SPACE AND DOMESTIC ACTIVITY IN A 20/80 CONDOMINIUM HOUSING UNIT

The case of Gellan III condominium, Addis Ababa

This thesis is submitted to the Ethiopian Institute of Architecture, Building Construction and City Development (EiABC), Addis Ababa University for partial fulfilment of all requirements for the degree of Master of Science in Housing and Sustainable Development.

Master Thesis

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EiABC, AAU

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October 2022

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DECLARATION

I declare that this thesis prepared for the partial fulfilment of the requirement for the degree of Master of Science in Housing and Sustainable Development titled **'Space and Domestic Activity in a 20/80 Condominium Housing Unit: The Case of Gellan III Condominium, Addis Ababa'** is my original research work prepared independently by my own effort with the close guidance and supervision of my advisor. I also declare that this thesis has not been presented for a degree in any university, and all sources that I used or quoted have been acknowledged by means of complete references.

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October 2022

CERTIFICATION

Here, I state that Biruktawit Yeshigeta Aklilu has carried out this research work on the topic entitled '**Space and Domestic Activity in a 20/80 Condominium Housing Unit: The Case of Gellan III Condominium, Addis Ababa.'** under my supervision and it is sufficient for submission.

Elias Yitbarek Alemayehu (PhD)

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Date: _____

ABSTRACT

The Ethiopian government has implemented the Integrated Housing Development Program (IHDP) to tackle housing challenges in Addis Ababa amid rapid urbanization. Previous researches have shown that the IHDP has had problems regarding responsiveness of the units and urban design to occupants' needs and activities. This study examines how Gellan III condominium inhabitants utilize their housing units for domestic activities, the impact of spatial design on these activities and the vice versa. Using qualitative methods, including semi-structured interviews and space syntax analysis, the study reveals clear distinctions between chore and leisure activities, with communal and individual activities being inversely related. Women predominantly perform household chores, with most activities centered in the living room and kitchen. The corridor and living room are highly integrated and control most activities, while the kitchen, bedroom, bathroom, and balcony are more private and less integrated. The corridor is pivotal in distributing activities to other rooms, followed by the living room. Domestic activities and spatial design mutually influence each other, depending on household characteristics, activity spatial needs, and space adaptability. Some domestic activities have been minimized, relocated, disappeared, or mechanized due to spatial constraints. Spatial modifications include adding rooms, functional changes, demolition, and enlargement due to rooms being smaller than the needs of the activity, lack of designated activity spaces, and household size mismatch with house typology, privacy needs, and storage issues. The study recommends designing typologies with end-user participation, incorporating Ethiopian vernacular housing studies, and considering the relationship between activity spaces. Allocation of house typologies, partition design and material selection of walls should consider the dynamism of household. Additionally, it suggests developing kitchen designs tailored to Ethiopian needs rather than European standards, creating wider corridors, and allocating space for all activities. These adjustments aim to address the dynamic needs of households and improve the functionality of housing units.

Keywords: *Condominium, domestic activities, spatial design, space syntax*

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Table of contents

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

AAHDPO: Addis Ababa Housing Development Program Office
AACA: Addis Ababa City Administration
AAGHP: Addis Ababa Grand Housing Program
AAHA: Addis Ababa Housing Agency
AAU: Addis Ababa University
ADL: Activities of Daily Living
ARHA: Agency for the Rental Housing Administration
AU: African Union
CV: Control Value
EBCS: Ethiopian Building Code Standard
EIABC: Ethiopian Institute of Architecture, Building construction, and City Development
EPDRF: Ethiopian People's Revolutionary Democratic Front
ETB: Ethiopian Birr
GHP: Grand Housing Program
GTZ: German Technical Cooperation
HCB: Hollow Concrete Block
HSS: Housing Sector Study
HW: Hand Wash
IC: Individual Chore
IHDP: Integrated Housing Development Program
IL: Individual Leisure
IRRA: Integration in relation to Real Relative Asymmetry
LCH: Low-Cost Housing
LDP: Local Development Program
MD: Mean Depth
MER: Men Environmental Research
MES: Men Environmental Science
MSE: Micro and Small Enterprises
MUDH: Ministry of Urban Development and Housing
NDP: Neighborhood Development Plan
NGO: Non-Governmental Organization
ORAAMP: Office for Revision of the Addis Ababa Master Plan
PADCO: Planning and Development Collaborative International Organization
RA: Relative Asymmetry
RRA: Real Relative Asymmetry
TD: Total Depth
USD: United States Dollar
WC: Washing Closet

LIST OF LOCAL TERMS

Chika wall: mud and straw plastered on wooden frame

Derg (also spelled Dergue): committee

Injera: Ethiopian flat bread

Kebele: formerly the smallest administrative unit of the government. One level below wereda

Mitad: a cultural oven used to bake injera with

Woreda: currently the lowest administrative unit of the government

GENERAL NOTES

- To protect the identity of the informants and households, names are not stated, and house numbers are given symbols.
- In the citations for Ethiopian names, first names are given, and in the reference first name is followed by father's name according to the Ethiopian naming system.
- Measurement system used is the metric system.
- Unless noted, all pictures, maps, tables, and figures are produced by the author.
- All years are in Gregorian calendar unless stated otherwise.

1. CHAPTER ONE-INTRODUCTION

1.1. Background of the study

Ethiopian urban areas, particularly Addis Ababa, have experienced rapid population growth due to high natural increase rates and rural-to-urban migration. Since 1970, Addis Ababa's population has nearly tripled, while its spatial expansion has increased twelvefold, far outpacing population growth. Consequently, urban population density decreased from approximately 29,000 per m^2 to 8,000 per m^2, leading to a more horizontally spread city (Cox, 2012)

Larsen, Yeshitela, Mulatu, Seifu, Desta (2019) attribute this spatial expansion to a surge in single-family units. Although informal housing decreased from 19% to 15% over the past decade, land occupied by single-family units increased from 5% to 25%, especially in the city's western side. This expansion, coupled with high population growth, has caused land scarcity and rising prices, pressuring the government to provide infrastructure, services, and affordable housing.

To address these issues, the government has adopted compact development as a guiding principle for future city development (AACPPO, 2017). Experts worldwide believe this strategy can foster economic development, innovation, and social interaction while reducing transportation, infrastructure, health care, education, and recreation costs. The Integrated Housing Development Plan (IHDP) is a key strategy under this goal, aimed at increasing affordable housing stock. Since its inception in 2004, over 160,000 housing units have been transferred to beneficiaries, and more than 100,000 units are under construction (Elias & Stark, 2018).

These condominium neighborhoods, designed for affordability, consist of modular building blocks with high adaptability but limited opportunities for appropriation, thus restricting changes and not providing sufficient space per room for individuals (Delz, 2015). The cultural reception of these units varies, influenced by housing typologies and sometimes lacking consideration for activities like coffee ceremonies, spice drying, and children's play areas (Ingwani, et al., 2010). Consequently, residents have made various modifications ranging from painting to altering internal rooms, closing off balconies, and redesigning partitions (Bisrat, 2008).

1.2. Statement of the problem

In prior condominium[1] projects in Addis Ababa, user involvement in the design process has been minimal, leading to limited responsiveness of the units and urban design to occupants' needs and activities. Despite concerns raised in research about this issue, subsequent building typologies have seen little alteration to better suit the lifestyles of residents. Instead, a focus on affordability through standardization has driven the project, aiming to modernize housing options without sufficient consideration for local vernacular usage. (HABITAT, 2011; Alazar, 2012; Delz, 2015).

This emphasis on standardization, influenced by the need for large-scale housing provision, has restricted design variations and perpetuated dependency on foreign knowledge and materials. Furthermore, housing standards have often been shaped by financial requirements, aligning with the priorities of mortgage banks rather than the lived experiences of inhabitants (Delz, 2015).

Research in environmental sciences emphasizes how the built environment can influence human behavior and quality of life. People's demands from their dwellings are rooted in their lifestyle and cultural practices, and if these needs are not met, individuals must adapt to the constraints of their housing (Y.Eid & Shehayeb, 2004).

For Ethiopian residents transitioning to condominium living, while access to clean, healthy housing has been provided, the vertical living spaces often fail to accommodate their accustomed lifestyles. Domestic, social, and economic activities traditionally grounded in horizontal spaces now face challenges in vertical settings, impacting tasks like traditional cooking practices which require specific spatial arrangements (HABITAT, 2011).

Considering the lack of predesign research, post-occupation evaluation and a thorough understanding of residents' needs, the problem of non-responsive housing units is likely to persist in future projects. Thus, this study focuses on assessing how inhabitants utilize their space post-occupation and examines the reciprocal effects between condominium units and domestic activities.

[1] "Condominium" means a building for residential or other purpose with five or more separately owned units and common elements, in a high-rise building (Ethiopia, 2003)

1.3. Research objectives

1.3.1. General objective

The primary objective of this research is to explore the relationship between indoor functional space and domestic activities in a multifamily buildings (condominiums) in Addis Ababa, Ethiopia, with a focus on understanding how the spatial layout and design of these housing unit impact domestic activities and the quality of life of residents.

1.3.2. Specific objectives

The specific objectives of this research are:

i. Identifying how activities in housing units of condominiums are performed.
ii. Identifying the relationship between the domestic activities and the spatial layout of the condominium housing units.
iii. Identifying how the inhabitants have been affected by the spatial layout of the housing units in relation to the domestic activities they need to carry out.
iv. To make recommendations for future projects based on the findings on how to provide an appropriate space according to the occupants need to perform the domestic activities.

1.4. Research questions

i. How is the housing unit in condominiums used?
    - What are the domestic activities performed?
    - Where are the domestic activities performed?
    - By which members of the households are the domestic activities performed?
ii. How are the domestic activities affected by the spatial layout of the condominium units?
iii. How is the spatial layout of the condominium units affected by the domestic activities performed?
iv. What methods can be used to provide spaces that accommodate domestic activities according to the needs of the inhabitants of the condominium units?

1.5. Significance of the research

With the growing population of the city, AACPPO (2017) estimates that there is a need for 1,172,195 housings in the coming ten years. But with the current situation of expensive land and construction prices, the IHDP is the accessible way to housing for the city's low and middle-income inhabitants. Since its conception, the affordable housing scheme that is being provided by the government has had some shortcomings, as the design was not based on a study on the day-to-day needs of the inhabitants as its major concern was providing cost-effective housing for low-income people.

Future condominium designs need to understand the significance of houses design on how people utilize the space and how it accommodates their lifestyle. To achieve this, there needs to be done a performance evaluation of the existing housings in terms of space usage to help with

- Understanding the effect of the physical environment (spatial aspect) of the condominium housing units on how people perform domestic activities and the vice versa
- Help explore possible measures that can be undertaken to enhance future condominium space designs

1.6. Scope of the study

The thematic scope of the research is limited to the study of domestic activities in relation to internal spaces of housing unit' of the Gellan III site which is a 20/80 condominium typology found in Akaki/Kality Sub city, Addis Ababa. The spatial aspects that were considered were room size, room arrangement/configuration, room amount, and furniture arrangement and size.

Only the activities that were considered essential were studied and activities in relation to movement and time were not explored as it would require a long time making the study vast and requiring an independent study.

1.7. Limitations of the study

One of the significant limitations of the study was the absence of comparable research examining how domestic activities interact with the spatial design of condominium units within the Ethiopian context. While there has been extensive research on how condominiums affect residents' social and economic status, there is a notable lack of detailed investigation into their impact on domestic activities, despite this issue being highlighted in previous studies.

1.8. Organization of the study

This thesis is organized into five chapters. Chapter 1, Introduction, Chapter 2, Literature Review, Chapter 3, Research Methodology, Chapter 4, Result and Discussion, Chapter 5, Conclusion and Recommendation. The issues addressed in each chapter are as follows.

The first chapter introduces the research problem, motivation, objective, questions to be answered, significance and limitations. The second chapter explores the information found on the topic of the study internationally and locally. It discusses the key concepts related to space and activity internationally and the history of condominiums and their design locally. The third chapter lays out the methods to be used to undertake the study. The fourth chapter is a presentation of the findings based on the analysis of the data gathered and discusses the meaning behind the findings and their implications. The last chapter, conclusion and recommendation lays out any suggestions for further studies.

2. CHAPTER TWO- LITERATURE REVIEW

2.1. Introduction

This chapter explores the theoretical and conceptual basis of this study. It explains the definitions and types of culture, space, form, activity and their relationships. By looking at these core ideas, the chapter aims to build a clear understanding of the factors that influence the study. It also reviews relevant international and contextual literature to place these elements in a broader context, highlighting important themes and findings that guide the research. This exploration sets the stage for analyzing how space and activity are interconnected, providing a solid foundation for the research methodology and analysis that follow.

2.2. Understanding the concepts

Nowadays, the biggest problem in design is that it is divorced from the user. People live in fragmented houses that were not made in consideration of their culture, beliefs, values, and lifestyle. This greatly affects and how the users utilize the space available. Based on the level of success of the design, the house can restrict and manipulate or enhance the life of the inhabitant. Thus, it is vital to understand the needs of the users and communicate them to the designer to ensure good house design (Rapoport, 1977).

Spaces cannot be designed and built without considering the criteria's developed in man-environmental research (MER)[2] as there is a range of people with different values, cultures, and needs. This needs the understanding of actual space use, which can, in turn, be used to assess the changing needs of the occupants through time (Asquith, 2006). Analyzing activities in relation to time, age, gender, the spatial type will provide a useful starting point to understanding the way we inhabit our homes (Rapoport, 1977).

2.2.1. Culture

It is agreed by anthropologists that "culture" is at the center of defining humanity but beyond that, they disagree on much more (Rapoport, 1980). There have been many definitions and concepts of culture throughout time. In 1952, Alfred Kroeber and Clyde Kluckhohn compiled a list of 164 definitions and the definitions have continued to evolve since then (Nath, 2018). But for the

[2] The theory of man-environmental research is discussed in detail in section 2.3 of this study

purposes of its relation to the built environment, culture can be viewed in three general and complimentary ways: as a way of life typical of a group, as a system of symbols and meanings, and as adaptive strategies for survival related to ecology and resources. (Rapoport, 1980).

Culture as a concept is a vast domain and built form is just one part of it. It is virtually impossible to link culture to built form, yet it is possible to relate built form to family structure, clans, moieties, religious institutions, sex roles, or status hierarchies (Rapoport, 1990).

Rapoport`s (1990) analysis of culture's abstractness and global nature offers a dual perspective on understanding its impact on the built environment. On one hand, he breaks down culture into ideational and social variables, bridging the gap between abstract concepts and observable manifestations like social structures and behaviors. This operationalizes culture, making it more tangible for analysis in the context of the built environment. On the other hand, Rapoport highlights the challenge of directly linking culture to specific design tasks, such as designing a home for a particular culture. Instead, Rapoport (1990; 2016) suggests designing for other components of culture that can be more feasibly connected to the built environment, thereby creating a mechanism to indirectly reflect cultural influences in design. These analyses together underscore the complexity of integrating culture into design processes, balancing theoretical understanding with practical implementation strategies. This link developed by Rapoport including world view, values, lifestyle, and activities can be shown in Figure 2-1 below.

