with an associated p-value 0.00. Likewise, the same significant difference was seen in the 1st versus the 3rd generations ($p = 0.02$, difference in the means = 0.337), in which the 1st generation perceived security as being better. Also, the 2nd generation showed lower scores in the perception of security compared to the 4th generation ($p = 0.000$, difference in the means = 0.3645). It, therefore, indicates that the environments identified with the 1st generation was perceived to be providing greater security compared to the 2nd, 3rd, and 4th generations.

The first generations are more secure than the other generation. Because of their design nature it is easier to monitor others building across thorough circulation space any suspicious activities can be easily identified by the dwellers both on the floor or in the building additionally dwellers can get a clear vision of who is around you when going up and down and circulating on the building.

Generation 2 are lese secured than the first generation. The position of the stair upfront didn't allow the dwellers to monitor any suspicious activities throughout the circulation system and on the building in addition to that it is difficult to get a clear vision of who is around you when going up and down and circulating on the building

Generation 3 are less secured because of its design one can't monitor others building across thorough circulation space since the circulation is closed off because of the allayment difference of the horizontal and vertical circulation it is difficult to get clear vision of who is around you when going up and down and circulating on the building sometimes dwellers can monitor any suspicious activity in the floor but it is difficult to monitor the building.

Ultimately security decrease when the generation increase because of the design complication and the density of the building it is very difficult to monitor others building across thorough circulation space sometimes monitoring suspicious activity on the floor is very difficult because of the existing dead ends or parts which didn't get clear vision.in fourth generation housing designs specially in L-shaped ones it is very difficult to get a clear vision of who is around you when going up and down and circulating on the floor. And it is very difficult to monitor the building.

Safety: - Safety perceptions varied significantly among generations (Table 5). The 1st generation rated safety higher than the 2nd ($p = 0.00$, mean diff = 0.2212), the 3rd ($p = 0.04$, mean diff = 0.023), and the 4th ($p = 0.02$, mean diff = 0.419), implying a consistently stronger perception of safety in the 1st generation condominiums. Moreover, the 2nd generation rated safety significantly lower than both the 3rd ($p = 0.04$, mean diff = 0.244) and 4th generations ($p = 0.009$, mean diff = 0.1982), confirming that the 2nd generation is perceived as the least safe among all. The 1st generation consistently stands out with higher safety perception across all comparisons.

Similar to security safety also decrease when generation increases because of its open nature of the horizontal and vertical circulation in generation one dwellers can monitor their children while they playing on the playground in addition to that since the playground is located in the central part of several building blocks the whole play ground is under the super vision of the whole house holds or dwellers. Children or other dwellers can walk

and visual monitored by other dwellers safely on the corridor and stairs (especially on the one who are constructed out of concrete).

In generation two the safety issues rises related with the position of the stair from the horizontal circulation it is easier to monitor children's while they play on the playground but sense the situation on the vertical circulation is difficult to monitor it is difficult for children to play on the corridors and on the stair.

In generation 3 monitor your children's across their children's while they play on the playground is difficult because the horizontal circulation is partially closed it is difficult to monitor the safety of children while circulating on the stairs and horizontal circulation.

Generation four has more complicated design than the other generations. This complication create some safety issue.it is difficult to monitor children's while they play on the playground or walking up and down the stairs.

Sense of Community: The multiple comparative table showed (Table 5) The feeling of community reveals highly significant differences between generations. The 1st generation rated this factor much lower than the 4th generation (p = 0.00, mean diff = -0.067), and the 2nd and 3rd generations were also lower than the 4th one (p = 0.000 and 0.025, respectively). Negative mean differences in all significant comparisons indicate 4th generation residents have a higher sense of community, i.e., greater communal relations or neighborhood contact in newer neighborhoods.

In generation one's and generation two's circulation is not wide enough to conduct social gathering so this type gathering take place in the communal unites but some generation two type designs relatively have wider space around their stair for small gatering.in general for socialization and for any festivity generation one is less preferable

Generation Three has a smaller space and closed circulation than generation four. Most generations of four types have small gathering space around the central circulation which helps to host small festivity.

In general, even though Generation four has relatively wider space around the main circulation to enhance sense of community but in all generation's occasional activities like life services memorial, any festival, cultural and regional occasions conduct on the ground floor.

Quality of Life: It is illustrated on (Table 5) that here were significant differences in quality of life between the comparisons of 1st and 4th generations (p = 0.01, mean diff = 0.243), where the 1st generation reported a better quality of life. The 2nd generation also perceived higher quality of life than both the 3rd (p = 0.02, mean diff = 0.071) and 4th generations (p = 0.000, mean diff = 0.0391). These findings suggest that earlier generation buildings, especially the 1st and 2nd are associated with higher perceived quality of life, which may be due to increased unit size, higher social interaction, or other design ideologies.

Dwellers in the first two generations have a better quality of life in each household the privacy in terms of standard perceiving a house with clear and comfortable (corridors and stairs), which results in leading to a great reason for socializing and also maintaining a living distance for privacy purposes.

Accessibility: Accessibility analysis between different generations of condominiums reveals that none of the comparisons between the generations were found to be statistically significant with all significance values being higher than the standard alpha value of 0.05 as illustrated on (Table 5). More specifically, comparison between the 1st and 2nd generation was found to have a significance value of 0.37 and a mean difference of 0.0410, while 1st vs 3rd generation had a significance value of 0.59 and a mean difference of 0.086. 1st and 4th generations showed a significant value of 0.64 with the mean difference of 0.273. Similarly, the 2nd and 3rd generations achieved a significant value of 0.75 with a mean difference of 0.045, while 2nd and 4th showed a significance of 0.531 with a mean difference of 0.2327. Lastly, the 3rd and 4th generations shared a significant value of 0.309 and a mean difference of 0.1869. The findings here are that although there are small differences in accessibility between the generations, none of them are statistically significant. This overall insignificance is largely attributed to the fact that no necessary accessibility features such as elevators, emergency exits, and ramps even though the building plans reserved space for them were ever implemented.

Unlike all the other factors' accessibility has significant impact in relation to the height of the building as the height increase the accessibility of the building block decrease significantly which makes generation four less accessible than the first three generetions.in addition to that accessibility depend on the quality of construction and supervision of the work.

For example when we analyses issues related to accessibility like if one can go up and down using the stair because the steps are clearly and visually highlighted? , if one can us elevators anytime? or A person with disabilities can visit you or you can visit (if you are) step-free access to the building entrance door for disabilities? we may get different result but the difference in there result is not because of the design it's because of poor supervision and poor implementation of rules and regulations so in general the result related with accessibility in all generation didn't show significant difference.

Health & Physiological Well-being: - Perceptions of health and psychological comfort were also highly heterogeneous. Generation 1 was better in terms of well-being than Generation 4 ($p = 0.04$, mean diff = 0.306), while Generation 2 indicated that this aspect was significantly higher than in Generation 3 ($p = 0.01$, mean diff = 0.803) and Generation 4 ($p = 0.000$, mean diff = 0.5443). These differences indicate that residents of older generation flats, specifically the 2nd, think they have healthier environments surrounding them, and that might be because of layout, ventilation, or communal dynamics.

Our health mainly affected by things which we perceive from the environment. When we see health related issues with in the generation, generation one and two are the most health among the others.in generation one housing unites what dwellers see when they open there door or steps outside gives mental satisfaction and delineate lighting is sufficient enough for the eye even it is possible to warm an infant with natural light. The open design of circulation space keep the whole building and the floor is less suffocated and and its impact on the health is significantly low. Since the arrangement of the circulation space versus the common area create strong connection within the community the possibility of feel loneliness based on the setup of the communal circulation space design significantly low.

The other two generations have double loaded circulation system which makes the central circulation space suffocated and influences the health of the inhabitants. During this type of circulation space what we see outside our door is mainly a dead wall which didn't give mental satisfaction and relief. Because of low or minimum lighting warm an infant with natural light is challenging in these two typologies.

Flow & Circulation: - Relative to the flow and circulation factor, the 1st generation rated the factor lower than the 4th generation ($p = 0.03$, mean diff = -0.291), an indication of perceived spatial constraint in older structures. The 2nd generation also reported lower flow and circulation than the 3rd ($p = 0.00$, mean diff = -0.065) and 4th generations ($p = 0.001$, mean diff = -0.2312). These results suggest that flow has improved in later generation condos, particularly in generation 4, which may have embraced modern design principles.

Light: - The lighting conditions were perceived differently by generations. The 1st generation was scored higher than the 3rd ($p = 0.04$, mean diff = 0.080) and 4th ($p = 0.05$, mean diff = 0.083) and indicate better lighting in older buildings. Equally, the 2nd generation also rated the lighting as much superior to that of the 3rd ($p = 0.00$, mean diff = 0.319) and 4th generations ($p = 0.000$, mean diff = 0.3232). Lighting quality, either natural or artificial, was discovered to be greater in previous generations maybe due to design, spacing, or window orientation.

Visual Contact: -Visual connection, representing openness and togetherness of living spaces, also showed significant generational differences. The 1st generation rated this factor higher compared to the 3rd ($p = 0.02$, mean diff = 0.370) and 4th generations ($p = 0.00$, mean diff = 0.112). As a result, the 2nd generation also liked visual contact more than the 3rd ($p = 0.01$, mean diff = 0.737) and 4th ($p = 0.000$, mean diff = 0.4800) generations. It is seen that older generations like open spaces or line of sight more, which can promote safety as well as social interaction.

4.7. Hypothesis testing result

This section presents the results of hypothesis testing which was developed on Chapter one of (Section 1.5) to determine whether there are any statistically significant differences

in residents' experiences and perceptions of communal spaces between the four generations of condominium spatial evolution. The alternative hypothesis (H_1) presumes that there is a significant difference in residential life among them in terms of various spatial and experiential parameters. Using a 95% confidence level ($\alpha = 0.05$), each variable was tested for both significance level and mean differences for generational pairings. The table summarizes the outcome of each variable, whether H_0 was rejected or accepted, and notes significant generational differences where applicable. These findings give insight into what aspects of communal space planning have shifted significantly through the generations and which have remained constant. The hypothesis testing result was using a 95% confidence interval ($\alpha = 0.05$) The table below shows each factor's significance and acceptance or rejection of the alternate and null hypothesis:

> **H_1:** There is a significant difference on the residential lives (at least one) between the four (4) generation of spatial transformations based on resident's preferences on the communal space. (Accepted)

Table 3: Hypothesis testing result

Variable	Min Sig. Value	Hypothesis Status	Remarks
SECURITY	0.000<0.05 **Significant**	Reject H_0, Accept H_1	Significant difference observed; null hypothesis rejected, alternate hypothesis accepted. For instance, the 1st generation scored higher than 2nd generation (Mean diff = 0.0846).
SAFTEY	0.000<0.05 **Significant**	Reject H_0, Accept H_1	Significant difference observed; null hypothesis rejected, alternate hypothesis accepted. For instance, 2nd generation scored higher than 4th generation (Mean diff = 0.1982).
SENSE OF COMMUNITY	0.000<0.05 **Significant**	Reject H_0, Accept H_1	Significant difference observed; null hypothesis rejected, alternate hypothesis accepted. For instance, 3rd generation scored lower than 4th generation (Mean diff = -0.2003).
QUALITY OF LIFE	0.000<0.05 **Significant**	Reject H_0, Accept H_1	Significant difference observed; null hypothesis rejected, alternate hypothesis accepted. For instance, 4th generation scored higher than 3rd generation (Mean diff = 0.243).
ACCESESABILITY	0.230>0.05 **Not Significant**	Accept H_0, Reject H_1	No significant difference: null hypothesis accepted, alternate hypothesis rejected. Differences are not statistically significant across generations.
HEALTH & PHYSIOLOGICAL	0.000<0.05 **Significant**	Reject H_0, Accept H_1	Significant difference observed; null hypothesis rejected, alternate hypothesis accepted. For instance, 2nd generation scored higher than 4th generation (Mean diff = 0.5443).

FLOW & CIRCULATION	0.030<0.05 **Significant**	Reject H_0, Accept H_1	Significant difference observed; null hypothesis rejected, alternate hypothesis accepted. For instance, 4th generation scored lower than 1st generation (Mean diff = -0.291).
LIGHT	0.000<0.05 **Significant**	Reject H_0, Accept H_1	Significant difference observed; null hypothesis rejected, alternate hypothesis accepted. For instance, 4th generation scored higher than 2nd generation (Mean diff = 0.3232).
TECHNOLOGY	0.230>0.05 **Not Significant**	Accept H_0, Reject H_1	No significant difference: null hypothesis accepted, alternate hypothesis rejected. Differences are not statistically significant across generations.
HAZARD COMUNICATION	0.275>0.05 **Not Significant**	Accept H_0, Reject H_1	No significant difference: null hypothesis accepted, alternate hypothesis rejected. Differences are not statistically significant across generations.
VISUAL CONTACT	0.000<0.05 **Significant**	Reject H_0, Accept H_1	Significant difference observed; null hypothesis rejected, alternate hypothesis accepted. For instance, 4th generation scored higher than 2nd generation (Mean diff = 0.4800).

4.8. Key Findings discussion and Summary

4.8.1. How have communal circulation space typologies changed over time?

- How have the communal circulation spaces (vertical and horizontal) within the building typologies of a mass housing project (condominiums) in Addis Ababa transformed over time?

During this analysis, the existing and constructed condominium housing design types were analyzed based on different factors. Design is one factor, and it plays a significant role during the construction process of those houses. Based on these findings, 44 different designs were constructed within the program (IHDP). All these designs have their special features, but to analyze their impact on the life of the dwellers, it is necessary to rearrange and minimize them by selecting some dominant characteristics. The factors include the construction period, design change, the arrangement of different blocks, the arrangement of housing units within a floor, and the position of vertical and horizontal circulation. Based on this, the four generations were identified.

Generation 1: - Out of the four generations, Generation one contains the first design types, including the pilot projects for the (IHDP). The program attempted to address the inevitable difficult cultural transition of some occupants in moving from low-rise buildings to high-rise buildings by providing a well-designed neighborhood, provision of communal buildings, and a strong connection to the land. (Condominium housing in Ethiopia, UN-Habitat)

Based on this, all generation one design types contain 2 basic design features to maximize the strong connection to the land and to minimize the impact of the cultural transition of occupants by providing a single loaded corridor and central and open vertical circulation. The single-loaded corridor system plays a significant role by creating more open and ventilated circulation. This open circulation allows the dwellers to view the surrounding area within or across the building in addition to its open spaces. The vertical circulation (stairs) was intentionally designed in the central part of the buildings, not only for easy access but also to increase security. The central circulation is visible from every direction, so for the dwellers, it is easy to monitor their surroundings and control their neighborhood.

For project sites that contain generation one rearranging unit blocks around outdoor green space in order to create common green areas were easier because of the position of the horizontal

circulation. Since this common green area is located in the center and visible from the corridors of the surrounding block it creates better social interaction and improves quality of life.

Generation 2: - During the construction and the implementation period of the pilot project sites the construction and quality of the central vertical circulation created differences between the contractor and dwellers. one respondent from the Addis Ababa housing office states that the dwellers reported about the quality of the vertical circulation (stair) since it was constructed separately by steel and connected to the main structure by bolt and escrow. So after this report, he stated that the office decided to change its construction to a concert structure initially, but through time the position of the stairs was completely changed and recessed into the building.

Even though the housing designs were similar with generation one and the quality of the vertical circulation was ensured, safety has become another point, in this generation from the horizontal circulation it is difficult to see what is happening in the vertical circulation and vice versa.

Since most designs allow to creation of the central green area but the position of the stairs far from public eye and makes it hard for the dwellers to navigate what is happening in the stair from the common space and from the adjacent blocks.

Generation 3: - is completely different from generation one but by the position of the stair similar to generation two. Buildings in this generation have either l shaped confined space or double loaded coridor.in this generation the position of both vertical and horizontal circulation change and the overall design forms in this generation shifts from the original idea which is strong connection to land.

The corridors found in the middle of the housing units are darker and no or minimum contact to the surrounding environment or with the other building block. Dwellers in this typology's completely separated from their surroundings.

The form and the arrangement of the housing units in generation three didn't allow the housing block to interact with its surroundings.

Generation 4: - This is among the last generations of the IHDP. At this point, the overall dimensions of the project changed, and Densification has become the driving concept behind condominium housing. The IHDP believes that it is generally more expensive to create lateral development than vertical development, so high-rise housing should be encouraged, especially in valuable inner-city locations. (Condominium housing in Ethiopia, UN-Habitat)

Even though the social makeup of society didn't change, the design of the housing block and the overall attempt to ward off socialization changes. Additional technologies were implemented to enhance vertical circulation, and long, narrow double-loaded corridors were implemented to accommodate the desired number.

The corridors become darker because of the arrangement of the housing units, and circulation monitoring within the building blocks becomes slightly difficult since the horizontal and vertical circulations are visually disconnected.

To conclude, the overall generation change negatively affects the dwellers. Both vertical and horizontal circulation become darker and recessed from the eye of the dwellers, which makes it difficult to supervise their surroundings. In addition, it is difficult to figure out the position of central circulation in recent generations. The social interaction and the arrangement of common green areas changed the amount of engagement. In recent generations, it has been difficult for the dwellers to oversee the common green area.

4.8.2. How do residents perceive the effectiveness of current circulation spaces?

The effectiveness of the recent circulation was determined by analyzing the 11 factors about residents' preferences and perceptions as follows:

Security: - In recent generations, the design of the building as well as the position of the circulation spaces has been more complicated than the previous generations. Because of long and dark horizontal circulation and recessed vertical circulation, it is difficult to get a clear vision of who is around you, even when going up and down, and even walking down the circulation. Since the space is closed off, it is difficult to monitor other buildings across through circulation spaces. In recent generations, monitoring any suspicious activities on the floor or building is not as easy as compared with the previous one.