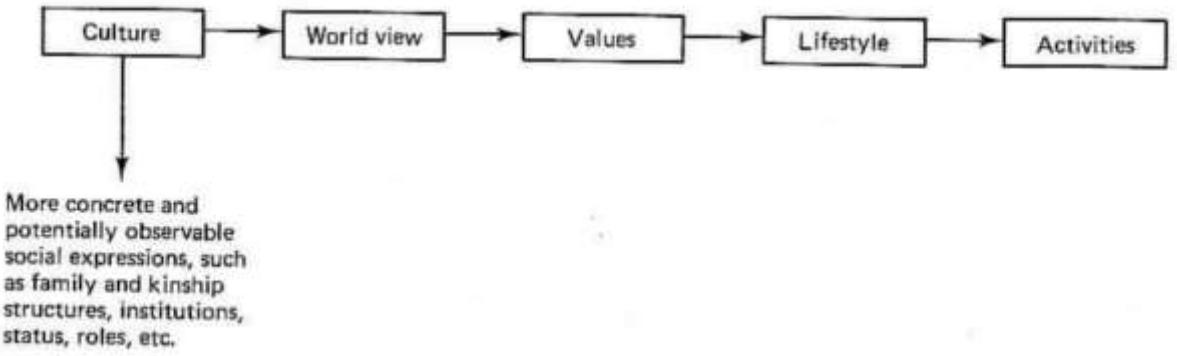


Figure 2-1 Two ways of 'dismantling' the concept of culture

Source: (Rapoport, 1990), Page 10

This concept of culture can be summarized as follows: Culture typically leads to a particular world view which is a characteristic way of looking at the world and in the case of design, of shaping the world. World views reflect ideals and lead to choices. Values are one aspect of the world in that they affect choices and result in particular lifestyles. Activities and activity systems are even more specific aspect of lifestyle which may offer an entry point into relating culture and environments via human behavior (Rapoport, 1980).

2.2.2. Lifestyle

Lifestyle is a characteristic of groups of individuals and is typical of them (Rapoport, 1990). It is their living condition, behavior, and habits and it is very relevant partly because it represents choice among alternatives (Rapoport, 1985). Lifestyle has been defined at different levels: the structural, positional, and individual levels. This research focuses on the individual household level of lifestyle which is a set of routine practices incorporated into habits of dressing, eating, acting, socializing, etc. Lifestyle is not a single or temporary choice but is developed over a longer period based on the complexity of the society. With the complexity of society, the level of choices for a different type of lifestyle also increases (Jensen, 2007). Rapaport (1990) states that it is more feasible to study the built form through lifestyle and activities of the people that perform them.

2.2.3. Environment, space, and form/house

i. Environment

The environment is a series of ordered and patterned relationships among elements and people. It is the setting that facilities the transaction between people and the physical elements of the world which are primarily spatial (Rapoport, 1977).

One recent approach to the study of the environment is man-environmental studies (MES). This is an area of study which is concerned with the systematic study of the mutual interaction of people and their environment. It stresses the idea that the physical environment, it's design and why it is designed a specific way can help understand first, how people shape their environment and which characteristics are relevant in shaping it, second, how and to what extent does the physical environment affect people and third, what mechanisms link people to their environment in this

two-way interaction (Rapoport, 1977). It is therefore essential to first identify what environment is to better understand how it affects people and vice versa.

Different experts have defined environment in different ways. Ittelson (1960) Cited in Rapoport (1977) defines environment as an ecological system with seven components

A. Perceptual- the way we experience the world. This principal links people to the environment.
B. Expressive- the effect of shapes, colours, etc. on people
C. The domain of aesthetic values of culture and the whole area values
D. Adoptive- the extent to which the environment hinders or helps activities of people
E. Integrative- kinds of social groupings that form as a result of environments hindrance or help
F. Instrumental- tools and facilities provided by the environment
G. The ecological interrelationships of the above

On the other hand, Lawton (1970) cited in Rapoport (1977) defines environment as an ecological system of five components

A. The individual
B. The natural and manmade physical environment that limits and facilities behaviour and the resources of the environment
C. The personal environment including the people around us control our behaviour
D. Supra-personal environment-The environment that results from the characteristics of people's characteristics due to grouping by age, gender, ethnicity, class, etc.
E. The social environment consisting of social norms and institutions

The relation between these two ideas is that they identify the role of the environment as social, cultural, and physical and imply the link between changes in the environment and its ability to provide a setting for people to change.

Rapaport (1980) states that built environments are intimately related to the images and schemata of groups. This is clearly seen in the fact that recognizable cultural landscapes emerge from the individual decisions of countless individuals. This can only happen if members of these groups share similar conceptual models of ideal environments as an ideal setting for their lives.

Most studies of home environments begin with people already in them and the studies undertaken in them deal with satisfaction. In reality, the main effect of environment on people is through choice or habitat selection. Choice is an expression of people's preference based heavily on the culture people are in and is important in their interaction with all environments. People's preferences are at many scales-countries, regions, small towns, neighborhoods, streets within neighborhoods, and most importantly, home environments. Given an opportunity, people would avoid or leave some environments and seek out others (Rapoport, 1985).

The fact that importance of designed environments is much more than physical environments is suggested in that the variety of designed environments created, importance of meanings and their use to establish a group identity so that they come to represent that specific group of people (Rapoport, 1980).

From this, it can be gathered that the research of environmental design must be first, cross cultural and historical by including the largest possible range of examples in order to validly generalize and, second, in order to understand man-environmental interaction, one must go beyond the material aspects of the environment and look at the nature of culture of environments and their relationships must play a central role (Rapoport, 1980).

ii. Space

Space is defined as the three-dimensional extension in which objects and people relate (Rapoport, 1977), reflecting the culture and lifestyle of different societies and indicating their transformations (Y.Eid & Shehayeb, 2004). It is an integral part of designed environments, encompassing meaning, communication, and time (Rapoport, 1980).

Spaces can be assembled into a larger continuous entity only by placing them next to one another or by putting them inside one another. Most of the time, people who use space do so 'with their feet on the ground which means that its two-dimensional extent has a more immediate impact on human activity than does the experience of volumetric space (Hanson, 1998).

Space can be seen from the point of view of boundaries and material usage. Space may or may not be demarcated as seen in the fire homes of the Kung Bushmen of the Kalahari Desert. In the fire home, the fire is a spatial gesture and signifies a place of residence. The boundary is not clear. A

house can be built or only a stick can be put to show where the entrance would be as if there was a building and directs the men & women to where they should sit. Sometimes, there is no stick and only fire. The house embodies a set of spatial concepts found in the architectural view and space is differentiated into an inside & outside, right & left up & down zone for the family members (Hanson, 1998). This shows that a space does not have to be defined by material boundaries to represent the concepts of architectural view.

In a more detailed explanation, Bill hillier in his book space is the machine (2007) defines space as the unit within which all human activities occur in. It reflects the social and cultural aspects of the city. It is a function of forms of solidarity which are in turn a product of the structure of society (Hillier & Hanson, 2005).

The link between society and space is bound by two things. The first is the culture and lifestyle of people. The other is how social formations acquire and change their form. This change in form is brought on by evolutions found in human society. For example, the start of agriculture resulted in the formation of fixed settlements (Hillier & Hanson, 2005).

The effect of culture on space defines its rules of organizations of the time, meaning, and communication (Kroeber & Kluckhohn, 1952). The rule of organization of space is about a group of people who share a set of values, beliefs, worldviews, and symbol systems. These create a system of rules and habits that reflect ideas and create lifestyle, behavior, roles guidelines and built form (Rapoport, 1977).

The arrangement of space influences how it is used according to how spaces are related to each other. This set of interdependent relations of space in which each is determined by its relation to others is called spatial configuration (Hillier & Hanson, 2005) and it is a more fundamental aspect of the designed environment than form, material, etc. (Rapoport, 1977).

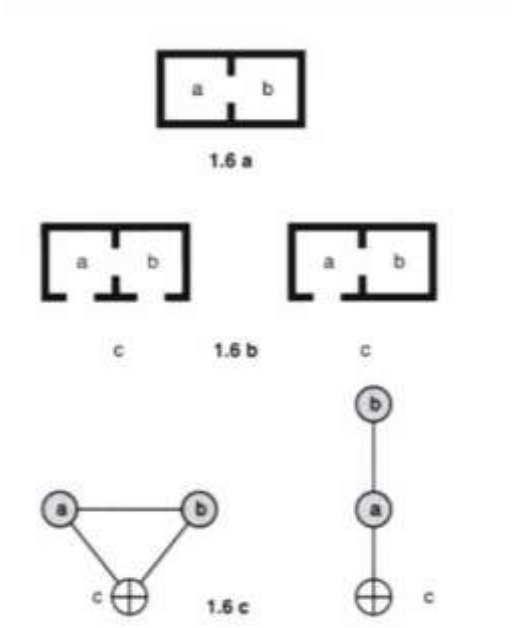
Spatial relations exist where there is any type of link between two spaces and configuration exists when the spatial relations of two spaces are changed according to how we relate each to a third or more (Hanson, 1998). If one changes the arrangements of a space, its meaning, symbolic representation, influences, importance, and effect on behaviour changes.

Therefore, Configurational descriptions deal with how a system of spaces is related together to form a pattern, rather than with the more localized properties of any particular space (Hanson,

1998). It is about ordering relations between people. It is a social object and it creates relationships between functional and social meanings in buildings. As a result of this society can enter the very nature and forms of buildings (Hillier & Hanson, 2005). Its characteristics also affect who communicates with who, how, when and where (Rapoport, 1977).

Space organized for social purposes cannot be viewed as purely continuous or purely bounded but it can be viewed as a conversion of the spatial continuum by a system of boundaries and permeabilities to effectively organize it for human social purposes (Hanson, 1998). This can be shown in the design of the elementary house represented through a justified access graph as shown in

Figure *2-2*.



1.6a shows two rooms with symmetrical spaces

1.6b –both spaces are still symmetrical with the addition of a third space: the outside

1.6b space has become asymmetrical as there is only one connection to the outside and room b must pass through the room a to access it

1.6c shows a simple graphic representation of 1.6b. Using the 'justified' access graph

Figure 2-2 Justified access graph

Source: (Hanson, 1998), Page 23

By looking at the houses with and without the external links to the exterior is an important part of Configurational analysis which helps to understand the inhabitant-inhabitant and inhabitant-visitor relationships for the planning and organization of a space or a home (Hanson, 1998). The graph also shows the level of control to access of one space from another can change just with the addition of an opening.

Thus, the effect of space on people, how they use it and interact with each other within it all need to be grasped. We need to understand space from the perspective of what people do in it. It is not a background to objects, but an intrinsic aspect of what human beings do (Hillier, 2007).

Space can be analyzed through the three geometric ideas Benedikt (1979) cited in Hillier (2007)

- Linearly- We can study the movement of people in a space by using lines
- Convex space- people interact with each other in convex spaces. Every point that can be seen at any point within a space can be analyzed using convex space analysis.
- Isovist- states that any point in space can be seen as variably shaped. If we move around in space, we can see changing visual fields.

Overall, the authors agree that space is not just a physical entity but also a social construct influenced by cultural, social, and behavioral factors. The organization and configuration of space are crucial in shaping human interactions and societal structures.

iii. Form/ house

The urban form we live in is a very special case of the environment (Rapoport, 1977). In principle, environments are created to support the activities and lifestyles of people (Rapoport, 1990) and form is the response of activities.

Form is a meaningful and functional assembly and transformations of elements/objects to create a building. It serves social use and is a means of showing the cultural identity of people. It sets itself apart from artefacts by creating and ordering empty volumes of space into a pattern-ordering of space. This is what gives a building purpose, not the elements used (Hillier & Hanson, 2005). Form essentially encompasses space, time, meaning, and communication (Rapoport, 2007)

The rules dictating the organization of space, time, meaning, and communications show regularity because they are linked to culture (Kroeber & Kluckhohn, 1952). These values of a group of people with shared beliefs, worldview, and symbolic systems that are learned and transmitted create a system of rules and habits that affects their lifestyle, roles, manners as well as the built form (Rapoport, 1977). These rules affect the separation of objects and people to various criteria's like age, sex, status, roles, etc. It is through this that we can recognize a society, that it exists and has a certain form.

Dwellings are not a static phenomenon. In many cultures, it takes on a dynamic aspect constantly growing, partitioning, and eventually dividing and reforming repeatedly due to the evolving composition of the domestic group. As this happens, the internal organizations of the space represent the social relations of the members of the household (Hanson, 1998). As the structure of the inhabitant's changes, rooms are accordingly added or deducted and their usage changes.

In summary Rapoport (1977; 1990; 2007) and Hillier & Hanson (2005) underscore the importance of form in architecture as a response to activities, social use, and cultural identity. They also highlight how rules dictating space organization are tied to culture, shaping lifestyle and roles. Kroeber & Kluckhohn (1952) contribute by connecting these rules to shared beliefs and symbolic systems within a group. Hanson (1998) adds a dynamic perspective by discussing how dwellings evolve with the changing composition of domestic groups, representing social relations within households. This dynamic aspect aligns with Rapoport's idea of built environments supporting evolving lifestyles and activities.

2.2.4. Activity

Activities are the programs that are performed within a space and domestic activities are what people do in and around their houses (Monteiro, 1997). The activities that take place within the domestic space depend on the inhabitants, the household size, occupation, personal tastes, customs cultures, and the existence of children (Pultar & Baykan, 1995). Monteiro (1997) adds that daily domestic activities are also closely linked to social and cultural factors as well as the spatial dimensions of the inhabitant’s dwellings.

Different researchers have categorized activity using different methods. These categorizations differ based on the focus of the research and based on for whom the activities are defined for. For example, the list of domestic activities or Activities of Daily Living (ADL) focus on health issues (Kisnarini, 2015). ADL defines domestic activities as routine activities people perform daily without the need of assistance. This are eating, bathing, dressing, toileting, transferring (walking), and staying.

Gehl (2010) Categorizes activity types into three. These are:

A. Necessary activities- This is the activity that has to be performed such as cooking, going to work or school, waiting for transportation, errands, and everyday tasks

B. Optional activities- This includes recreational activities that are dependent on the persons wants such as getting fresh air, standing around, sitting, and enjoying the view, resting, etc.
C. Social/resultant activities- all communications between people. This activity requires the presence of other people, and it can be watching others perform things, children playing, conversing, etc. watching and hearing are the dominant activities in this group.

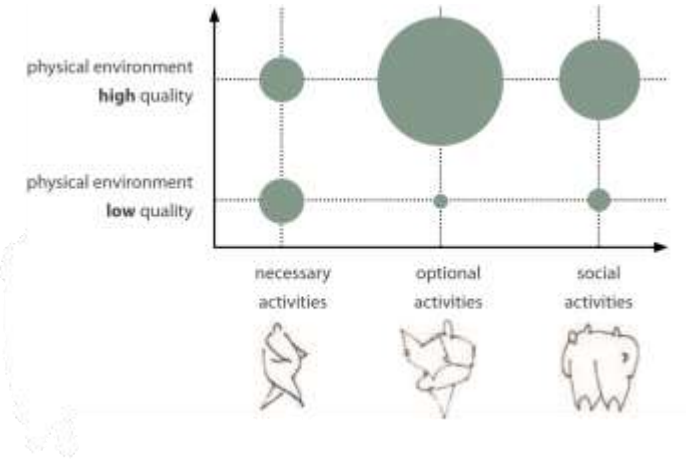


Figure 2-3 Graphic representation between outdoor quality and outdoor activities

Source: (Gehl, 2010), Page 21

The above figure shows the relation between the quality of the environment and the activities performed. Cities and spaces can set the stage for specific activities. If the environment provided for undertaking the activities has high quality, the number of optional activities done, and time spent will increase. This will help in naturally creating density in cities as people usually gather around areas where there is the greatest chance of something happening (Gehl, 2010). This can also be seen in internal spaces where the quality of space will create an encouraging and inviting space to perform the different types of activities.