Safety: - The safety issue mainly relates to the building design. In recent designs, because of the arrangement and complication of communal space, safety has become a big issue. The corridor space is not safe for children to play in since it is darker, and most of the time it is difficult to monitor the circulation. In addition to that, since the building is closed off, it is difficult for the dwellers to monitor their children while they are playing in the communal playground.

Sense of community: - In recent generations, the horizontal circulation is a bit wider to accommodate the density, and in some designs, there is intentional open space around the vertical circulation (elevator) to facilitate the circulation. During occasional activities like life

memorials or any small festivals, the residents use these spaces even though the space is dark. Since the corridors are double loaded, the circulations are confined, which makes the space suitable to ease social gatherings.

Quality of life: - Privacy is one indicator of the quality of life in the recent housing designs, because of its horizontal and vertical densification, it is challenging to address privacy properly. During the special arrangement of the housing units, the designers chose a double double-loaded corridor system to accommodate the maximum number of users since the layout of the house ranges on both sides of the circulation, the arrangement influences on day-to-day life of the dwellers and decreases their privacy.

Accessibility: accessibility in this case is mainly affected by the construction and supervision of the buildings. During this research period, a lot of supervision and construction mistakes were observed, but since the last generation's high-rise and complicated designs, more mistakes were observed. It is difficult for a person with disabilities to access the buildings since in most of the buildings, elevators weren't installed, and even if the steps weren't placed evenly, any individual can trip while walking on the stairs.

Health & physiological well-being: - Most of the time, our health is influenced by what we perceive from our surroundings. Our surroundings in the long run improve or deteriorate our health. In the recent designs, the chance of getting natural light sufficient for the eye is low, and it is difficult to warm an infant with natural light without going to the playground or public space. The space is suffocated and what they see when they step outside their houses doesn't give them mental satisfaction since what they get is a row of housing units.

Flow and circulation: - Recent designs the circulation is relatively wider and longer, it is not hard for two people to move on the corider.it is not hard to use a stroller or a wheelchair in the horizontal circulation but since the elevator didn't install the effectiveness of the circulation race a question.

Light and ventilation: - the amount of light and ventilation is determined mainly by the design since the recent designs are closed off the corridor, stair and circulation spaces didn't get proper light and ventilation.in some design the corridors have good circulation but in some it is suffocated.

Technology: - In recent housing design, some advanced technologies were incorporated in the design, but since the supervision and implementation of rules and regulations are low, this technology wasn't implemented in most of the buildings. There is no surveillance system or access control system. The building didn't use eco-friendly and renewable light sources, and most

importantly, since these recent constrictions are high-rise space, the elevator did provide, but no installation. This creates more hazardous situations for the inhabitants.

Hazard communication: - This communication medium is considered a luxury in the country. Even if they are crucial in a building, we only get them in private buildings or luxurious apartments or hotels. These signs help the residents to be alert about what is going on there building and help them to evacuate safely during emergencies. Signs of stairs, floor numbers, exit marks, and alerts that notice a fire or other hazard weren't installed in any building blocks. This makes communication difficult for the inhabitants.

Visual contact: - In the early generations, because of their open nature, building blocks and open green areas were connected visually, and this created a strong social bond and a sense of community. In recent designs, because of the closed nature of the building visual connection is restricted. What dwellers perceived in front of their houses when they opened their doors didn't encourage an active lifestyle. It is difficult to monitor what is going on in the playground, open space, and green area is difficult because the building is closed off and doesn't encourage or consider this kind of interaction.

4.8.3. How do these spatial transformations impact the daily lives of residents?

The overall special transformation affects the day-to-day lives of the residents. Dwellers who live in the early generations (Generation One and Generation 2) feel more secure and safe because of their circulation space design. Since their circulation is open and the position of the vertical circulation any suspicious activity monitored by the whole society (within or across the building) this makes the generations more secure and safer. But in recent designs because of the closed or semi-closed circulation the dwellers feel less secure and safe.

The sense of community and social life plays a big role in the life of the dwellers in early condominiums. The social interaction and the social bond are strong because their building arrangement helps them to interact visually, and this interaction leads to a strong bond. In recent designs, the closed future of the designs didn't allow the dwellers to interact visually or physically the buildings stand alone, and it is difficult to supervise what is going on their floor or in their building, creating loneliness.

In terms of health, dwellers in early generations get natural light and adequate light for the eye in their doorsteps, and the open nature of the design gives them proper air circulation In addition, what they see when they step out of their door is more satisfying than in the latest generation.

The confined nature of the early generation affects the health of the dwellers. The amount of light they get is relatively low, and the air circulation is not satisfactory.

Finally, all the issues related to technology (elevator) or communication (signs) are common throughout the four generations, but since the last generation is high-rise the implementation of these technologies was crucial, and their absence affects the life of the dwellers significantly. The implementation of rules and regulations during and after the construction of the house and the lack of proper supervision during the construction process affect the day-to-day life of the dwellers, especially in the recent high-rise condominiums.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

Based on the results and key findings the following conclusion was drawn regarding the Transformations of Communal Circulation Spaces in Addis Ababa's Condominiums. From the first generation to the last fourth generation not only housings are provided with low cost but also plays a vital role in promoting urban development by covering total Area of 90,509,869 square meters having 36,652 buildings Number of Buildings in Adis Ababa. A significant spatial transformation was observed regarding the communal space circulation spaces between 1st generation, 2nd generation, 3rd generation, and 4th generation each having different designs, features, and functions. The correlation results suggested that according to 407 residents the factors Security, Safety, Accessibility, Health, physical and Philological impact, Flow and circulation, Light and ventilation, Technology, and Visual contact showed positive and negative significant association with the Four types of generation. Univariate Analysis of factors shows factors with their significance value: security (0.04 <0.05 (α)), safety (0.00 <0.05(α)), sense of community (0.032 <0.05(α)), (quality of life 0.03 <0.05 (α)), health & physiological (0.00 <0.05 (α)), flow & circulation (0.00 <0.05 (α)), light (0.003 <0.05 (α)), and visual contact (0.00 <0.05(α)), showed a significance difference perception between dwellers of four types of generations. The investigation finds that new condominium generations demonstrate slight safety and security gains although inhabitants perceive them poorly regarding accessibility and illumination and health consequences and technology integration and visual quality. The contradictory results reveal design evolution discrepancies which demand deeper research for design enhancement. Accessibility and technological factors were found to be not significant as perceived by the residents due to implementation like Elevator, ramps, caution signals remained although the space and designs are allocated.

The topological of communal and circulation space evolution assessment finding showed 1st generation and 2nd generation found out to be easier to monitor activities on the communal space because the stairs, corridors, and houses on the floor will not block the vision of residents to monitor activities. Which results in more security and safety gained on earlier generations. The recent generations (4th generation) likely evolved to become confined making the communal and stair access hidden from the public view, although this promotes privacy, residents perceived worried regarding the activities and also lacks natural lighting inside the common area.

All in all, all the generations of the condominiums have their own unique features. transformation of communal circulation spaces across condominium generations in Addis Ababa reflects inconsistent design evolution. These shifts highlight the need for a more balanced and user-centered approach in future designs to ensure that spatial transformations enhance both functionality and livability.

5.2. Recommendation

As per the findings of this study, it is obvious that the development of communal circulation areas among condominium generations in Addis Ababa varies significantly, influencing inhabitants' daily lives and quality of life. For betterment of the design, functional efficiency, and long-term use of condominium housing, the recommendations given below are made:

- Sustainably assess opportunities for improving community circulation space through diagnosis of functional needs and application of best practices with focus towards user needs.
- Develop housing strategies focused on user design that places residents' physical, psychological, and accessibility requirements at the center of space circulation design.
- Implement strong accountability and quality measures throughout project delivery to ensure outcomes match expectations in terms of time, cost, and construction quality.

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APPENDIX A: QUESTIONER

EiABC
Ethiopian Institute of Architecture, Building Construction and City Development
የኢትዮጵያ አርክቴክቸር፣ ህንፃ ግንባታ እና ከተማ ልማት ተቋም
Addis Ababa University
አዲስ አበባ ዩኒቨርሲቲ

TRANSFORMATIONS OF COMMUNAL CIRCULATION SPACES IN ADDIS ABABA'S CONDOMINIUMS

This questionnaire has been designed to collect data for a research study entitled "Transformations of Communal Circulation Spaces in Addis Ababa's Condominiums", and I invite you to provide us with your honest and humble perceptions on the matter. Your responses will remain confidential and will be used in an effort to better understand the specifics of the topic. I ask that you take the time to write as much detail, facts, and semantic richness as possible so that our results can be further refined. Your input is invaluable to my study, and I thank you for taking the time to contribute your perspective. The more accurate information you provide with, the clearer the results will become. Also, please ensure that each response includes a high level of semantic richness - think beyond just words when writing out your responses and consider how they could relate back to other topics within the larger context of the study.