Rapaport (1977) On the other hand, categorizes activities into four components:

A. The nature of the activity itself- these are necessary activities such as eating, sleeping, drinking, walking
B. How it is carried out-this specifies where activities are done, by whom they are done. For example, drinking in a bar, walking in the street, sitting on the floor, eating with other people. This is discussed in systems of activities as one cannot fully comprehend the effect of an individual activity.

C. Associated activities that go with the activities that are combined to create an activity system such as gossiping while eating, courting while walking, etc. This is further studies how systems of activities occur in systems of settings

D. The symbolic aspect of the activity explains why we do a certain activity. E.g., shopping for consumption, cooking as a ritual, etc.

It is the difference between these four aspects of activities that lead to specific forms of their settings, differences in their relative importance, the amount of time spent in them, who is involved and so on. The understanding of these activities in an orderly manner will help in designing a house as they are the things that affect the built form and how activities are done (Rapoport, 1977).

When we come into the realm of the home, canter, 1983; Oseland and Donald, 1993; Ahrentzen, (1989) cited in (Monteiro, 1997) have refined and grouped the activities representing different sets of domestic activities: household chores and extended chores, active and passive leisure and, personal and communal needs.

Household chores are the necessary activities that must be performed such as cooking, cleaning, washing. The active/ interactive and passive leisure's are the optional and resultant activities respectively such as chatting and meeting friends and watching TV, reading. The extended chores include activities such as playing with children and shopping while the communal needs are the ones that are done as a family such as having coffee, lunch. The private needs are the ones that need to be carried out on a personal level such as bathing and sleeping (Monteiro, 1997). Other notable categorizations of activity are shown in the Table *2-1* below.

Table 2-1 other notable categorizations of activities through time

Source: multiple

Source	Activity category	Activity lists
Alzheimer's & Association (2010) Based on the particular daily routines of persons with dementia. It is aimed at determining the strategies to	Chores	Dusting, sweeping, doing laundry
	Mealtime	Preparing food, cooking, eating
	Personal care	Bathing, shaving, getting dressed
	Creative	Painting, playing the piano
	Intellectual	Reading a book, doing crossword puzzles
	Physical	Taking a walk, playing catch

activate people with dementia in a more responsive manner.	Social	Having coffee, talking, playing cards
	spiritual	Praying, singing a hymn
	Spontaneous	Going out to dinner, visiting friends
	Work related	Making notes, typing, fixing something
Ahrentzen (1989) Similar to Monteiro (1997) But into five categories instead of six. He substituted the extended chores to childcare activities emphasizing the need infants have in households	Domestic work	Preparation and cooking food, cleaning, laundry, ironing, repair & upkeep of cloth, animal care, upkeep of heat and water supplies, etc.
	Childcare activities	Feeding, bathing, reading of stories, indoor games, medical care, being affectionate with child, putting to bed, etc.
	Private needs	Personal hygiene, medical care, sleep, etc.
	Active leisure	Hobbies, needlework, artistic creation, etc.
	Passive leisure	Listening to music or radio, watching tv, reading, conversing, relaxing, etc.
Omata (1992) His categorization emphasizes the entertaining and celebration activities	Bathing	
	Cooking	
	Sleeping	
	Family communication	Talking and discussing on domestic matters
	Celebration	Parties, religious activities
	entertaining	Entertaining neighbors, friends, playing with children, taking snack with neighbors, having a meal with relatives
	Work and study	
	Leisure time	
	Storing matters	

These activities have their own pattern in which users perform them. The importance of understanding patterns of activities through questions like "How many?" (Studying movement patterns), "Who?" (Analyzing user behavior in groups), "Where?" (Designing spaces based on activity locations), "What?" (Understanding specific activity requirements), and "How long?" (Determining activity durations) (Gehl & Svarre, 2013).

Who does what, where, when, including or excluding whom and why questions are only answered if activities are considered in systems that are organized in space and time (Rapoport, 1990). People use a variety of outdoor and indoor spaces, settlements, and whole regions: they inhabit cultural landscapes. Thus, the systems of activities take place in systems of settings. The analysis of these points reveals the multifaceted nature of activities within domestic spaces and the importance of considering social, cultural, and spatial factors in activity categorization and analysis. Understanding activity patterns is crucial for designing spaces that effectively accommodate user needs and behaviors.

2.3. The relationship between form and activity

The study of the relationship between form and activity in the built environment serves several purposes. Firstly, it allows us to analyze how the built environment influences and is influenced by human behavior, guiding and constraining it. Secondly, it emphasizes the idea that the built environment is crafted to support desired behaviors, suggesting that architecture shapes behavior as much as behavior shapes architecture. (Rapoport, 1990).

This relationship is further explored in environmental studies, as discussed in environment section 2.2.3 , which systematically examine the interaction between people and their surroundings (Rapoport, 1977), asking crucial questions about how people shape their environment and how the physical environment affects people nd what are the mechanisms which link people and environments in this two-way interaction.

The first question is concerned with the characteristics of people that affect how the environment is shaped. These characteristics are the people’s groupings, cultures, and their memberships in a society which can affect how they use the environment and their roles in shaping it (Rapoport, 1977). They demand certain types of characteristics in their dwellings based on these criteria’s.

The type and combination of activities in a house affect the spatial pattern. Through considering the differences among simple activities, we get an understanding of lifestyle-values-world views-subcultures as they relate to the built environment Rapoport (1980:17) cited in Asquith (2006).

The lifestyle of people consisting of manners, rules, choices, role allocations and distribution of resources affect how a house is constructed. The socio-cultural factors that affect how a house is constructed are Rapoport (1969) cited in Asquith (2006):

A. Some basic needs are the activities we perform and where we perform them. The type and combination of activities affect the spatial as it is built considering which activities can take place where. Room function is studied in relation to domestic routine and ritual. Some activities can occur simultaneously in one room and some rooms can have little use. The main activities need to be defined, how many there are and where they take place, the rooms accommodating the majority of the activities and which rooms are used for the activities they were not intended for.
B. Family is studied in relation to the concepts of age, gender. The roles of both gender groups and their relations in the home rather than their perceived roles need to be studied. Activities and also room use should be assessed in relation to gender. How men and women perceive space and how they claim it in the home can inform how the communication within the home and their status affects the spatial organization.

   The age of the members of the family also is an important consideration. Their interaction according to their age group and how that affects domestic spatial organization needs to be highlighted.
C. Position of women- women's position in relation to their gender within the house and their status outside the home.
D. Privacy- studied in relation to age, gender and spatial arrangement and configuration. Separation of spaces can occur unconsciously according to age because of changing needs or through methods of control such as physical barriers used for privacy.
E. Social intercourse- the communication between family members and the structuring and restructuring of time and the spatial type.

   What activities are performed by which age groups and how much time is spent on it in the home? The activities can change through time and the way space is used is structured and

restructured because of it. People with different rhythms and tempos can occupy the same space at different times. There are also periods of times when houses are filled with activities and times when they are not. Studying this can establish patterns of space use in relation to routines and rituals.

F. Space - it is possible to evaluate how the configuration of spaces may translate cultural and behavioral codes of social acting by analyzing how rooms relate to each other within the house and by establishing patterns of behaviour across spatial types (Hiller 1996). How we perform each activity with the influence of our cultural practices and individual choice, determines how space is used and claimed.

   The physical form of the house, how the spaces are linked, and its boundaries affect where we perform these activities.

The difference between the four components of activities categorized by Rapoport (1977), activity proper, specific way of doing an activity, associated activities and symbolic aspect of activity lead to specific forms of settings and affect the built environment.

The second question: how and to what extent does the physical environment affect people considers the environment as a nonverbal communication system studied through fixed feature space (walls, doors, etc.), semi-fixed feature space (furniture), and non-fixed feature elements (people) hall (1966) cited in Rapoport (1977) and analyses the effects they have on human behavior, mood or wellbeing (Rapoport, 1977).

A home's characteristics defined by the three features play a significant role in how people utilize the space (Y.Eid & Shehayeb, 2004). How the features are arranged, security, reasonable space, visual quality, etc. set the stage for specific activities (Gehl, 2010) and the way activities are distributed indicates the extent to which a home allows people to fulfil their social and psychological needs in a way that fits their lifestyle.

If we look at the necessary, optional, and important group of social activities, the environment creates the preconditions for strengthening all forms of social activities. It is because of this that the environment is considered a powerful manipulator of lifestyle (Y.Eid & Shehayeb, 2004). The people are forced to adjust their activities to the possibilities and restrictions provided

In geography, there are three determinants of the built environment that can affect human behaviour. They are:

i. Environmental determinism –this is the view that the environment can have a major effect on the human behaviour.
ii. Possibilism- this is the idea that the physical environment provides possibilities and constraints within which people make choices on other criteria's, mainly their culture.
iii. Probabilism- this is the idea that the physical environment acts as a setting for human activities. Where the environment provides possibilities for choice. As some environments can be facilitating while others constrain but it cannot generate activities. It only makes some choices more probable than others in certain settings and cannot block difficult activities.

The environment provides the setting for different activities with inhabiting and supporting attributes. People then act according to their readings of the environmental cues by acting appropriately to their setting. Physical elements in the environment have varying meanings and their influence, importance and their effect on behaviour change accordingly. People are not acted upon by their environment but that they choose their preferred environment down to the furniture although this choice can be blocked by poverty, discrimination, or infirmity which can lead to forced habitation in an unwanted environment (Rapoport, 1977).

Bafna & Chambers (2014) further theorized that in cases where the influence of space on activities where deliberate attention to the physical environment is not a requirement, the effect of space on behavior is not constant, but modified by the social life within it, and by the type of activity carried out with in it.

Hanson (1998), adds the most important part of the house is not the list of activities but "but that it is a pattern of space which is governed by what spaces there are, how they are connected, and sequenced, which activities go together, and which are separated out". The interaction between these activities is influenced by the spatial organization of the spaces.

The third and final question, what is the mechanism that links people and environments is answered by Culture, where people try to match their characteristics, values, expectations, and norms, behaviors and so on to the physical environment through design or migration (Rapoport, 1977).

This interaction between systems of activities is linked to systems of settings through their meaning. The settings and their boundaries are culturally defined and so are the rules that apply to them. As the settings change from culture to culture, it also provides different yet appropriate conditions for behaviors and activities to take place (Rapoport, 1990). People can interpret the cues in settings many times a day and change their behavior accordingly.

Settings that guide behaviors (i.e., the non-fixed feature elements), through fixed and semi-feature elements which provide the cues. The same space can become a different setting through the changes in the semi-fixed elements and the varied activities of the occupants (Rapoport, 1990).

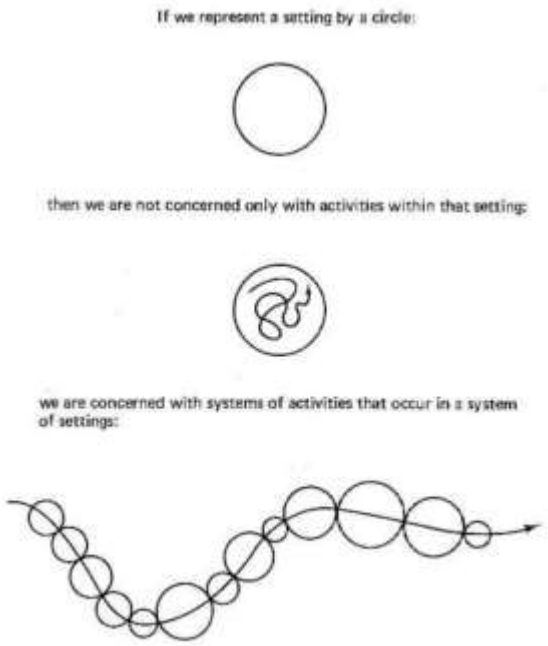


Figure 2-4 Activities within a single setting versus activity of systems in systems of settings

Source: (Rapoport, 1990), Page 13

Figure *2-4* represents relations between systems of activities and settings as a bead that must be studied as a single entity.

Most of the time, appropriations in systems of activities as a result of changing situations are reflected in the changes of the non-fixed feature elements such as furniture.

Interaction between people also requires a reasonable amount of space. The environment provided must be able to regulate, develop, and wrap up events. If we're seated at a dining room table or around a coffee table, we can lean backwards and forward and thus continually regulate the conversational distance by small increments.

Wherever people communicate directly with others, we can see how they constantly use space and distance (Gehl, 2010). The more distance we create, we signify that we do not want contact. If we use different rooms while we are in the same house, we are saying we do not want to communicate. The spaces provided need to be just the right size to assist in communication.

Forms of buildings also affect the communication between the internal environment and the external. People living on the top floors of apartments, workshops, etc. venture into the city less often than those who live and work in lower story buildings (Gehl, 2010). Short buildings show more street life and socializing per household than those with taller buildings. The more there is a connection between the internal and external environment, the more the activities from the internal areas move out into the external. Because of this not only internal spaces need to be studied but also the building as a whole and its components need to be studied to analyze the full effect of the space on the user's social life outside the house.

This can only be known if we set down analysis methods to study the activities in their natural environment as they are performed.

2.4. Contextual review

2.4.1. Introduction to Addis Ababa

Addis Ababa, the permanent capital of Ethiopia, since 1886 (Dawit, et al., 2017) covers an area of 54,000ha and is the seat of the federal government. The city is also the seat of the headquarters of various international organizations such as the African Union (AU), and the United Nations Economic Commissions for Africa (UNECA) (Elias, 2008).

Prior to the formation of Addis Ababa as the capital, there was a practice of "wandering capitals" and the capital changed as the emperors moved their political centers from place to place for expansion, and subjugation of local warlords and kings (Elias, 2008). In 1884, Emperor Menilik selected Entoto as the new capital which was crucial for the establishment of Addis Ababa. Entoto is a mountainous area with steep slope, harsh storm, cold weather and deforestation caused by the settlement which created a scarcity for firewood (Giorghis & Gérard, 2007). During that time, Empress Taitu frequented the hot springs of Filwoha, located on the lower altitude to the south of Entoto (Dawit, et al., 2017). Coupled with the Empresses frequent visits of the hot springs and the favorable natural topographic and weather conditions, the capital soon shifted to Addis Ababa according to Fasil & Gerard (2007).

Emerging without any formal planning as a garrison town, since its founding, Addis Ababa has had nine master plans with none of them ever being fully implemented (Elias, 2018) and the early development was spontaneous without any formal planning (Dawit, et al., 2017). Inhabitants congregated around the palace, the churches, the compounds of the noblemen and military leaders

with the early houses constructed using *chika* walls and thatched roofs. This early social and spatial pattern has contributed to today's mixed income characteristics of the old neighborhoods of the city (Dawit, et al., 2017).The city can now be understood as a juxtaposition between traces of master plans and unforeseen and unplanned construction and use by residents on the ground (Elias, 2018).