Please put a thick mark on the agreement scale				
1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
			✓	

Thank you in advance

Sincerely yours!

Hawi Hikam

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Section One: Questions to analyze the effect of spatial transformation of designs on the daily lives of residents

Security	5	4	3	2	1
1. Less burglar accessibility on the building floors					
2. You can monitor others building across thorough circulation space					
3. You can get a clear vision of who is around you when going up and down and circulating on the building					
4. Easy to monitor any suspicious activity on the floor or building					
Safety	**5**	**4**	**3**	**2**	**1**
1. You feel safe when your children's are playing at the corridor and stairs					
2. You can monitor your children's across their children's while they play on the playground					
3. Children's are safe while circulating on the stairs					
4. There are an authorized access control (like gates on the floor)					
5. Do you feel safe if an accident happens like fire, have a safe evacuation route on the building.					
Sense of community	**5**	**4**	**3**	**2**	**1**
1. The corridors (horizontal circulation) design ease social gatherings					
2. The corridors are a great place to socialize with neighbours					
3. The communal circulation space affluence casual encounters with neighbours					
4. The communal circulation space is very convenient Doing a community clean-up on the floor and building					
5. The communal circulation space is very suitable reaching out to others					
6. It Is easy to conduct occasional activities like life services memorial, any festival, cultural and regional occasions on the corridor					
Quality of life	**5**	**4**	**3**	**2**	**1**
1. The standard of life you are living is high					
2. The passage to your house is clear and comfortable (corridors and stairs)					
3. Socializing					

4. Privacy					
Accessibility	**5**	**4**	**3**	**2**	**1**
1. There is sufficient clear space for manoeuvrability or movement on the corridor and stairs					
2. A person with disabilities can visit you or you can visit (if you are) step-free access to the building entrance door for disabilities					
3. You can access the stairs easily using the handrails which are incorporated to both sides of walkways					
4. You can go up and down using the stair because the steps are clearly and visually highlighted					
5. You will not get tripped while walking on the stairs					
6. You can use Lifts or elevators anytime you want.					
7. It is easy to transport, load, and unload your objects like furniture's, large items via the current corridor and stairs.					
Health, physical and Philological impact	**5**	**4**	**3**	**2**	**1**
1. When you open your door what you see will give you a mental satisfaction and relief when you step outside.					
2. The lighting (Whether natural or manmade light) is sufficient enough for the eye.					
3. You can warm an infant with natural light without going down to the playground or public space (while you are at your corridor)					
4. You will feel loneliness based on the setup of the communal circulation space design setting					
5. There is suffocation on the corridor which needs proper ventilation setup which can lead to serious health problem.					
Flow and circulation	**5**	**4**	**3**	**2**	**1**
1. The circulation space is easy to pass by without any congestion or bottleneck					
2. The flow or movement of (e.g two) persons on one corridor at the same time is practicable (the corridor is two way)					
3. It is easy to move carrying a baby with a stroller or wheel chair					
4. You can use the circulation area as a temporary hangout place without hampering the privacy of other neighbours					
Light and ventilation	**5**	**4**	**3**	**2**	**1**
1. The corridor, stairs and the circulation space get proper light and ventilation					
2. You can see what is going on the circulation space including who is standing and any suspicion activities					
3. The circulation of air on the communal space makes the floor smells fresh					

4. The building design is designed according sites lighting and air flow setting and air space available per person and the degree of physical activity.					
Technology	**5**	**4**	**3**	**2**	**1**
1. You are able to use elevator to go upstairs					
2. The block communal circulation space used eco-friendly and renewable light source					
3. There is an authorized access control on your specific floor					
4. There is a surveillance system on the floor you are living					
Hazard communication	**5**	**4**	**3**	**2**	**1**
1. Signs of stairs, floor numbers, and exits marks were clearly and visibly located at the appropriate place.					
2. Evacuation routes (emergency exit) and circulation spaces were provided on the design.					
3. You can alert notice an accident (fire, hazard) which is in front of you by standing on the corridor or stair					
4. You can sense a hazard initiated on your floor					
Visual contact	**5**	**4**	**3**	**2**	**1**
1. What you see in front of your house when you open the door encourages you an active lifestyle.					
2. You can monitor what is going on the ground play, open space, green area and in the compound just looking through communal circulation space.					
3. You can reach out or see what is happening on building in front or beside your block					

APPENDIX B: JOURNAL ARTICLE MANUSCRIPT

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TRANSFORMATIONS OF COMMUNAL CIRCULATION SPACES IN ADDIS ABABA'S CONDOMINIUMS.

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ABSTRACT

The spatial evolution of communal circulation spaces particularly corridors, stairs, and shared access ways of IHDP evolves through time. This article is aimed to understanding how the evolution of design typologies through history has affected the current spatial formations and what impact these have on the day-to-day experiences and expectations of residents. Using proportionate sampling methods, data were collected from 407 residents through self-administered questionnaires, with results further supported by research methods such as direct observation. Systematic recording and comparison of typological differences between the four generations of condominiums were made. Analysis revealed significant differences in residents' perceptions in the areas of safety, security, health and physiological comfort, circulation flow, lighting, and visual connectivity. Earlier generations, particularly the first and second generations, were more stable, coherent, and accessible, whereas recent designs manifested numerous inconsistencies and functional limitations. The observations highlight the importance of spatial restructuring on housing satisfaction and emphasize the need for the adoption of user-friendly, inclusive, and responsive design strategies to improve the quality and functionality of communal spaces in future housing developments in Addis Ababa.

Key words: *Condominiums, Circulation Spaces, Communal Spaces, Evolution, Generations, Spatial Transformations, Residents*

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INTRODUCTION

Addis Ababa, the capital city of Ethiopia, has experienced rapid urbanization and population growth in recent decades, leading to a severe shortage of affordable housing. To address this issue, the government has implemented several mass housing projects, including the initiation of the nationwide integrated housing development Program - IHDP in 2003 aiming at supplying affordable housing units for low and middle income Households (AHMED and BAŞDOĞAN).

This scheme has been continuing to develop with varied alterations spatial designs to the overall design and communal circulation spaces to address the impending different challenges such as resolving the high urban housing demand, changing the image of the city by upgrading environmentally polluted areas like slums, job creation for unemployed residents of the city, creating market opportunity to small scale enterprises, Promoting affordable housing scheme, Promote targeted subsidy to the urban poor (Ingwani, Gondo et al. 2010, Keller and Mukudi-Omwami 2017).

Building blocks constructed under the IHDP are characterized by having variety of design transformation communal circulation spaces, both vertical (elevators and stairs) and horizontal (corridors and common areas), which play a critical role in the daily lives of their residents.

METHODOLOGY

Data types and Data source

Both Primary and Secondary dates were used for the research. Self-observation and Self-administered questioner were used to further investigation. In addition to that plan, site plan and 3d illustrations used as a data source.

Sampling methods

Given that this study needs a longitudinal survey, the method suggested by (Viechtbauer, Smits et al. 2015) would be the most suited for determining the sample size.

$$n = \frac{(1.96^2 xpxq)}{e^2} \ldots\ldots\ldots\ldots\ldots Equation\ 1$$

(For population >100,000)

(n):-sample size

(p):-prevalence of the condition

(q):- likelihood

(e):-estimation's accuracy

(z):-1.96 (from the conventional normal variety tables)

$$n = \frac{(1.96^2 x0.05x0.05)}{2.718^2}$$

$$= 384.6\ approximatley\ 385\ up\ to\ 400$$

The total number of residential owners or dwellers considered as respondents were around 400. Those 385 resources will be selected using proportional sampling based on the total number of residents and the type generation from each site as follows:

For 400 sample respondents the proportion will be computed taking 400 as 100%

Type of generating	Number of residents	Proportional sample
4th	163530	171.1438 approximately 171
3rd	36840	38.55523 approximately 39
2nd	143460	150.1393 approximately150
1st	38375	40.16169 approximately 41

Data analysis and interpretation

Both Qualitative and Quantitative data's were used for the research. Quantitative analyses was utilized to describe means,

percentages, frequencies, coefficients of variation, and standard deviations using both descriptive and inferential statistical approaches. To make comparisons, arguments, and interpretations, the qualitative analyses were utilized. Dwellers or residents as the responders of the self-administrative questionnaires in a longitudinal study design utilizing a deductive technique. On a Likert scale with five possible responses, the questioner (Appendix A) will receive an answer.

The result data will be presented using qualitative description, quantitative analysis by charts, tables, and figures.

The descriptive and inferential statistics were computed on as statistical tool which is called Statistical Package for the Social Sciences (SPSS) version 32.and Confirmatory Factor Analysis techniques will be computed using AMOS Plugin. For drafting of topologies Adobe Illustrator version 20.1 and REVIT software for plan and 3D were used.

Assessment of historical evolution of typologies and their circulation system.

During this analysis, the existing and constructed housing design types under IHDP were analyzed based on different factors. Design is one factor, and it plays a significant role during the construction process of those houses. Based on these findings, 44 different designs were constructed within the program (IHDP).

All these designs have their special features, but to analyze their impact on the life of the dwellers, it is necessary to rearrange and minimize them by selecting some dominant characteristics. The factors include the **construction period**, **design change**, **the arrangement of different blocks**, the **arrangement of housing units within a floor**, **and the position of vertical and horizontal circulation**.

Based on this, the four (4) generations were identified.

First Generation Condominiums: Site Assessment

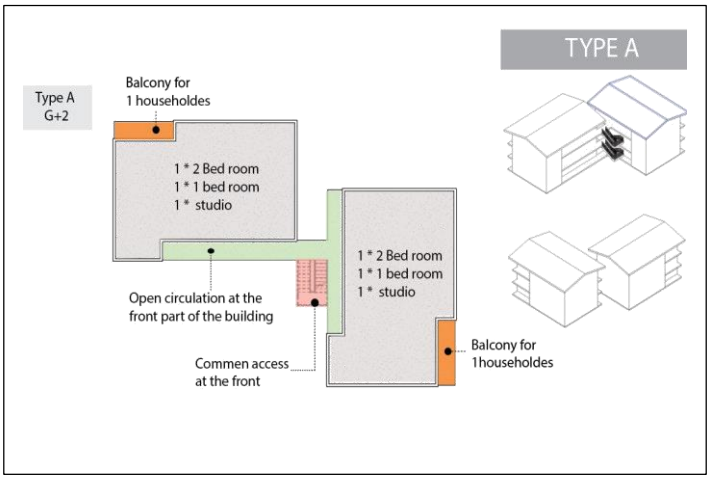
The first-generation condominium housing schemes are a key initial effort in the integrated housing development Program (IHDP), formulated to address growing urbanization and widening demand for affordable residential infrastructure. The findings of the assessment are that 102 separate sites are envisaged under the first-generation condominium schemes. The projects are located in 11 sub-cities, an apparent deliberate effort at achieving balanced spatial coverage and accessibility in Addis Ababa.

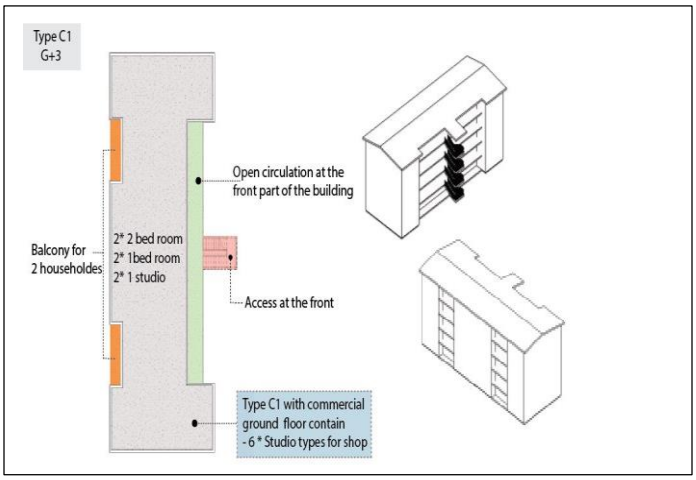
The inventory revealed that the sites contain a total of 1,535 residential structures with a total land area of approximately 3,674,253 square meters (or 367.4 hectares). The scale reflects the government's huge investment in urban housing during the early stages of the condominium program. There were also a total of 470 communal areas found to be playing a significant role of making the sites more habitable. These common areas include shared green spaces, recreational

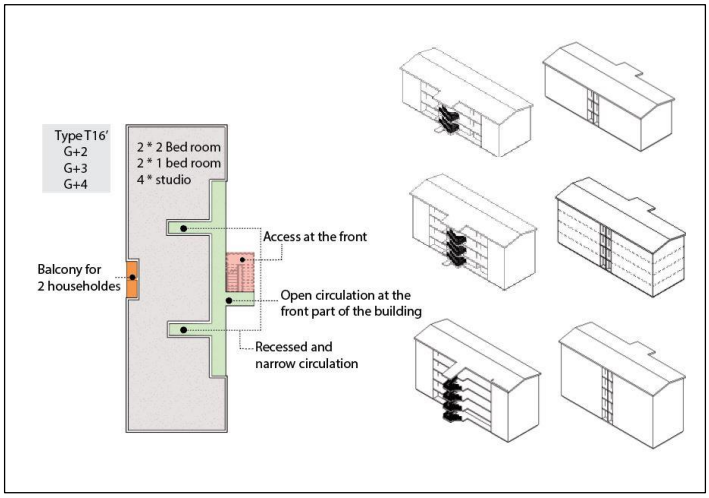
spaces, and open courtyards that are designed to enhance social interaction, community engagement, and a more desirable urban way of life.

Out of the four generations, Generation one contains the first design types, including the pilot projects for the (IHDP). The program attempted to address the inevitable difficult cultural transition of some occupants in moving from low-rise buildings to high-rise buildings by providing a well-designed neighborhood, provision of communal buildings, and a strong connection to the land. (Condominium housing in Ethiopia, UN-Habitat).

Based on this, all generation one design types contain 2 basic design features to maximize the strong connection to the land and to minimize the impact of the cultural transition of occupants by providing a single loaded corridor and central and open vertical circulation. The single-loaded corridor system plays a significant role by creating more open and ventilated circulation. This open circulation allows the dwellers to view the surrounding area within or across the building in addition to its open spaces. The vertical circulation (stairs) was intentionally designed in the central part of the buildings, not only for easy access but also to increase security. The central circulation is visible from every direction, so for the dwellers, it is easy to monitor their surroundings and control their neighborhood. Even though they all have common features in general there are about 18 different building designs.







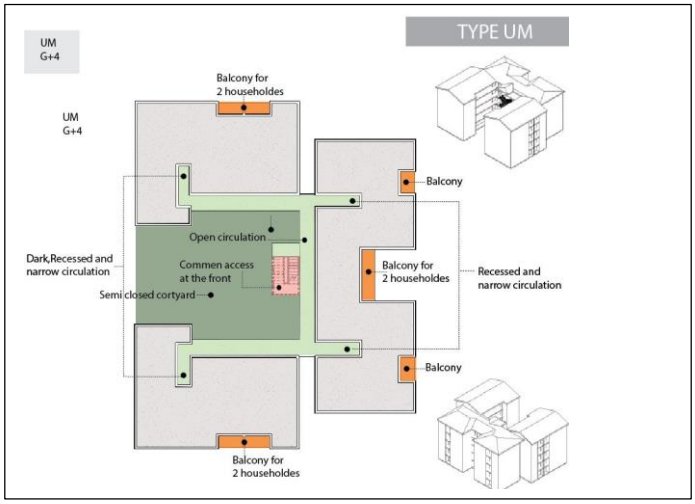


Figure1: First Generation Typology exemplary buildings

Source (Author, 2025)

Second Generation Condominiums: Site Assessment

The second-generation condominiums are found in five strategically located sub cities of Kolfe Keranio, Nefas Silk Lafto, Yeka, Bole, and Akaki Kaliti. These take up a vast 11,811,835 square meters space, and include a total of 4,782 buildings, and therefore this generation is the largest in terms of size. The discovery of the assessment highlighted the wide spatial extent and the substantial investment in the residential infrastructure of different zones of the city. 534 community facilities were incorporated, and it reflects a keen commitment to encouraging interaction between communities and the quality of city life. Places like Jemo and Hana Mariam are unique in size and accessibility, and places like Bole Bulbula focus on accessibility and integration into transport corridors.

The second design types were designed by slightly altering the design of generation one with recessed vertical circulation. In this generation from the horizontal circulation it is difficult to see what is happening in the vertical circulation and vice versa. But they can see across the building in addition to its open spaces. In addition to that it is not easy to find the location vertical circulation and it is not visible from every direction, it is hard for the dwellers to monitor their surroundings and control their neighborhood.

Since most designs allow to creation of the central green area but the position of the stairs far from public eye and makes it hard for the dwellers to navigate what is happening in the stair from the common space and from the adjacent blocks.