2.4.2. Housing in Addis Ababa

The housing conditions of Addis Ababa from the beginning of its formation can be categorized according to the governmental changes as Emperor Menelik II era, Emperor Haile Selassie, Derg and finally the EPDRF. Each government had different ideologies of tenure practices.

From Emperor Menelik II to Derg (1974-1991)

During Emperor Menelik II's reign in the 1900s, Addis Ababa emerged as a garrison town with housing resembling village huts. The city's early layout, centered around camps called sefers, housed nobility, clergy, and military chiefs, with free buffer zones towards neighboring sefers (Delz, 2015). Menelik II's introduction of land charters in 1907 spurred a construction boom, bringing new techniques and materials, including stone houses and corrugated metal roofs (Delz, 2015).

Under Emperor Haile Selassie, property rights were clarified in the 1930s, but urban development lacked planning, leading to mixed economic neighborhoods (Elias, 2008).The Italian occupation from 1935 to 1941 brought forced reorganization, racial segregation, and a tax-based economy, doubling the city's population and exacerbating housing shortages (Dawit, et al., 2017).

Post-Italian occupation, housing issues persisted, compounded by the feudal tenure system and lack of master plan implementation (Elias, 2008). Low-income groups faced housing challenges, with informal developments and poor-quality construction dominating the landscape (Delz, 2015). Attempts to address housing shortages during Emperor Haile Selassie's rule saw limited success, with sporadic implementation of master plans and insufficient public housing initiatives (Elias, 2008).

The Derg regime (1974-1991) nationalized urban land, aiming to provide low-cost housing through neighborhood associations (Kebeles) (Dawit, et al., 2017).However, population growth

outpaced housing construction, and nationalized houses deteriorated due to poor management (Delz, 2015).Despite efforts by the World Bank to improve housing conditions, informal housing proliferated, and formal housing production stagnated (Delz, 2015).

In the mid-1980s, proclamation no. 94 allowed homeowners to rent out rooms, but housing production remained low, leading to further decline in the city's housing stock (Delz, 2015).Urban renewal plans were proposed but not implemented, exacerbating housing deterioration (Dawit, et al., 2017). Overall, Addis Ababa's housing history reflects a complex interplay of political, economic, and social factors, shaping the city's urban fabric and housing landscape over time.

Current situation (1991/EPRDF up to now)

Following the fall of the Derg regime in 1991, the new government retained ownership of land and nationalized buildings (Dawit, et al., 2017). In 1994, the government initiated a 'market-oriented land and housing development system', aiming to address housing demands by blending state-owned land with free market tenure policies (Delz, 2015). However, this approach failed to alleviate housing shortages due to insufficient land supply, leading to overcrowding in inner-city settlements and the emergence of informal settlements on the city's outskirts (Elias, 2008).

During the mid-1990s, the government commissioned a housing study known as the ‘Housing Sector Study’ (HSS), which identified deficits in housing policies, including over-reliance on the public sector and unsustainable subsidies (Delz, 2015). Subsequent studies highlighted the dire shortage and poor quality of housing stock, with an estimated backlog of 233,000 housing units by 2000 (Delz, 2015). To address these challenges, the government collaborated with international partners like the German Technical Cooperation (GTZ) to develop low-cost housing prototypes and explore strategies for affordable housing who stated developing low cost-housing (LCH) prototypes in 1999 with test sites in Tigray region and Addis Ababa. The LCH’s objective was to provide adequate and affordable housing whilst promoting the construction sector (Delz, 2015).

While LCH was being tested, ORAAMP started to identify various areas for housing upgrading and expansion for its future structure plan and provided an interventions map for in-fill, upgrading and urban renewal. One of the proposals, to introduce condominium housings got picked up. During the second phase of the LCH project between 2000-2006, (Delz, 2016) a pilot

condominium project was implemented at Gerji, an inner-city infill sites under the name, Addis Ababa Grand Housing Program (AAGHP) and later the Integrated Housing Development Program (IHDP) (Delz, 2016).

According to Bisrat (2008), the main objective and assumptions of the GHP were to address the problem of the decaying center and to:

- Construct affordable housing low- and middle-income households
- Create job opportunities through MSEs
- Develop the vocational and training through the construction industry
- Renew and upgrade the slum areas and secure efficient land use system through densification with vertical growth
- Strengthen the construction industry and improve vocational training systems
- Empower citizens through ownership of houses and crate fair distribution of wealth

The Gerji pilot site was launched in 2004 and completed in eight months' time on plot of 12000m^2 of land accommodated 754 families. The houses ranged from 22m^2 to 105m^2 (GTZ & Affairs, 2003), and The LDP & NDP was done by GTZ. The design was concerned with the affordability. The finishing materials and room size were considered (Bisrat, 2008).

The success of pilot sites like Gerji prompted the development of additional 102 infill sites across Addis Ababa. These sites chosen based on availability, accessibility, and ease to start construction were infill sites and were distributed in every sub city to bring balanced development and facilitate the work while working close with the city administration (Bisrat, 2008). Expansion sites were later introduced to accommodate a larger population and mitigate public resistance to slum relocations (Bisrat, 2008). However, challenges persisted, including payment systems, housing typologies, and inadequate planning for expansion sites (Redeat, 2016).

Design of the IHDP from pilot project to now

The first set of designs done by professional architects from Addis Ababa University proposals showed abstract yet relevant sketches on basic spatial considerations presenting the spatial relationship between housing blocks, height, open space, and street. The second compilation was more detailed schematic design of the housing typologies. After this two of the professors involved in the proposals were invited to join the Gerji pilot project (Delz, 2015).

The designs of the first four typologies (TYPE A, B, C & D) of the pilot project based on the Ethiopian Building Code standard (EBCS) (GTZ & Affairs, 2003), were mainly concerned with minimizing cost of each unit (Bisrat, 2008). The housing design considers land as a scarce commodity and the provision of basic infrastructure as relevant cost factor and emphasizes densification, small plot sizes and vertical growth (GTZ & Affairs, 2003).

The cost efficiency was achieved by technical methods like standardization of building elements, and prefabrication or by design driven schemes that use certain building elements in a dual way. From the initial stage of the housing program, the concept of standardization, standalone housing blocks was the main defining aspect of both the general building and comprehensive program design (Delz, 2015). The standardized elements to reduce wastage of materials were modularized HCB, openings (doors, windows), beams and columns (equal to modular HCB plus mortar joints). This reduced the number of different building parts leading to reduction of different types of formworks (GTZ & Affairs, 2003).

The buildings used grid structural layout, shared common wall, minimum circulation area, external staircases and kitchens and toilet which opened to the main corridor. Although the designs were modified by the project office a number of types, it was mainly on internal modifications of partition walls (Bisrat, 2008). These changes based on TYPE C typology (C1, C2, C3, and C4) done to make the buildings even more cost effective resulted in lack of privacy, narrow rooms, interior with inadequate natural light and aesthetically poor blocks that were not in harmony with the surrounding.

Even with those considerations, there was more room for material and room size research and the number of units was less than intended as the units had ample space and the LDP & NHD were made by and NGO encouraging flexibility in experimental design and production (Redeat, 2016).

After the pilot, for the 102 infill sits, the four initial designs were further improved upon through design competition launched by AAAHDPO in 2005 and the design efforts of AAHDPO itself. The housing typologies were to consider the social, cultural, economic and other aspects in addition to the functional and adaptability of typologies to different sites (Bisrat, 2008). The terms of reference for the design competition included the following details according to Kifle (2008):

- The height of the building shall be in compliance with the requirements of the master plan of the city.
- The building should be designed in such a way that it creates harmony with the environment. The minimum and maximum number of stories shall be four and five respectively.
- Design concept should incorporate
    - Historical assets
    - Cultural and traditional assets
    - Socio political assets and
    - Structural grid: 4m & 5m structural grid are preferable
- The floor areas of each unit typology are to be
    - Studio: 16 m^2 to 22m^2
    - 1-bedroom: 25 m^2 to 35m^2
    - 2-bedrooms: 40m^2 to 50m^2
    - 3-bedrooms: 55m^2 to 70m^2
- The composition of each building was later updated by AAHDPO as discussed earlier to
    - 10% studio
    - 40% one bedroom
    - 20% two bedrooms
    - 10% three bedrooms
    - 10% commercial/ shops

The typologies that were improved upon extensively were TYPE B and C while TYPE A and D were sorted out. The TYPE C was modified into T-16 and T-18 (I shape), T-4 and T-3 (Bisrat, 2008). Other typologies were also introduced: T-9 (by adding a third volume to TYPE D), M-1 (L shaped derived from TYPE A), M-2 (T shaped derived from TYPE A). This were again revised again for peripheral IHDP construction mainly by making the open staircases part of the enclosed building volume (Delz, 2015).

For the M-1 and M-2 typologies, a 4mx4m, and for the -16 & T18, a 4mx4m, 4mx5m, and 5mx5m grids were used which allowed for different types of apartment layouts and the creation of open areas within the grid to make access to balconies. From the architectural point of view, the designs

look organized, consistent, and placed within the blocks volume but from a social and economic aspect, the way the housings are built creates quite the leap from the existing living conditions (Delz, 2015).

Although the grid layout has potential adoptability, the houses are deliberately designed as a closed system leaving no space for appropriation freezing the ever-changing circumstances of the inhabitants into fixed walls, openings, volume, room sizes, appliances, and divisions (Delz, 2015). It was also found that the 1-bedroom typologies and studio units do not have enough for comfortable living with the person per room density being too large according to international standards. The standards state one person need at least $7m^2$ but the studio and 1-bedroom typologies have 5-8 people on average in a space ranging from 16 m^2 to $35m^2$.

The cultural receptions of the condominium units have had different effects many of which are related directly to the housing typologies. For example, the importance of the daily activities directly related to the ground floor, economic activities such as selling injera, laundry still done by hand. Residents from lower floors and upper middle class seem to adopt to such issues more easily (Delz, 2015). Other activities that were not considered are coffee grinding area, spice drying area, coffee ceremony space, children's playground (Ingwani, et al., 2010).

Inhabitants of the condominium units did several modification ranging from painting to changes of internal rooms with some redesigning rooms by changing partitions, closing off balconies and functional changes of rooms (Bisrat, 2008). This has been due to the lack of public participation. This lack of participation was affected by many factors according to Kifle (2008), such as low public participation during the design of the projects, producer's lack of interest and lack of funds to involve the public, lack of awareness, technical problems, and limited time.

The typologies that have been done so far are on different housing rounds are

Table 2-2 List of housing typologies

A1	A2	B1	B2	C1	C2	C3	C4	C5	D2
E1	E2	L1	L2	L3	M1	M2	T16	T18	

Source: (Redeat, 2016)

2.5. Conclusion

- The built form can be related to culture using built forms link to family structure, clans, moieties religious institutions, sex roles or status hierarchies and cultures link to lifestyle and activities of people.
- The environment has social, cultural, and physical roles implying its ability to provide a setting for people to change. It creates the preconditions for strengthening all forms of social activities making it a powerful manipulator of lifestyle. The importance of designed environments can be seen in the variety of designs existing, their importance in meaning, and their use to establish a group's identity.
- Space is the unit with in which all human activities occur in and can either be demarcated or not. Culture and lifestyle of people are the two links that bind space and society together and the effect of culture on space defines spaces rules of organizations of time, meaning and communications.
- The arrangement of spaces in relation to each other is known as configuration and the changing of one characteristic will change the spaces meaning, symbolic representations, and influence, importance, and behavior changes.
- Space syntax studies help to understand inhabitant-inhabitant and inhabitant-visitor relationships based on organizations of a space or a home. Just the level of control of access to one space from another can change with the addition of an opening thus changing the effect on people and how they use and interact with each other.
- Dwellings in many cultures are dynamic and are constantly growing, partitioning, and eventually dividing and reforming repeatedly due to the evolving composition of the domestic group. The internal organization of the space represent the social relations of the members of the household. as the structures of the family changes, the house also accordingly changes.
- Activities taking place within the domestic space depend on the inhabitants, the household size, occupation, personal tastes, customs, cultures, existence of children and also the spatial dimensions of the inhabitant's dwelling.
- Quality of an environment is related to the activities performed in the space.
- The man environmental studies ask three questions, first, which characteristics of people affect how the environment is shaped, second, how and to what extent the physical

environment affects people and third, what is the mechanism that links people and environments.

- The effects of a building as a whole and its components need to be analyzed to find out the full effect of space on the inhabitants' life.
- Overall, the authors agree that space is not just a physical entity but also a social construct influenced by cultural, social, and behavioral factors. The organization and configuration of space are crucial in shaping human interactions and societal structures.
- The housing characteristics and types of construction of Addis Ababa has been influenced by its emergence as a garrison town with no plan.
- To address the problem of the decaying center of the city that have happened over the decades since its emergence and to construct affordable housing for low- and middle-income households, the EPDRF expanded the LCH into the GHP which later evolved into IHDP.
- The housing program was mainly concerned with minimizing cost of each unit and promoting density using technical methods like standardization of building elements (modular HCB, openings, beams and columns), and prefabrication or by design driven schemes that use certain building elements in a dual way.
- The housing designs typologies developed since the commencement of the program were not based on vernacular studies, public participation, had producers lack of interest and lack of funds to involve the public, lack of awareness, technical problems, and limited time.
- Many of the cultural receptions of the condominium units have been directly related to the housing typologies and the ability of the space to contain the daily activities and income provision affects. The inhabitants have done several modifications to the interior of the housings from painting, to changes of rooms with some redesigning by changing partitions, closing of balconies and functional changes.

3. CHAPTER THREE- RESEARCH METHODOLOGY

3.1. Introduction

According to Abiy *et al.* (2009), research is a human activity based on intellectual application in the investigation of a matter. Its ultimate goal is identifying & explaining the causes or consequences of a specific problem. In other words, it is a systematic process of collecting, analyzing, and interpreting evidence on a phenomenon using controlled, ethically, and morally acceptable and replicable scientific methods. It contributes to human knowledge and is a necessary step towards the development of generalizations and principles that assist in the prediction and control of events to improve the way we live.

The following sections give a thorough explanation of the methodologies[3] that have been implemented in this study.

3.2. Research method/design

The research design[4] ensures the smooth sailing of various research operations making the research process as efficient as possible (Abiy, et al., 2009). It contains the blueprint for the collection, measurement, and analysis of data. It must at least contain the procedures and techniques to be used for gathering information, the population to be studied and the methods to be used in the processing and analyzing data (Kothari, 2004).

3.2.1. Research application: pure

There are two broad classifications of research based on the nature of the problem that the research is trying to solve (Abiy, et al., 2009). They are basic/pure[5] and applied[6] research types. The goal of this research is to explore the suitability of domestic spaces of condominiums units for the inhabitants' lifestyle and understand the effects of space and activity on each other which fall under the application.

[3] Methodologies encompasses our entire approach to research and describes the theory of how inquiry should proceed (Abiy, et al., 2009).
[4] A research design/ method is the range of approaches used in research to gather data to gain an understanding of a phenomena (Abiy, et al., 2009). It refers to a particular research technique used to gather data.
[5] Basic/pure research is mainly concerned with the theoretical understanding of the relations among variables and the formulation of a theory. Its goal is to expand the human knowledge on a phenomenon (Abiy, et al., 2009).
[6] Applied research is concerned with discovering, interpreting, and developing methods and systems for solving practical problems under the conditions in which they are found in practice (Abiy, et al., 2009).