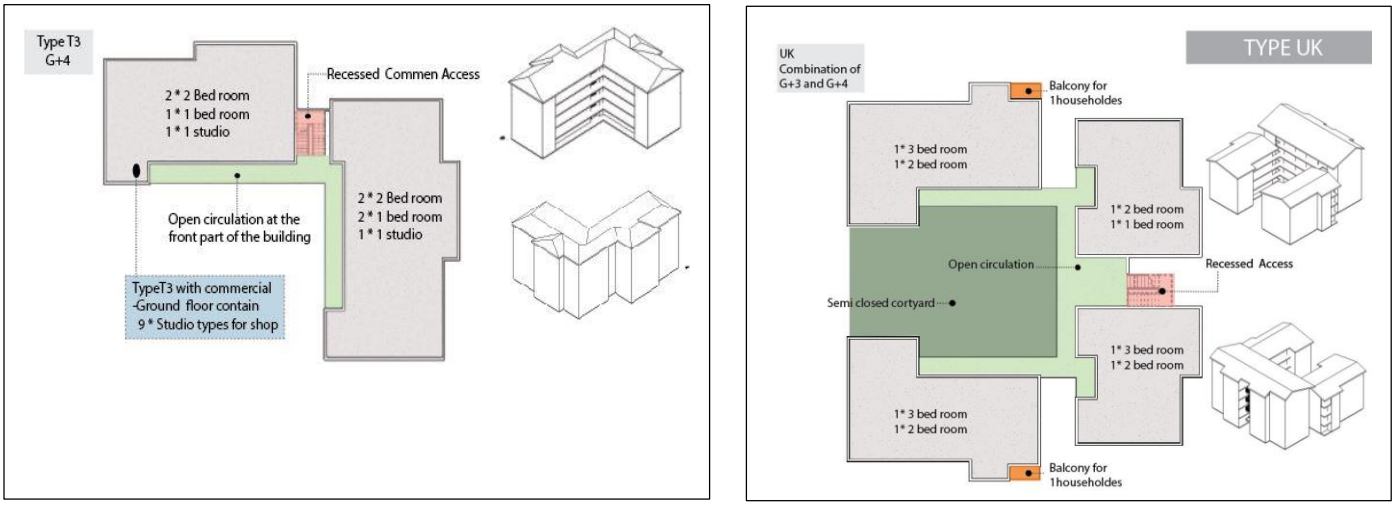


Figure 2: Second Generation Typology *exemplary buildings*

Source (Author, 2025)

The next two images are exemplary images which could be taken as example to show designs in generation one were slightly altered with recessed circulation and converted to generation two typology.

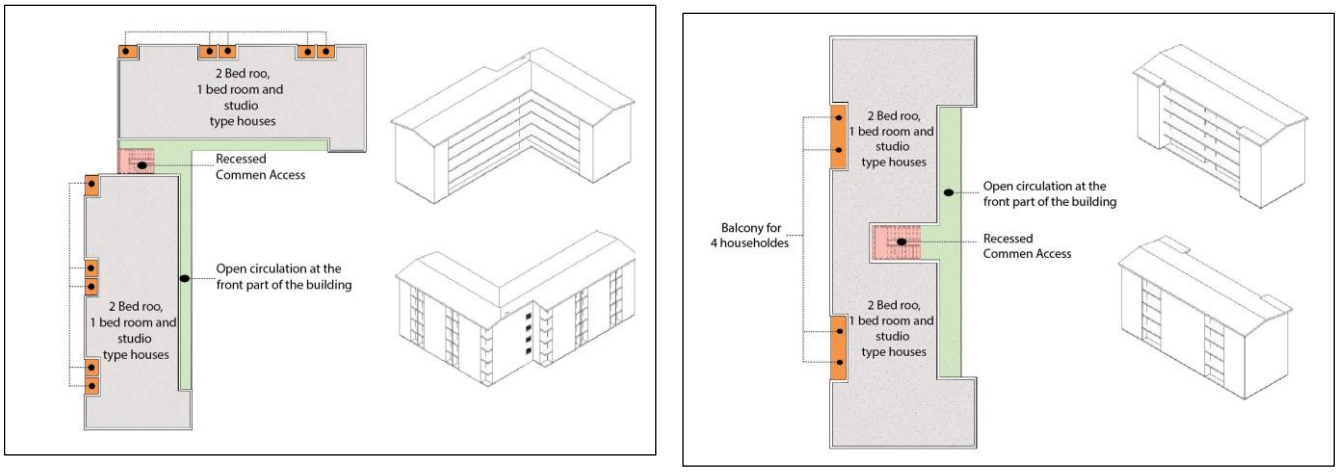


Figure 3: Second Generation Typology *exemplary buildings*

Source (Author, 2025)

Third Generation Condominiums: Site Assessment

More densely and centrally concentrated, third-generation condominiums are found in three sub cities, Ledeta, Arada, and Bole. Covering a small 130,139 square meters, this generation consists of 921 buildings. The effects of the assessment were greater emphasis, with growth being focused in infill lots and highly sought-after urban areas. Growth only covered 2 community areas, suggesting a more limited supply for common facilities, possibly due to spatial constraints. The locations, although smaller in number, are well-positioned like Arada and Ledeta utilizing under-developed plots within aging neighborhoods to support increased housing supply where the demand is particularly significant.

The Third generation is completely different from generation one but by the position of the stair similar to generation two. Buildings in this generation have either L shaped confined space or double loaded coridor.in this generation the position of both vertical and horizontal circulation change and the overall design forms in this generation shifts from the original idea which is strong connection to land.

The corridors found in the middle of the housing units are darker and no or minimum contact to the surrounding environment or with the other building block. Dwellers in this typology's completely separated from their surroundings.

The form and the arrangement of the housing units in generation three didn't allow the housing block to interact with its surroundings.

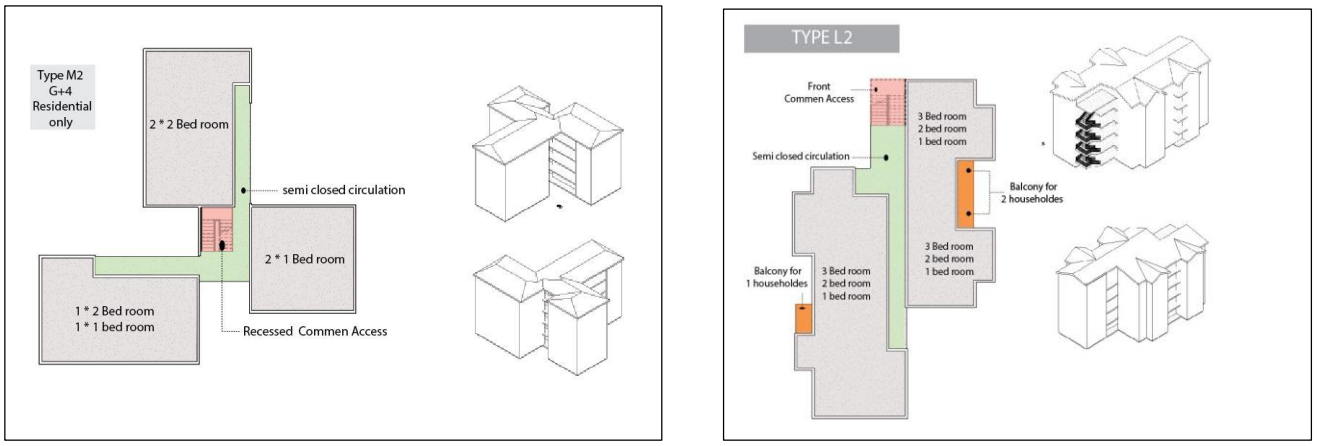


Figure 4: Third Generation Typology *exemplary buildings*

Source (Author, 2025)

Fourth Generation Condominiums: Site Assessment

The fourth-generation development is dispersed over five sub cities: Kolfe Keranio (K.K), Nefas Silk Lafto (N.L), Yeka, Bole, and Akaki Kaliti. Developed over a total of 6,092,677 square meters with 1,817 buildings, this phase is a continuation of high-density, large-scale development. Spatial efficiency and communal support infrastructure were identified as the prime focus, and a total of 462 communal spaces were built to accommodate social and recreational uses. The developments include key sites such as Jemo Gara and parts of Bole Arabsa, which were defined by possessing a well-designed pattern and proximity to public amenities. This generation demonstrates a developing urban design approach with integration of housing within communal as well as infrastructural planning.

This is among the last generations of the IHDP. At this point, the overall dimensions of the project changed, and Densification has become the driving concept behind condominium housing. The IHDP believes that it is generally more expensive to create lateral development than vertical development, so high-rise housing should be encouraged, especially in valuable inner-city locations. (Condominium housing in Ethiopia, UN-Habitat)

Even though the social makeup of society didn't change, the design of the housing block and the overall attempt to ward off socialization changes. Additional technologies were implemented to enhance vertical circulation, and long, narrow double-loaded corridors were implemented to accommodate the desired number.

The corridors become darker because of the arrangement of the housing units, and circulation monitoring within the building blocks becomes slightly difficult since the horizontal and vertical circulations are visually disconnected.

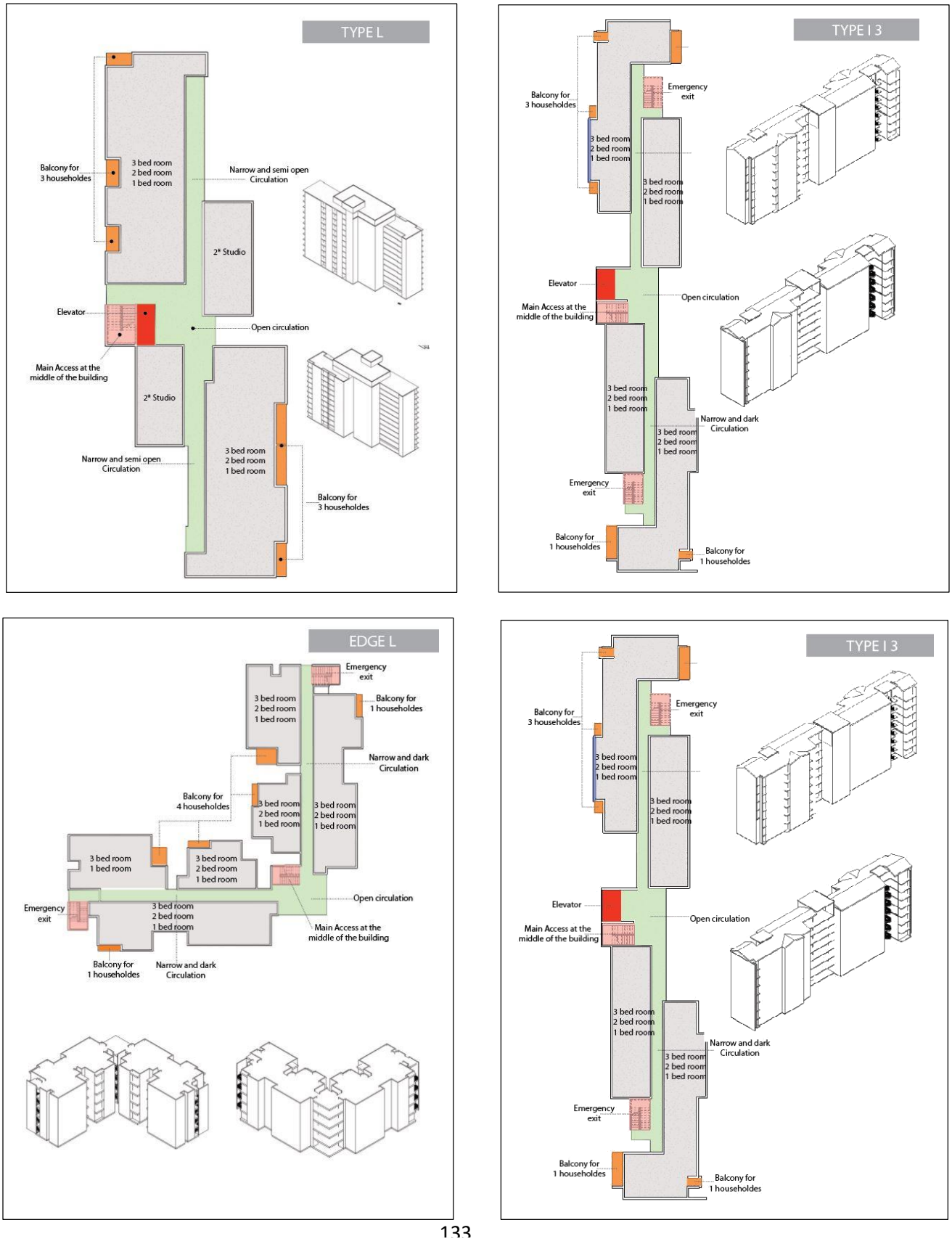


Figure 5 Fourth Generation Typology exemplary buildings

Source (Author, 2025)

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS.

Summary of findings

The effectiveness of the recent circulation was determined by analyzing the 11 factors about residents' preferences and perceptions as follows:

Security: - In recent generations, the design of the building as well as the position of the circulation spaces has been more complicated than the previous generations. Because of long and dark horizontal circulation and recessed vertical circulation, it is difficult to get a clear vision of who is around you, even when going up and down, and even walking down the circulation. Since the space is closed off, it is difficult to monitor other buildings across through circulation spaces. In recent generations, monitoring any suspicious activities on the floor or building is not as easy as compared with the previous one.

Safety: - The safety issue mainly relates to the building design. In recent designs, because of the arrangement and complication of communal space, safety has become a big issue. The corridor space is not safe for children to play in since it is darker, and most of the time it is difficult to monitor the circulation. In addition to that, since the building is closed off, it is difficult for the dwellers to monitor their children while they are playing in the communal playground.

Sense of community: - In recent generations, the horizontal circulation is a bit wider to accommodate the density, and in some designs, there is intentional open space around the vertical circulation (elevator) to facilitate the circulation. During occasional activities like life memorials or any small festivals, the residents use these spaces even though the space is dark. Since the corridors are double loaded, the circulations are confined, which makes the space suitable to ease social gatherings.

Quality of life: - Privacy is one indicator of the quality of life in the recent housing designs, because of its horizontal and vertical densification, it is challenging to address privacy properly. During the special arrangement of the housing units, the designers chose a double double-loaded corridor system to accommodate the maximum number of users since the layout of the house ranges on both sides of the circulation, the arrangement influences on day-to-day life of the dwellers and decreases their privacy.

Accessibility: accessibility in this case is mainly affected by the construction and supervision of the buildings. During this research period, a lot of supervision and construction mistakes were observed, but since the last generation's high-rise and complicated designs, more mistakes were observed. It is difficult for a person with disabilities to access the buildings since in most of the buildings, elevators weren't installed, and even if the steps weren't placed evenly, any individual can trip while walking on the stairs.

Health & physiological well-being: - Most of the time, our health is influenced by what we perceive from our surroundings. Our surroundings in the long run improve or deteriorate our health. In the recent designs,

the chance of getting natural light sufficient for the eye is low, and it is difficult to warm an infant with natural light without going to the playground or public space. The space is suffocated and what they see when they step outside their houses doesn't give them mental satisfaction since what they get is a row of housing units.

Flow and circulation: - Recent designs the circulation is relatively wider and longer, it is not hard for two people to move on the corider.it is not hard to use a stroller or a wheelchair in the horizontal circulation but since the elevator didn't install the effectiveness of the circulation race a question.

Light and ventilation: - the amount of light and ventilation is determined mainly by the design since the recent designs are closed off the corridor, stair and circulation spaces didn't get proper light and ventilation.in some design the corridors have good circulation but in some it is suffocated.

Technology: - In recent housing design, some advanced technologies were incorporated in the design, but since the supervision and implementation of rules and regulations are low, this technology wasn't implemented in most of the buildings. There is no surveillance system or access control system. The building didn't use eco-friendly and renewable light sources, and most importantly, since these recent constrictions are high-rise space, the elevator did provide, but no installation. This creates more hazardous situations for the inhabitants.

Hazard communication: - This communication medium or signs often considered as luxury in our country Ethiopia. Even if they are crucial in a building, we only get them in private buildings or luxurious apartments or hotels. These signs help the residents to be alert about what is going on there building and help them to evacuate safely during emergencies. Signs of stairs, floor numbers, exit marks, and alerts that notice a fire or other hazard weren't installed in any building blocks. This makes communication difficult for the inhabitants.

Visual contact: - In the early generations, because of their open nature, building blocks and open green areas were connected visually, and this created a strong social bond and a sense of community. In recent designs, because of the closed nature of the building visual connection is restricted. What dwellers perceived in front of their houses when they opened their doors didn't encourage an active lifestyle. It is difficult to monitor what is going on in the playground, open space, and green area is difficult because the building is closed off and doesn't encourage or consider this kind of interaction.

Multiple comparison

The overall generation change in most cases affects the dwellers negatively. In recent generations both vertical and horizontal circulation become darker and recessed from the eye of the dwellers, which makes it difficult to supervise their surroundings. In addition, it is difficult to figure out the position of central circulation. The closed off design of the building blocks and the arrangement of common green areas changed the amount of engagement of the dwellers and affects their social interaction. In recent generations, it has been difficult for the dwellers to oversee the common green area.

Security and Safety: - The overall special transformation affects the day-to-day lives of the residents. Dwellers who live in the early generations (Generation One and Generation 2) feel more secure and safe because of their circulation space design. Since their circulation is open and the position of the vertical circulation any suspicious activity monitored by the whole society (within or across the building) this makes the generations more secure and safer. But in recent designs because of the closed or semi-closed circulation the dwellers feel less secure and safe.

The sense of community and social life:- The sense of community and social life plays a big role in the life of the dwellers in early condominiums. The social interaction and the social bond are strong because their building arrangement helps them to interact visually, and this interaction leads to a strong bond. In recent designs, the closed future of the designs didn't allow the dwellers to interact visually or physically the buildings stand alone, and it is difficult to supervise what is going on their floor or in their building, creating loneliness.