3.2.2. Research approach- Qualitative

The research approach is the plan and procedures for research that involves the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation. According to Creswell W & Creswell J (2018) there are three research approaches: Qualitative[7], quantitative[8], and mixed[9] methods. This research gives priority to the experiences and perspectives of the participants to get an in-depth understanding of the utilization of domestic space. Due to this a qualitative approach is used. The data gathered using the qualitative methods will go through a less rigorous quantitative interpretation using the space syntax method.

3.2.3. Study design: Case study

The type of study design[10] depends on three different conditions: the type of questions posed, the degree of control the investigator has over actual behavioral events, and the degree of focus on contemporary as opposed to historical events (Yin, 2014). These conditions can establish five different types of methods a researcher can use to conduct research: experiment, survey, archival analysis, history, and case study[11].

Based on the first condition, the type of research question asked, research is categorized into exploratory[12], explanatory[13] and descriptive research. Exploratory research is done when there is little known on the phenomenon being studied and it is a small-scale study with a short duration. Any of the five different methods can be used as exploratory research (Abiy, et al., 2009).

However, exploratory research posed in the form of ‘what’, ‘who’ and ‘where’ inquiry is more concerned with a survey or archival strategy and is related to frequencies of an occurrence. The ‘what’ question can be asked in the form of ‘how many, ‘how much’ (Yin, 2014).

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[7] Qualitative research explores the meanings of people’s lives as experienced under real world conditions and allows for an in-depth understanding of the phenomena under study (Yin, 2016).
[8] Quantitative approach is used for testing objective theories by examining the relationship among variables which can intern be measured and interpreted using statistical procedures (Yin, 2016).
[9] Mixed method is found between qualitative and quantitative method as it incorporates both data collection approaches (Creswell & Creswell, 2018).
[10] A study design is part of the larger research design, and it dictates the research design type (Abiy, et al., 2009)
[11] A case study is a detailed contextual analysis of a limited number of events or conditions and their relationships. It can provide a rich exploration of a phenomenon being studied (Abiy, et al., 2009).
[12] Exploratory research provides insights into and comprehension of an issue or situation when there are few or no earlier studies to which references can be made for information. It leads to a more rigorous investigation later (Abiy, et al., 2009).
[13] Explanatory research is a continuation of an exploratory research and is undertaken when we encounter an issue that is known and have a description of it without the answer for why it is happening (Abiy, et al., 2009) .

On the other hand, explanatory research used to study the distribution of characteristics can be posed in the form of 'how' and 'why' questions. It is used by case studies, histories, and experiments as a research strategy, which is concerned with operational links needing to be traced over time (Yin, 2014).

The second condition of research design; control of behavioral events, the effect of an intervention on events, which are under study are analyzed. Only the experimental research strategy can use this where both the experimental group and interventions are controlled (Abiy, et al., 2009).

Based on the questions raised and the limited amount of existing data found to support the research, a case study method will be used to explore and describe the situation within the events of the contextual environment. This method will help take a detailed, accurate, and complete description of the situation.

3.2.4. Source of data: Triangulation[14]

Both primary and secondary sources of data have been used in this study. The primary data was collected through semi structured[15] in-depth interviews conducted with inhabitants of Gellan III condominiums and key informants from administration of the Gellan III condominium.

The secondary data was collected through the reviewing of documents such as books, articles, magazines, websites, and research articles and data collected from City Government of Addis Ababa Housing Development and Administration Bureau, Ministry of Urban Development, and Construction. The data was relevant in discovering and assessing the theories, existing situations, and gaps found in the current topic.

3.2.5. Data source selection/sample design: Multistage sampling

Sampling is the process of selecting a number of study units from a defined study population (Abiy, et al., 2009) to yield the most relevant and information-rich data (Yin, 2016). It is the key element of the validity of the research.

[14] Triangulation refers to the use of multiple methods or data sources in qualitative research to develop a comprehensive understanding of a phenomena (Carter, et al., 2014). It increases the credibility and validity of the research through the convergence of information from different sources which makes the research rich and clear.

[15] Semi structured interviews fall between closed ended and unstructured interviews. Specific & predetermined questions are asked to the respondents in a particular order (Abiy, et al., 2009).

Kothari (2004) states that samples can either be probability[16] or non-probability/purposive samples[17]. Probability samples are those that are based on simple random sampling[18], systematic sampling[19], stratified sampling, cluster area sampling[20]. Non-probability samples on the other hand are those that are based on convenience sampling[21], judgment sampling[22], and quota sampling techniques.

The samples of qualitative research are likely to be chosen using purposive sampling (K.Yin, 2011). But the number of eligible candidates is too large for this research and warrants a multi-stage sampling[23] approach which is a development of the cluster sampling method.

The first stage of this multi-stage approach is the collection of relevant quantitative data about the entire population (Yin, 2016). Once the population is defined, other relevant criteria need to be defined to reduce the number of the study population. A detailed outline of the approach to select the condominium site and the sample group can be found in **Appendix 3: Criteria's for choosing Case study area location.**

Based on the criteria's set out, the study area chosen was the Gellan III condominium site. The site is located on the periphery of the city in Wereda 04 of Akaki/kality Sub-city. It is bordered by the Gellan I & II condominium sites its northeast to southeast side and the highway to Haile Garment on the west. The site rests on about 880,500m^2 of land which was previously a farmland and has a

[16] In Probability sampling, the inclusion of all representatives of a population are given a priority and the information is used to generalize findings to the entire population (Abiy, et al., 2009).
[17] Non-probability sampling also known as purposive sampling involves the deliberate selection of particular units of the universe to represent the rest and is used when the universe being considered is small and a known characteristics of are to be studied in-depth (Kothari, 2004). Although, this isn't always the case as it is equally important to select cases that provide the broadest range of information and perspectives on the subject of the study (Yin, 2016)
[18] In simple random sampling, each and every item in the population has an equal chance of inclusion and a chance of being selected (Kothari, 2004).
[19] Systematic sampling involves selecting a random point to start on the list of population and then every *n*th element is selected until the design=red number is secured (Kothari, 2004).
[20] Cluster sampling is used when the population under consideration happens to be a big one and involves selecting groups or clusters instead of individual elements for inclusion in the sample (Kothari, 2004).
[21] Convenience sampling is the method of selecting units simply because of their ease of availability and it is generally preferred as it can likely produce an unknown degree of incompleteness as the readily available data may not be the most informative one. It is also likely to produce an unwanted bias (Yin, 2016).
[22] Judgment sampling involves the usage of the research ability of judgment to select items which he/she considers as a representative of the population. It is used when the goal of the research is to develop hypotheses rather than to generalize findings to larger populations (Kothari, 2004)
[23] Multi-stage sampling is a development is used for big inquires extending over a large geographical area. If the one of the techniques used under this is random sampling, the sampling procedure is described as multi-stage random sampling (Kothari, 2004).

total of 5231 shop and residential units. The building typologies and the total number of residential units can be seen in Table 3.1-1.

Table 3.1-1 Building and bedroom typologies found in Gellan III site

Building typology		No of blocks	Bedroom typologies per building				
			studio	1-bedroom	2-bedroom	3-bedroom	Total units
A'1	Residential	9	10	10	10	-	270
E'1	Residential	52	5	15	5	5	1560
	With shop	20	4	12	4	4	480
E'2	Residential	83	10	10	-	-	1660
	With shop	15	8	8	-	-	240
L'1	Residential	21	5	12	10	5	672
	With shop	8	5	12	5	5	216
						Total no of housing units	**5098**

Source: Addis Ababa Housing Development and Administration Bureau & personal observations

The site was transferred using four methods: by lottery, relocation because of redevelopment, for teachers, and for governmental officials. The lottery was drawn in 2015 G.C (2007 E.C) and the inhabitants moved in in 2016 G.C (2008 E.C).

The typical floor plan of the chosen building typologies E'1 & L'1 can be found in Appendix 4: Floor plan of chosen building typologies and Figure 3.1-1 below shows the location of the case study area.

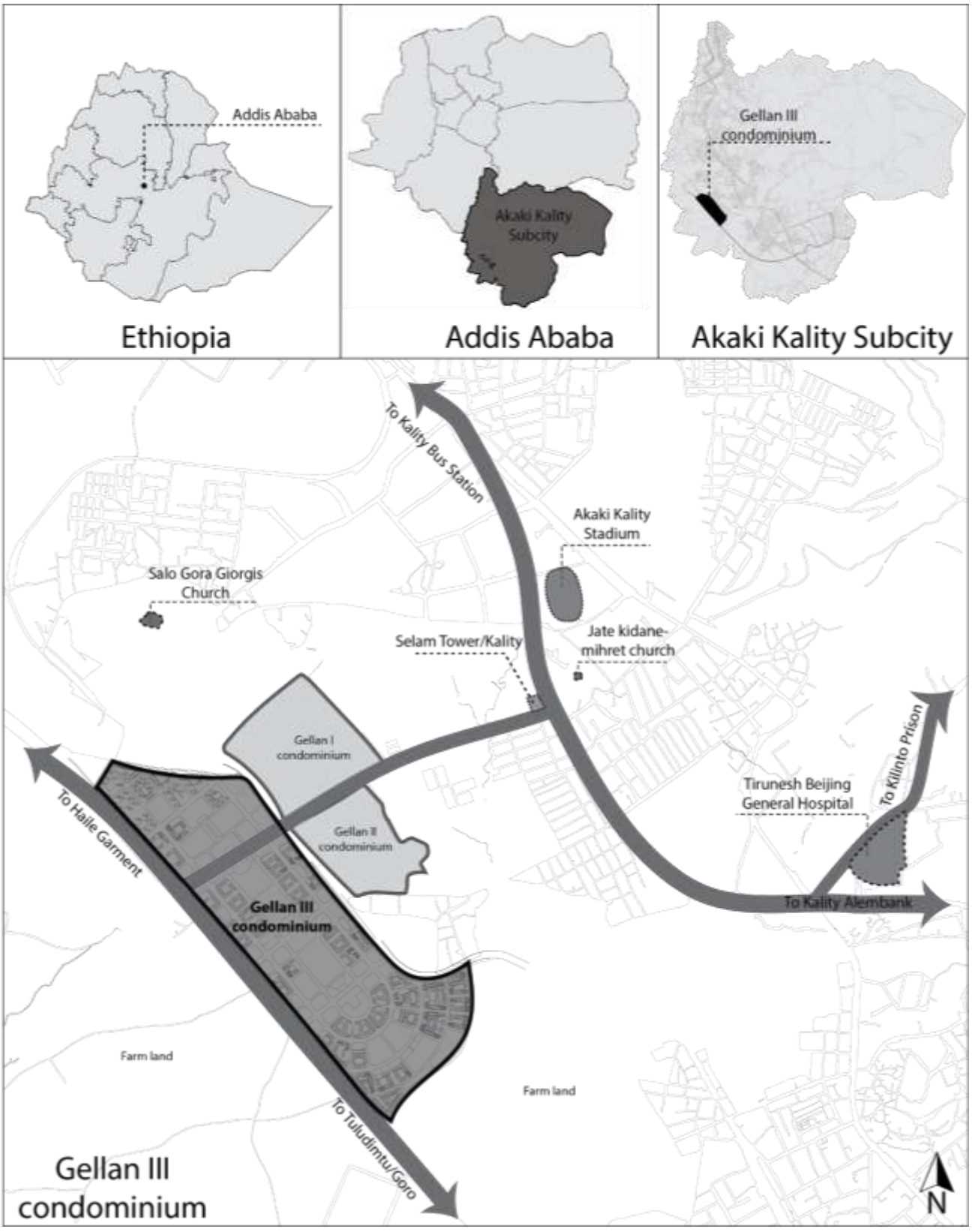


Figure 3.1-1 Location of study area

3.2.6. Data source size: Repetition

For a case study design type, there is no formula for defining the desired sample size (Yin, 2016) and it is typically small (Schich, 2019). This is because the purpose of a qualitative research is not to generalize findings to the whole population but to describe or explain what is happening within a smaller group of people (Dawson, 2002). In other words, case study research does not follow a sampling design (Yin, 2016) and the same research can be done on another group of people with different results.

A case study design could be undertaken by taking or single case[24] and multiple cases[25] designs (Yin, 2014). This research follows the multiple-case design method which affords the researcher the ability to gather a strong and compelling data and follows the theory of "replication" design which is different from the multiple respondents' design in a survey or multiple subjects within an experiment.

Unlike other methods, the replication method does not have a clear cut-off point. Instead, the data collection process stops when enough data has been collected a) confirming evidence for the research questions that have been asked b) when the evidence includes attempts to investigate rival hypotheses or explanations (Yin, 2014).

A total of 32 cases were carried out in this research. Each housing unit typology was studied until replication of data was found that sufficiently answered the research questions. The 1-bedroom unit typology had a larger amount in the sample frame and also various designs, so the cases were doubled in compression to the other typologies: - the 2 and 3-bedroom typologies. Sixteen 1-bedroom typologies, eight 2-bedroom typologies and eight 3-bedroom typologies were undertaken in total.

3.2.7. Data collection instruments: Triangulation

There are several data collection methods, and one should select the method which is better suited to the objective of the research and gather the right type of information (Abiy, et al., 2009). A triangulation method involving both primary and secondary data collection methods were used in

[24] The single case study design has two variants known as the holistic design containing a single unit and the embedded design having multiple subunits. The rationales of undertaking a single case study are the need to represent the critical test of a significant theory, to represent an extreme or unusual case deviating from theoretical norms or a situation which has been inaccessible to empirical study before and the study of a longitudinal case which is the researching of the same single case in different points of time (Yin, 2014).

[25] If a case study contains more than a single case, it is known as a multiple case design (Yin, 2014).

this research. The primary data was collected through mapping of each house, direct observation[26], semi-structured in-depth interview[27] with inhabitants and key informants.

Observation has several advantages such as the ability of the researcher to record the natural behavior of the group, verify the truth of statements made by informants, find out about information left out by the informants (Kothari, 2004).

A mapping of each house was also used to record the arrangement of each space and semi-fixed features, the transformation of the house and the activity pattern of the household. This also helped cross analyze the information that was collected through the questionnaire.

The secondary data on the international and contextual issue of the research topic was referred through government policies and guidelines, newspapers, previous research works, articles, maps, and books. Various documents on condominiums space designs have also been acquired from the City Government of Addis Ababa Housing Development and Administration Bureau.

3.2.8. Data analysis and interpretation techniques

Unlike the analysis of quantitative data, in the analysis of qualitative data there are few fixed formulas to generate results. Even with the use of software's for encoding, output of collected data put through the software must be studied by the researchers to determine whether any meaningful patterns are emerging as the software will not do the finished analysis on its own (Yin, 2016).

The data collected was encoded using Microsoft excel for this research and the analysis was done starting from the research questions. Yin (2016) recommends this technique of starting from the smallest question and continuing to the largest question of the research to do draw the necessary information for analysis. This helps to draw tentative conclusion based on the weight of the evidence.

[26] An observation is the assessment of the occurrence of certain types of behaviors during periods of time in the field with the observer fully participating in the actions being studied or merely observing passively (Yin, 2014).
[27] In-depth interviews are designed to discover underlying motives and desires which help to explore the needs, desires, and feelings of the informants (Kothari, 2004). Semi structured interviews fall somewhere in between informal conversations and highly structured formal interviews with fixed responses. It has predetermined specific questions asked in a particular order or issues to be covered during the interview (Abiy, et al., 2009).