Health and Visual contact:- In terms of health, dwellers in early generations get natural light and adequate light for the eye in their doorsteps, and the open nature of the design gives them proper air circulation In addition, what they see when they step out of their door is more satisfying than in the latest generation. The confined nature of the early generation affects the health of the dwellers. The amount of light they get is relatively low, and the air circulation is not satisfactory.

Technology and Hazard communication: - all the issues related to technology (elevator) or communication (signs) are common throughout the four generations, but since the last generation is high-rise the implementation of these technologies was crucial, and their absence affects the life of the dwellers significantly. The implementation of rules and regulations during and after the construction of the house and the lack of proper supervision during the construction process affect the day-to-day life of the dwellers, especially in the recent high-rise condominiums.

Conclusions

Based on the results and key findings the following conclusion was drawn regarding the Transformations of Communal Circulation Spaces in Addis Ababa's Condominiums. From the first generation to the last fourth generation not only housings are provided with low cost but also plays a vital role in promoting urban development by covering total Area of 90,509,869 square meters having 36,652 buildings Number of Buildings in Addis Ababa. A significant spatial transformation was observed regarding the communal space circulation spaces between 1st generation, 2nd generation, 3rd generation, and 4th generation each having different designs, features, and functions. The correlation results suggested that according to 407 residents the factors Security, Safety, Accessibility, Health, physical and Philological impact, Flow and circulation, Light and ventilation, Technology, and Visual contact showed positive and negative significant association with the four types of generation.

Univariate Analysis of factors showed a significance difference perception between dwellers of four types of generations. The investigation finds that Accessibility and technological factors were found to be not significant as perceived by the residents due to implementation like Elevator, ramps, caution signals remained although the space and designs are allocated.

The topological of communal and circulation space evolution assessment finding showed 1st generation and 2nd generation found out to be easier to monitor activities on the communal space because the stairs, corridors, and housing unite on the floor will not block the vision of residents to monitor activities. Which results in more security and safety gained on earlier generations. The modest generations (4th generation) likely evolved to become confined making the communal and stair access hidden form the public view, although this promotes privacy, residents perceived worried regarding the activities and also lacks natural lighting inside the common area.

All in all, all the generations of the condominiums have their own unique features. transformation of communal circulation spaces across condominium generations in Addis Ababa reflects inconsistent design evolution. These shifts highlight the need for a more balanced and user-centered approach in future designs to ensure that spatial transformations enhance both functionality and livability.

Recommendations

As per the findings of this study, it is obvious that the development of communal circulation areas among condominium generations in Addis Ababa varies significantly, influencing inhabitants' daily lives and quality of life. For betterment of the design, functional efficiency, and long-term use of condominium housing, the recommendations given below are made:

Implementing user friendly and sustainable design approaches. Sustainably assess opportunities for improving community circulation space through diagnosis of functional needs and application of best practices with focus towards user needs.

Develop housing strategies focused on user design that places residents' physical, psychological, and accessibility requirements at the center of space circulation design.

Implement strong accountability and quality measures throughout project delivery to ensure outcomes match expectations in terms of time, cost, and construction quality.

Acknowledgement

Above all, I would like to thank the Almighty God without whose blessing; it would have been not possible for all my wishes to come into reality.

I would like to express my deepest gratitude to my advisor Alazar Assefa (Ph.D.) for his marked role in restructuring my work and guiding me through to recent approach study. His insightful comments about the improvement of the whole work were appreciable

ANNEX A: CORRELATION ANALYSIS

Table 4: Correlation Analysis

Correlations		
Variable Vs Pearson correlation coefficient and significant value		**Type of Generation**
MEAN SECURITY	Pearson Correlation	0.174**
	Sig. (2-tailed)	0.000
	N	407
MEANS AFTEY	Pearson Correlation	0.171**
	Sig. (2-tailed)	0.001
	N	407
MEAN SENSE COMMUNITY	Pearson Correlation	0.017
	Sig. (2-tailed)	0.736
	N	407
MEAN QUALITY OF LIFE	Pearson Correlation	-0.074
	Sig. (2-tailed)	0.137
	N	407
MEAN ACCESESABILITY	Pearson Correlation	-0.181**
	Sig. (2-tailed)	0.000
	N	407
MEAN HEALTH & PHYSIOLOGICAL	Pearson Correlation	-0.238**
	Sig. (2-tailed)	0.000
	N	407
MEAN FLOW & CIRCULATION	Pearson Correlation	0.104*
	Sig. (2-tailed)	0.036
	N	407
MEAN LIGHT	Pearson Correlation	-0.111*
	Sig. (2-tailed)	0.025
	N	407
MEAN TECHNOLOGY	Pearson Correlation	-0.434**
	Sig. (2-tailed)	0.000
	N	407
MEAN HAZARD COMUNICATION	Pearson Correlation	0.052
	Sig. (2-tailed)	0.294
	N	407
MEAN VISUAL	Pearson Correlation	-0.138**
	Sig. (2-tailed)	0.005
	N	407
Type of Generation	Pearson Correlation	1
	Sig. (2-tailed)	
	N	407
**. Correlation is significant at the 0.01 level (2-tailed).		

ANNEX B: ANOVA FACTOR ANALYSIS

Table 5: Univariate Analysis of factors (ANOVA)

Tests of Between-Subjects Effects						
Dependent Variable: Type of Generation						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Remark**
Corrected Model	419.808[a]	179	2.345	6.996	.000	
Intercept	38.693	1	38.693	115.42	.000	
SECURITY	8.489	15	.566	1.688	0.045	Sig (0.04) <0.05(α)
SAFTEY	16.826	18	.935	2.788	0.000	Sig (0.00) <0.05(α)
SSENSE OF COMMUNITY	11.494	20	.575	1.714	0.032	Sig (0.032) <0.05(α)
QUALITY OF LIFE	5.621	15	.375	1.118	0.037	Sig (0.037) <0.05 (α)
ACCESESABILITY	9.672	21	.461	1.374	0.132	Sig (0.132)>0.05 (α)
HEALTH & PHYSIOLOGICAL	20.650	20	1.033	3.080	0.000	Sig (0.00) <0.05 (α)
FLOW & CIRCULATION	9.934	8	1.242	3.704	0.000	Sig (0.00) <0.05 (α)
LIGHT	12.573	16	.786	2.344	0.003	Sig (0.003) <0.05 (α)
TECHNOLOGY	6.242	16	.390	1.164	0.299	Sig (0.29) <0.05 (α)
HAZARD COMUNICATION	6.842	12	.570	1.701	0.068	Sig (0.068) >0.05 (α)
VISUAL CONTACT	18.669	14	1.334	3.978	0.000	Sig (0.00) <0.05 (α)
Error	76.099	227	.335			
Total	3734.000	407				
Corrected Total	495.907	406				
a. R Squared = .847 (Adjusted R Squared = .726)						

ANNEX C: MULTIPLE COMPARISON OF GENERATIONS

Table 6: Multiple comparison from independent sample t-test

I Vs J and the mean difference is i-j												
INDEPENDENT VARIABLE	c		1ST G Vs 3RD G		1ST G Vs 4TH G		2ND G Vs 3RD G		2ND G Vs 4TH G		3rd G Vs 4TH G	
	Sig.	Mean Difference	Sig.	Mean Difference	Sig.	Mean Difference	Sig.	Mean Difference	Sig.	Mean Difference	Sig.	Mean Difference
SECURITY	0.00	0.0846	0.02	0.337	0.09	0.279	0.05	0.422	0.000	0.3645	0.120	0.0578
SAFTEY	0.00	0.2212	0.04	0.023	0.02	0.419	0.04	0.244	0.009	0.1982	0.235	0.4427
SENSE OF COMMUNITY	0.96	-0.0715	0.39	0.267	0.00	-0.067	0.20	0.196	0.000	-0.0040	0.025	-0.2003
QUALITY OF LIFE	0.60	0.2040	0.06	0.132	0.01	0.243	0.02	0.071	0.000	0.0391	0.302	0.1107
ACCESESABILITY	0.37	0.0410	0.59	0.086	0.64	0.273	0.75	0.045	0.531	0.2327	0.309	0.1869
HEALTH & PHYSIOLOGICAL	0.23	0.2375	0.07	0.565	0.04	0.306	0.01	0.803	0.000	0.5443	0.506	0.2587
FLOW & CIRCULATION	0.34	-0.0604	0.08	-0.126	0.03	-0.291	0.00	-0.065	0.001	-0.2312	0.737	-0.1654
LIGHT	0.46	0.2395	0.04	0.080	0.05	0.083	0.00	0.319	0.000	0.3232	0.439	0.0034
TECHNOLOGY	0.65	0.2531	0.60	0.574	0.71	0.546	0.23	0.321	0.305	0.2934	0.967	0.0279
HAZARD COMUNICATION	0.98	0.1553	0.44	0.944	0.68	-0.031	0.56	0.789	0.645	-0.1871	0.275	-0.9767
VISUAL CONTACT	0.46	0.3675	0.02	0.370	0.00	0.112	0.01	0.737	0.000	0.4800	0.342	0.2579