The collected data was interpreted through the usage of

i. Tables & graphs
ii. Spatial configuration diagrams

Spatial configuration diagrams, a method formulated by bill hillier in space syntax, shows how spaces within the house relate to each other spatially through graphical analysis and mathematical interpretations. It offers a way of studying the relationship between configurational patterns in the built environment and their generative or reproductive social structure (Ostwald & Dawes, 2018).

The methods used help to represent studied spaces concisely and scientifically through mathematical representations. Space syntax has three stages in its analytical techniques: abstraction, analysis/configuration, and interpretation. The methods are described as follows

A. Abstraction/representation-reduces or abstracts an environment into a series of differentiated components. The method used for this study is the convex space abstraction method. Functional convex space has been used to analyze the activity spaces and patterned convex space to analyze the spatial. The abstraction has four different types of techniques. The technique used for this research is the functional convex space technique.

   The convex space technique abstracts the environment into a set of connected convex spaces before analyzing this set both visually and mathematically (Ostwald & Dawes, 2018). The functional convex space technique overlooks the fewest and fattest rule and instead arranges the same functional areas in a space into one convex space (Monteiro, 1997). This helps to study the spatial pattern of activity in a home instead of the spatial configurations.

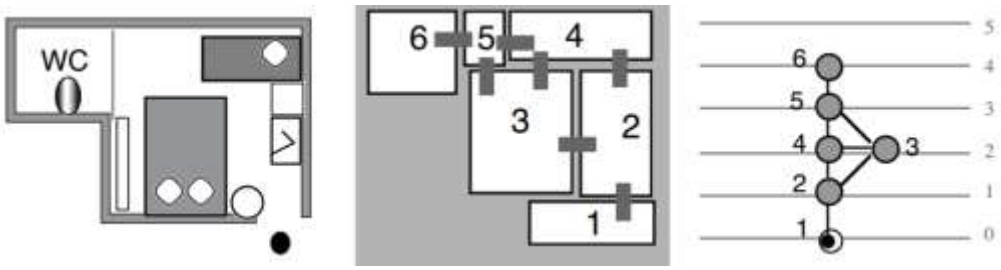


Figure 3.1-2 Architectural plan, functional convex space and justified graph of a Favela house

Source: (Monteiro, 1997), Page 20.5

B. Analysis/ configuration- starts with the derivation of collective measures including the number of nodes, edges, which then can be compared to the results of other similarly constructed graphs. The measurements that can be used are, total depth (TD), mean depth (MD), relative asymmetry (RA), control value (CV), integration (*i),* real relative asymmetry (RRA), Integration (IRRA/HH)

   The software AGRAPH[28] was used to generate justified graphs (J-graph) while DepthmapX[29] software was used to generate calculations. The first set of houses were calculated manually and compared with the DepthmapX calculations to ensure the software calculations were correct.

C. Interpretation- The interpretations can be done visually based on the J-Graph or from the mathematical meanings of the calculated measurements. The meanings of the calculated measurements are as follows:

- MD- a depth higher than the mean is more isolated and a depth lower than the mean is less isolated.
- RA- calculated for different graphs with similar node numbers, the higher the RA, the more isolated a space is. The results range from 0 to 1.
- RRA- used to compare graphs with radically different nodes, it is an indicator of symmetry-asymmetry and describes how permeable/ accessible a particular space is. The lower the RRA, the higher the space is integrated and the vice versa.
- IRRA/HH- shows the degree of integration of a space and is the inverse of RRA. It measures privacy of a space. the higher the number, the more public it is and the lower the number the more private it is.

[28] AGRAPH is a PC-application for drawing space syntax graphs and doing space syntax calculation. It was developed by Paul Benze and Bendik Manum and later developed by Espen Rusten and Bendik Manum. The software can be found at https://www.ntnu.no/ad/spacesyntax .

[29] DepthmapX is a multi-platform software to perform a set of spatial network analysis designed to understand social processes within the built environment (team, 2017). It was initially developed by Alasdair Turner from the space syntax group as Depthmap. Now the open-source software can be found at http://archtech.gr/varoudis/depthmapX/.

Table 3.1-2 below summarizes the meanings of the mathematical calculations for the space syntax method.

Table 3.1-2 Space syntax calculations interpretation

	High number	Lower numbers
Control (CV)	High control	Low control
Integration (IRRA/HH)	Public	Private
Mean depth (MD)	Isolated	Not isolated
Relative asymmetry (RA)	Isolated	Not isolated
Real Relative Asymmetry (RRA)	Segregated	Integrated

3.2.9. Validity and reliability

The quality of any given research design can be tested using four logical tests which have been used to establish the quality of any empirical social research which case study research is part of (Yin, 2014). The four testes are construct validity[30], internal validity[31], external validity[32], and reliability[33].

Validity in qualitative study is not a companion to reliability (examining stability) or generalizability (the external validity of applying results to new settings, people, or samples).

According to the requirements of the four tests, the objective and research questions were initially ensured they have a clear focus of direction and specific topic. Then a questionnaire was developed based on the data collected through the literature review and piloted to test if the questions were clear and answered the research questions. Multiple sourced of data were collected using desk research (literature review) primary data through the interview, mapping, direct observation.

[30] Construct validity uses multiple sources of evidence to establish chain of evidence and have key informants review draft case study report (Yin, 2014).
[31] Internal validity used for explanatory or casual studies only seeks to establish a causal relationship whereby certain conditions are believed to lead to other conditions (Yin, 2014).
[32] External validity defines the domain to which a study's findings can be generalized and uses theory in single-case studies and replication logic in multiple-case studies (Yin, 2014).
[33] Reliability demonstrates that the operations of a study such as the data collection procedures can be repeated with the same results (Yin, 2014).

The collected data using the in-depth interview was encoded using excel and manually analyzed. The maps were computed using AutoCAD and then transferred to space syntax software's: DepthmapX and AGRAPH to cross analyze with the findings collected from excel.

The external validity of a case study is hard to do as the sample size used for a case study is too small to generalize the findings to the larger population. Instead, houses were studied until a replication of data was found. For the reliability, the procedures used for doing this study are described in detail to ensure the goals of reliability which are to minimize errors and biases in the study and allow other researchers to undertake the study again and arrive at the same result.

3.2.10. Summary

This chapter outlined all the research methodology adopted for this study. It established the appropriate research design that was taken to answer the research questions defined in section 1.4 of this study and included the research application, method of reasoning, research approach, study design, source of data, data source selection, data source size, data collection instruments, and data analysis techniques. The following table summarizes the elements discussed in the chapter.

Table 3.1-3 Summary of research methodology

Research question		**Data type**	**Method of data collection**
How are the housing units in Gellan III condominium used?	What	Primary & secondary	Semi structured In-depth interview, mapping, direct observation, document review
	Where	Primary	Semi structured In-depth interview, mapping, direct observation
	By whom		
How are domestic activities affected by the spatial layout of the condominium units and vice versa?		Primary & secondary	Semi structured In-depth interview, mapping, direct observation, document review
Identifying how the inhabitants have been affected by the spatial layout of the housing units in relation to the domestic activities they need to carry out.		Primary & secondary	Semi structured In-depth interview, mapping, direct observation, document review
What procedures can be used to provide spaces that accommodate the needs of the domestic activities?		Primary & secondary	Semi structured In-depth interview, document review

4. CHAPTER FOUR- RESULTS AND DISCUSSION

4.1. Introduction

This chapter presents the analysis of the data collected for this research via document review, semi-structured in-depth interview, and direct observation. The chapter is grouped into three sections excluding the introductory section based on the research questions and findings extracted from the research. The first section presents the background information of the respondents, and the second section presents the findings based on the three research questions. In the last section summary of findings extracted and discussion is presented.

The interview was conducted among the selected group of inhabitants of the Gellan III condominium and the data collection continued until a repetition of data was found as discussed in section 3.2.6. All interviews were conducted in Amharic by the researcher to eliminate the difficulty in communication and to ensure that the concept of the questions was fully understood by the respondents.

4.2. Background information of respondents

This section provides background information about the respondents in the semi-structured in-depth interview about their housing typology, sample size from each housing type, rooms found in each housing typology, tenure type, and family type by gender and size. A total of 32 households were interviewed in person. 16 of the households were from L'1 building typology while the other 16 were from E'1 building typology.

The sample size of each housing unit typology from the selected buildings in relation to the house area are shown in Table 4-1.

Table 4-1 Sampled housing unit types in respect to the house area.

Building typology	**Housing typology**	**Sample size**	**House area (m^2)**	**Percentage in the sample (%)**
E'1	1-bedroom (Type A)	4	32.8	12.5
	1-bedroom (Type B)	4	34.8	12.5
	2-Bedroom	4	51	12.5
	3-Bedroom	4	63	12.5
L'1	1-bedroom (Type A)	4	36.1	12.5
	1-bedroom (Type B)	4	39.5	12.5
	2-Bedroom	4	50.6	12.5
	3-Bedroom	4	64	12.5
Total		32		100

It can be seen from the table that, the total sample size for 1 bed-room typologies is double in number than the other housing typologies. This was because each building typology had a higher composition of 1-bedroom typologies with two different design types. The table showing the housing unit typology composition of E'1 & L'1 is shown in **Appendix 3: Criteria's for choosing Case study area location**.

The room types found in each house typology based on the design are shown in Table 4-2 below. 'O' indicates the room is found while 'X' indicates that the room is not found in the typology.

Table 4-2 Room types found in each housing typology based on the design

Building typology	**Housing typology**	**Living room**	**Dining room/area**	**Kitchen**	**bathroom**	**Bedroom**			**Corridor**	**Balcony**
						1	**2**	**3**		
E'1	1-bedroom (Type A)	O	X	O	O	O	X	X	O	X
	1-bedroom (Type B)	O	X	O	O	O	X	X	O	X
	2-Bedroom	O	O	O	O	O	O	X	O	O
	3-Bedroom	O	O	O	O	O	O	O	O	O
L'1	1-bedroom (Type A)	O	O	O	O	O	X	X	O	X
	1-bedroom (Type B)	O	O	O	O	O	X	X	O	O
	2-Bedroom	O	O	O	O	O	O	X	O	O
	3-Bedroom	O	X	O	O	O	O	O	O	O

Each typology has a bedroom unit relative to its name along with a living room, corridor, bathroom, and kitchen. The one difference that can be seen is in the balcony. Unlike the other 1-bedroom typologies found in both buildings, the TYPE B 1-bedroom typology in L'1 building does have a balcony space. The remaining 2- & 3-bedroom typologies all have a balcony.

As shown in

Table 4-3 below, of the 32 houses sampled 16 were owners, 15 were renters and 1 was a custodian. Of the 16 owners, 4 were lottery winners, 9 were relocated for development and 3 purchased their

houses from individuals. Of the 15 renters, 8 of them are teachers and 1 is a governmental worker while the rest are rented from private owners. The teachers and governmental worker were assigned their respective houses, mostly the 1-bedroom typology, from the government at a lower rent price. The final custodian is taking care of the house for her brother who got the house through a teaching position.

Table 4-3 Tenure type with respect to housing typology

Building typology	Housing typology	Sampled size	Tenure type		
			Owner	Renters	custodian
E'1	1 bedroom-Type A	4	3	1	0
	1 bedroom-Type B	4	1	2	1
	2 Bedroom	4	2	2	0
	3 Bedroom	4	4	0	0
L'1	1 bedroom-Type A	4	0	4	0
	1 bedroom-Type B	4	0	4	0
	2 Bedroom	4	3	1	0
	3 Bedroom	4	3	1	0
Total		**32**	**16**	**15**	**1**
Percentage (%)		**100%**	**53%**	**44%**	**3%**

Of the residents that have been interviewed, 6.24% have been in their current house for 3 years, 25% for 4 years and 68.74% for 5-6 years. 34.37% came from Arada Sub city, 28.12% from Akaki/Kality, 6.25% each from Kolfe, Yeka & Lideta sub cities. 12.15% were from outside of Addis Ababa while there was 1 occurrence from Nifas Silk Sub city.

Table 4-4 below shows the gender composition of the households studied: 51.39% male and 48.6% female. The 1-bedroom typologies had the lowest average household size with 4 to 5.25 people per household, while the 3-bedroom typology in the L'1 building had the highest (7.75 people), followed by the 2-bedroom typology in the E'1 building (7.25 people).

Comparing household size with the number of bedrooms in each typology, the 1-bedroom typology had the highest number of people per bedroom (up to 4.75), followed by the 2-bedroom typology (up to 3.625 people per bedroom), and the 3-bedroom typology had the lowest (2.58 people per bedroom).

Table 4-4 Household size and gender in relation to housing type

Building typology	Housing typology	Sampled size	Women	Men	Average household size	Average people per bedroom
E'1	1 bedroom-Type A	4	9	10	4.75	**4.75**
	1 bedroom-Type B	4	6	12	4.5	**4.5**
	2 Bedroom	4	15	14	7.25	3.625
	3 Bedroom	4	11	10	5.25	1.75
L'1	1 bedroom-Type A	4	9	7	4	**4**
	1 bedroom-Type B	4	8	13	5.25	**5.25**
	2 Bedroom	4	11	13	6	3
	3 Bedroom	4	18	13	7.75	2.58
Total		**32**	87	92		
Percentage (%)		**100%**	**48.6%**	**51.39%**		

4.3. Interview analysis

The encoding of the interview data was done using Microsoft excel and analyzed manually while the drawings sketched on site were at first computed using AutoCAD. The drawing was then transferred to the space syntax software's DepthmapX and AGRAPH for abstraction, analysis, and interpretation. The results are presented in the order of the research questions asked as follows.

4.3.1. How are the housing units used?

Among the objectives of this research, the first was to identify how the domestic activities are performed in the condominium units. To answer this, the questions of the activity type, location of the activities, the performer's gender and position in the family was undertaken. Each variable was analyzed separately, and the results are described as follows.

4.3.1.1. What are the domestic activities performed?

Initially a list of possible domestic activities was created during the document review and pilot data collection process. Respondents were asked which activities they performed on a regular, seasonal, and annual basis. Any remnant signs of activities were also recorded and added onto the list while drawing house plans and furniture's. The activities from the document review and pilot were then further edited during the first couple houses in main data collection and any activities in the list that were not included were added. The final 23 activities can be seen in Table 4-5.

Table 4-5 List of final domestic activities

<table>
<tr><td>Cleaning the house</td><td>chatting</td><td colspan="2">Reading (non-school)</td><td colspan="2">Resting (sitting/nap)</td></tr>
<tr><td>Washing children</td><td>Accepting visitors</td><td colspan="2">Studying</td><td colspan="2">Sleeping</td></tr>
<tr><td>Washing cloth</td><td>Washing dishes</td><td colspan="2">Preparing traditional drinks</td><td colspan="2">Watching tv-news, movies, drama, …</td></tr>
<tr><td rowspan="4">Personal hygiene keeping (washing face, brushing tooth, shower, cleaning hair</td><td>Drinking coffee</td><td colspan="2">Preparing injera</td><td colspan="2">Burning coal</td></tr>
<tr><td rowspan="3">Coffee ceremony (washing, toasting, grinding, brewing, etc)</td><td rowspan="3">Cooking</td><td>Breakfast</td><td rowspan="3">Eating</td><td>Breakfast</td></tr>
<tr><td>Lunch</td><td>Lunch</td></tr>
<tr><td>dinner</td><td>Dinner</td></tr>
</table>

A new domestic activity category was created based on the ones discussed in section of 2.2.4 while studying the activity types. This new category grouped activities into chores and leisure which can distinguish if the activities are necessary or optional & resultant activities respectively. These activities were then crossed with communal and individual categorizations to analyze if multiple people are involved in the undertaking of these activities or not. The resultant categories are thus: communal chore (CC), communal leisure (CL), individual chore (IC), and individual leisure (IL). This along with the recorded semi-fixed fixtures (furnishings) helps to understand how much space is needed to perform a certain activity. The respondents were then asked to sort the 23 activities into the four categories.

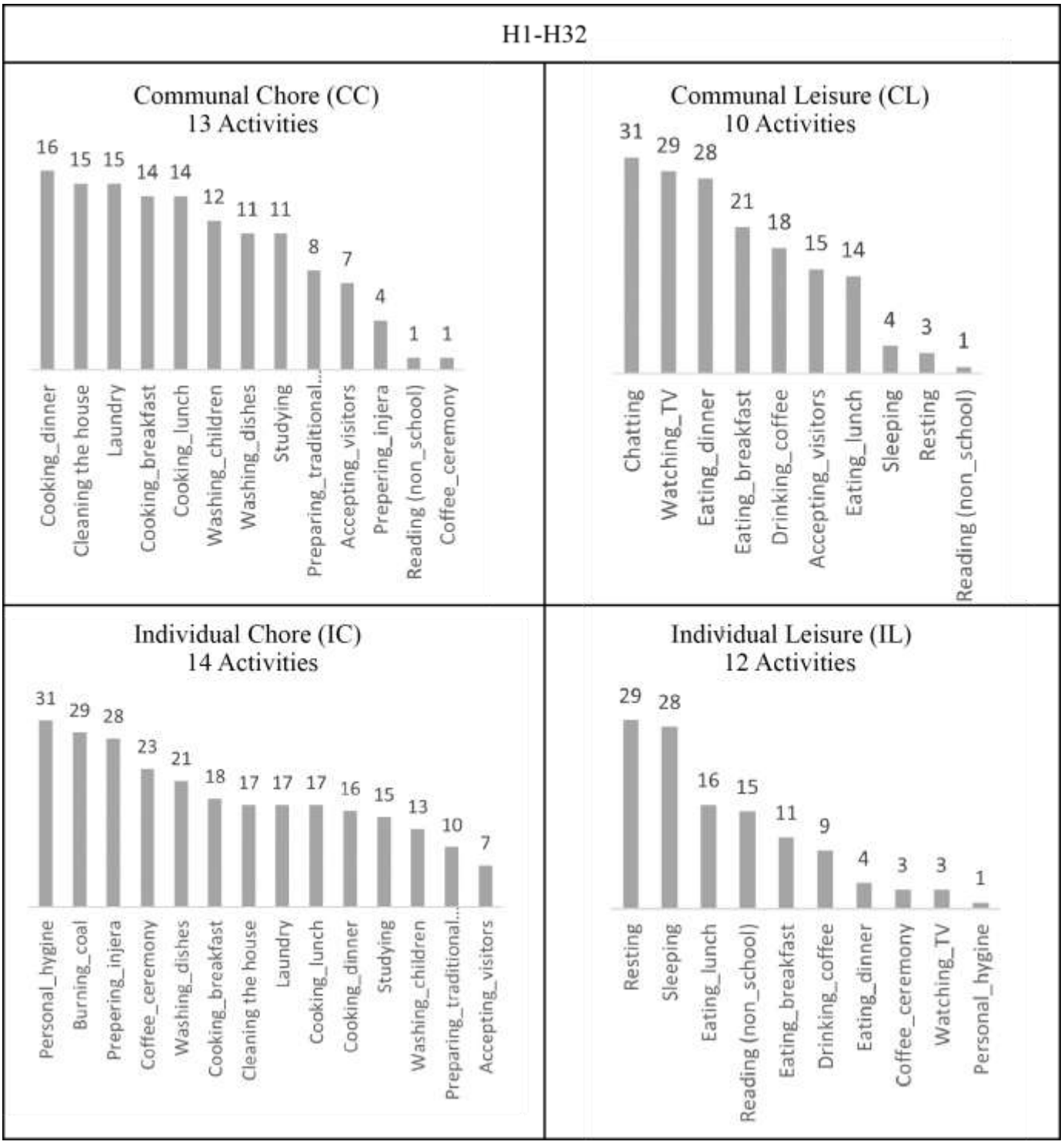


Figure 4-1 Activity type categories in all 32 households

As it can be seen in Figure 4-1, which summarizes activities by type in all 32 houses, shows there is little overlap between leisure and chore activities. The only activities that overlap as leisure in some households and chores in others are accepting visitors, coffee ceremonies, non-school reading, and preparing traditional drinks. Accepting visitors is split almost evenly, with 14 households viewing it as a chore and 15 as leisure.

Coffee ceremonies and preparing traditional drinks are mainly seen as individual chores, though three respondents answered coffee ceremony is a leisure with one interviewee stating that she considers it as such as she enjoys drinking coffee and the preparation of it is the time of the day she gets to relax and enjoy herself after finishing her daily chores. Two other interviewees echoed this view. The other 23 interviewees saw this activity as purely a chore and five households prefer tea over daily coffee ceremonies, although they maintain the necessary items for a traditional coffee ceremony.

The rest of the activities had a clear distinction between being a chore and a leisure. The difference was in how many people participated some being communal and others being individual. The activities that were largely categorized as CC are a cooking, cleaning house, laundry and washing children. These same activities also took up most of the IC category with the addition of personal hygiene, preparing injera, burning coal and coffee ceremony having more instances.

As for the leisure activities, the individual and communal are inversely related with the highest incidence of individual being the lowest for the communal and the vice versa. The activities with highest incidences in CL are chatting, watching TV, eating dinner and breakfast, and drinking coffee. The highest for the IL on the other hand are resting, sleeping, eating lunch, and reading (non-school). The leading reason given by interviewees behind eating lunch being an IL instead of a CL unlike eating breakfast and dinner is that most family members spent the day outside of the home on the weekdays and in some instances on Saturday too. If the responders were at home, they were likely alone hence the eating alone.

For further analysis, the activity categories separated by bedroom typology can be found in **Appendix 5: Summary of activities by type categorization in 1-, 2- & 3-bedroom typologies.**

4.3.1.2. Where are the domestic activities performed?

As mentioned in Table *4-2* each housing typology has different spaces inside. As such, the places where activities took place in each housing typology will be presented by bedroom typology before they are summarized together.

It can be noted that the list of activities discussed in Table 4-5 have been edited to include other things occurring in the house that are not considered an activity but are significant in discussing as they affect how spaces in the household are used. These new added lists are visitor sleeping area and storage spaces for food, cleaning, water, energy source and cloth. Cleaning the house was removed from activity place analysis as every part of the house is cleaned. The added lists are discussed as activities for ease of discussion together with the activities listed in Table 4-5.

i. One bedroom typology

Figure 4-2, illustrates the activities in the 16 1-bedroom typologies summarized by the places they are performed in as recorded from the interview and sketched house plans. The activities have been partitioned into three categories based on outcome of the activity types as discussed in the previous section.

In the sense of incidence of activities per room, the living room is the most utilized space, accommodating 17 different activities, followed by the kitchen with 13 activities, and the corridor and outside spaces with 11 and 9 activities, respectively. But it is also apparent that although there are several activities occurring in the corridor, balcony and outside, those activities don't take place in said places in every household. For example, activities such as drinking coffee, cooking, eating, storage of cooking and cleaning materials occur in the corridor in a limited number of households, but the cooking and storing activities occur more frequently in the kitchen and the coffee drinking and eating activities occur most in the living room in more households. This numbers can be found in **Appendix 7: Summary of all activities by place in all house typologies.**

In terms of frequency across households, the living room and kitchen are the most consistently used spaces, followed by the bathroom. As can be seen in Figure 4-2, the living room frequently hosts eating, accepting visitors, sleeping, resting, studying, reading, and coffee ceremonies. The kitchen is primarily used for chores and storage, including food, water, cleaning products, and energy sources (charcoal, gasoil), as well as cooking, dishwashing and, injera preparation. There were some instances of coffee brewing and drinking, and laundry.

The bathroom mainly accommodated the activities that can be regarded as hygiene and storage related. Water, cleaning, and energy source materials were stored in the bathroom aside from the kitchen and outside space. It was also noted during the house drawing process the bathroom often contains lines for drying clothes and multiple wash basins for laundry.

Notably, three out of the 16 households have added a second bedroom by partitioning the living room. This additional bedroom is used for sleeping and clothes storage. In households without a second bedroom, a mattress is stored in the main bedroom or corridor and used in the living room at night.

As for the balcony, only one typology in the 1-bedrooms had a balcony of which 4 houses were studied. The activities that appeared in studied houses are cloth storage (all 4 houses), sleeping & resting (3houses). For the sleeping activity, one balcony had a bed while the other three only had a mattress that was put against the wall during the day.

It can also be seen in Figure 4-2, that Overall, chore activities are evenly distributed throughout the house, leisure activities are concentrated in the bedroom and living room, and other activities are mainly around the living room, kitchen, bathroom, and bedroom.

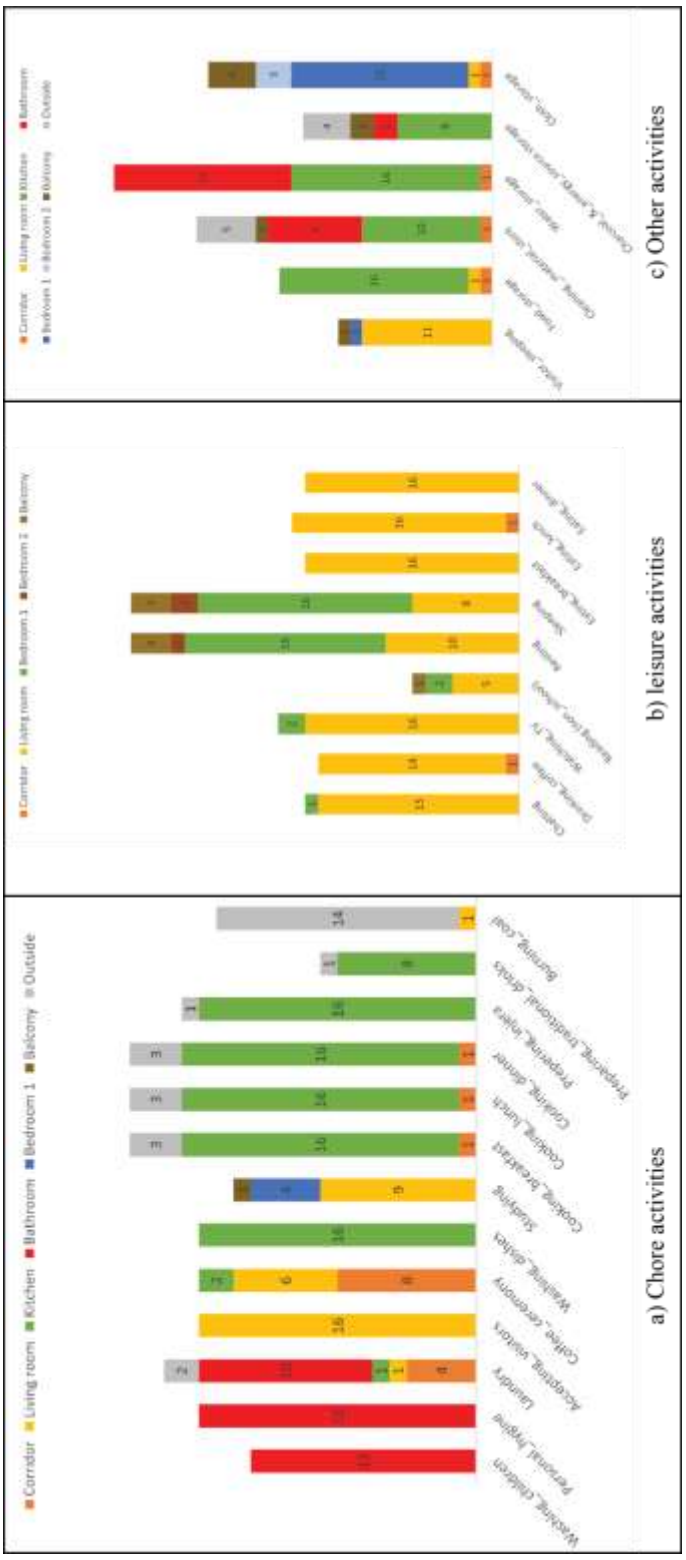


Figure 4-2 Summary of activities by place in relation to activity type in 1-bedroom typology households

ii. Two-bedroom typology

In the 2-bedroom typologies, the living room, kitchen, and bedroom 2 hold the top places for the different types of activities with 18, 11 and 8 activity types respectively as can be seen in Figure 4-3 Summary of activities by place in relation to activity type in 2-bedroom typology households. But as in the case of the 1-bedroom typologies, not all the counted activities occurred in all 8 2-bedroom typology households studied.

Similar to the 1-bedroom typologies, the living room and kitchen consistently hosted the most activities across all households. The living room activities included chatting, hosting visitors, watching TV, coffee drinking, eating, and coffee ceremonies, with some households also engaging in reading, studying, sleeping, and cooking. The kitchen activities involved dishwashing, cooking, injera preparation, and storage of water, food, energy sources, and cleaning materials, with one instances of studying while performing other tasks.

The bathroom accommodated the hygiene, water, and cleaning product storage with also three households having a cloth hanging line installed. There were five cases of cloth washing with one extending out into the corridor with the use of a laundry machine for large quantities of cloth. The other three households did their laundry out in the corridor using a laundry machine. Bedrooms 1 & 2 hold the same activities of resting, sleeping, cloth storage with some occasional appearances of chatting, studying, and reading activities. The balcony mainly was used as a storage place for charcoal, cloth, cleaning materials and food. Three households also used the 2nd bedroom for a sleeping space for visitors. For the informants this was because the visitors were respected family members, and the children sleep in the living area during the night to offer the visitors more comfort. One of this three households let some visitors sleep in the living room. In the other households, Visitors slept in the living room in other households with the mattress stored in the balcony.

The outside space was mainly used for storing and burning charcoal with one household each doing their breakfast and lunch cooking and laundry. The respondent stated cooking in the outside space only happened during times when large quantities of food need to be prepared for celebrations.

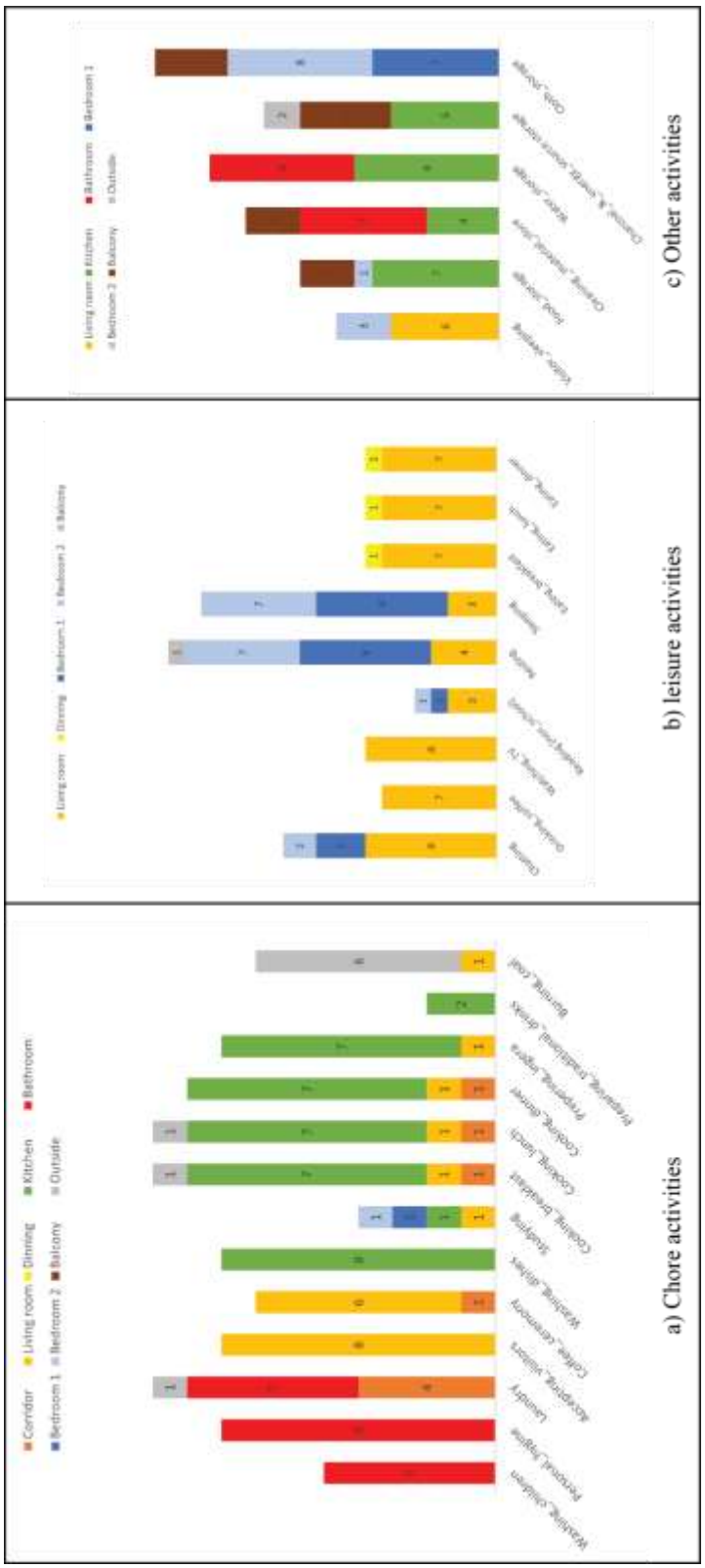


Figure 4-3 Summary of activities by place in relation to activity type in 2-bedroom typology households

iii. Three-bedroom typology

Similar to the 1 & 2-bedroom typologies, the spaces that had the most incidences of activities as well as the most activities occurring in all households are the living room and kitchen. The activity types appearing in the space are also similar to the previous typologies with the exception of if a 3rd bedroom being present in this new typology.

There are four cases of coffee ceremony and laundry each in the corridor. The other households hold their coffee ceremony in the living room and laundry in the bathroom. Seven of the eight households have a laundry machine with four placing it in the corridor. There are also two cases of sleeping in the living room. This is a result of two households who demolished the kitchen and moved the function into the 3rd bedroom and hence making the house type a 2-bedroom typology. Because of this they did not have enough space for their house helps and visitors to sleep in resulting in the living room being used as a sleeping area.

The activity of eating is also done in the dining area in addition to the living area. The 3-bedroom typology has the highest number of houses with a dining table of all the typologies with the 1 & 2 bedroom only having one household with a dining table each.

There are two cases of burning coal in the kitchen and two cases of preparing injera in the balcony which didn't happen in the other typologies. The summary of activities by place in the 3-bedroom typology is presented in **Appendix 6: Activities location by bedroom type.**

The chore activities are found in the bathroom, corridor, living room, bedroom 2, kitchen and the leisure activities are found in the living room, bedrooms while the other activities are found distributed around the house as can be seen in Figure 4-4.

Pictures of households with furniture arrangement showing the location of remnant activities can be found in **Appendix 12: Pictures of the condominium units**

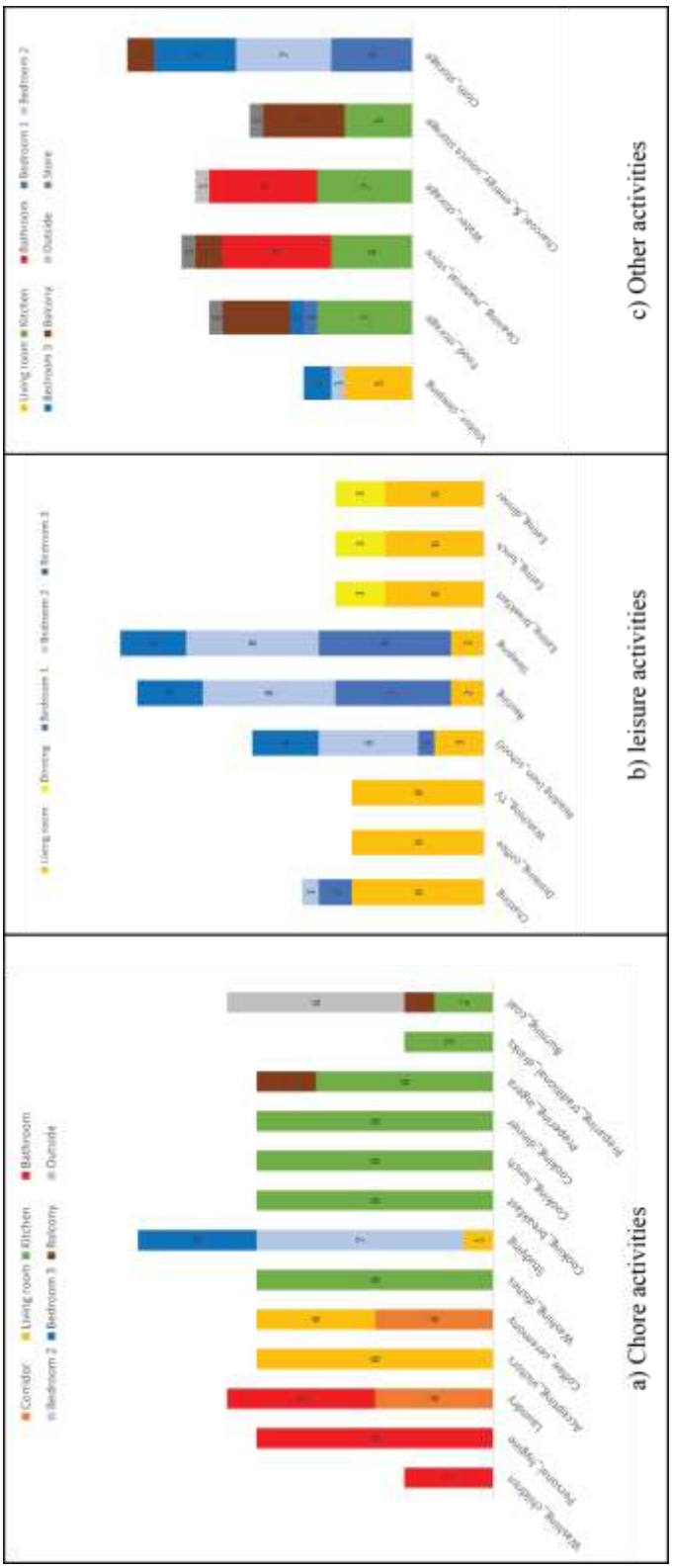


Figure 4-4 Summary of activities by place in relation to activity type in 3-bedroom typology households

It can be summarized that across all typologies, the living room is the most versatile space, accommodating a wide range of activities from leisure to chores. This indicates a multifunctional use of the main communal space in all housing types. The kitchen consistently serves as a hub for cooking and storage across all typologies, emphasizing its central role in household chores. Balconies and outside spaces are primarily used for storage and specific chores, with limited leisure activities. This usage highlights the utilitarian function of these areas rather than as extensions of living space. With activity distribution, chore activities are widely distributed throughout the house in all typologies, while leisure activities are concentrated in the living room and bedrooms. This suggests that while chores are spread out, leisure activities are more centralized. For space adaptation, One-bedroom households often modify their living spaces to create additional sleeping areas, indicating a need for more sleeping quarters. This trend is less common in larger typologies where more dedicated rooms are available.

4.3.1.3. By which members of the household are the activities performed?

Although the data for all activities and performers were collected the activities that were analyzed are mainly the ones that were considered a chore in section 4.3.1.1 under activity types with an addition of one activity considered mainly a leisure: drinking coffee. It was found that the mothers of the households undertook most of the chores followed by the other female members (daughters, female relatives, house helps). The activities the mothers performed from top to bottom are the cooking, injera preparation, laundry, cleaning the house, washing children, coffee ceremony, dish washing, traditional drink preparation, studying.

The top activities that the daughters performed were studying, laundry, dish washing and cooking. The female relatives performed the activities of cleaning the house, dish washing, laundry, studying, cooking, etc. only 9 household had relatives living with them, but they performed as many activities as the mothers while the male relatives found in 4 households rarely contributed to any of the chores. 6 households had house helps with 5 living with the family and 1 being a day only help.

The activities by performer type can be seen in and the activities summarized by gender can be seen in

The activity types summarized by gender can be seen Figure 4-5 and by the summary by position in family can be found in **Appendix 8: Summary of activities by performer.**

None of the male household heads/ fathers performed the activities that were undertaken in the kitchen. Only one father helped with the preparation of dinner from time to time. Some fathers contributed to the children washing (7), laundry (3), house cleaning (2) activities but were daily. None of the sons contributed to the chores except for one household who helped in the house cleaning.

In can also be seen from the activity by gender type in Figure 4-5 that the activities performed by female members of the households is larger than the ones done by the males except for the studying activity. The next activities that had a large number of male members performing them are the drinking coffee (18 males) and non-studying reading (13males).

It is important to note that the 17 mothers (household heads) out of the 32 households were housewives but the other 15 were full time workers. The mothers who had to go to work informed that they had to get up before sunup to prepare breakfast, wash dishes, pack lunch for the family members and dealt with the sending off their children to school and husband to work. One mother stated that she prepared the lunch the prior night and packed it in the morning, a statement shared by five other mothers. The female members that undertook the house chores continued on to prepare & serve dinner, prepare injera, and clean the house & dishes when they returned home. The activity of baking injera was done 2 to 3 times a week in all household and could be done at any time of the day as the electricity power is good in the neighborhood.

The women also performed the activity of filling the water storage barrels early in the morning as the water is cut off every day by mid-day from 12pm to 1pm.

The informants were asked if one person performed any activities simultaneously side by side. Apart from three households, all stated that they do. The chore activities that were performed in combination with other activities were the injera baking, cooking, and cloth washing with laundry machine. These activities were the ones that do not require full time attention with intervals of free time in between while performing them and were combined with each other and other activities like cleaning the house and watching tv. The activities of eating with family members (lunch &

dinner) and drinking coffee was also another activity that was combined with watching TV and chatting.

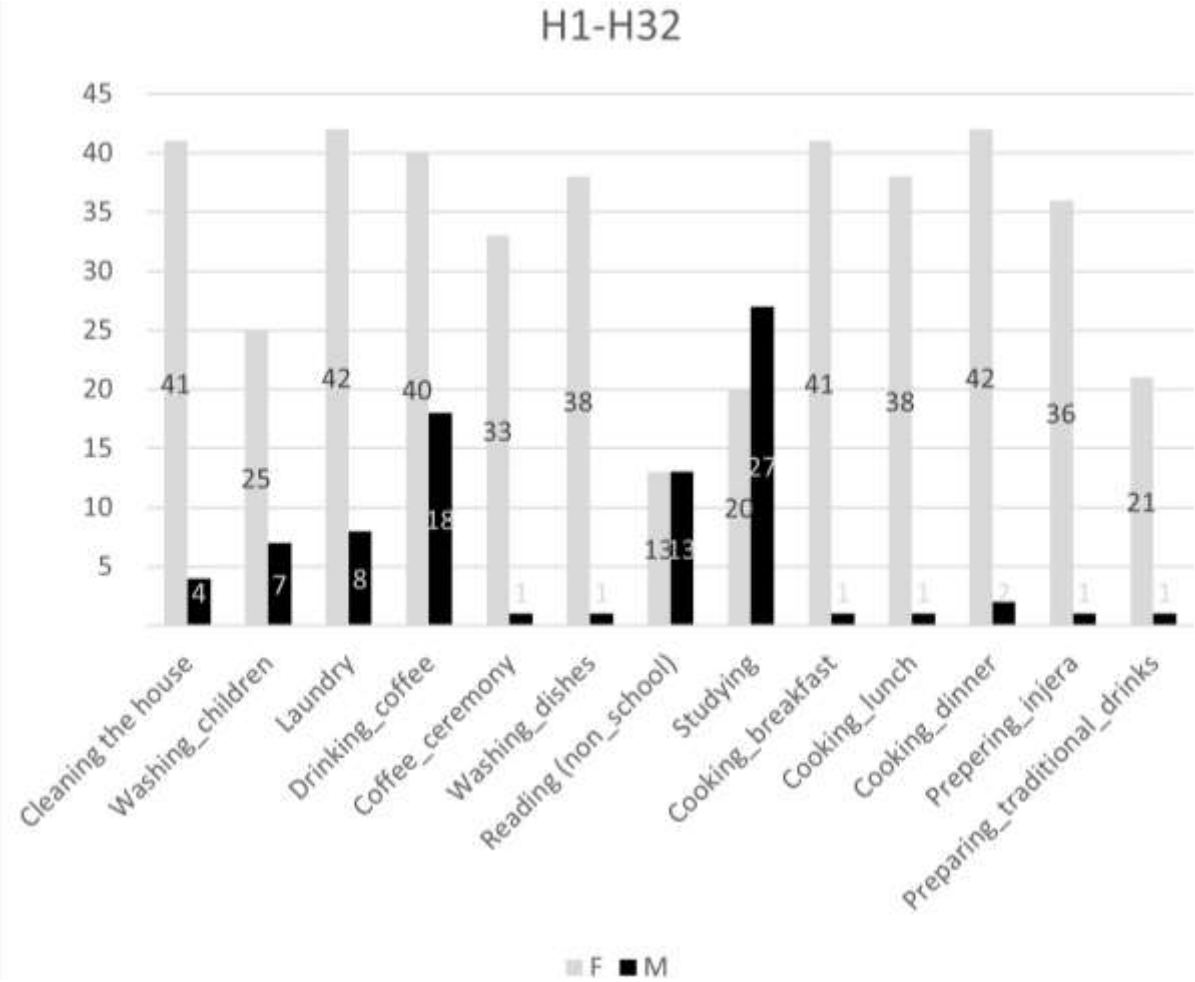


Figure 4-5 Summary of activities by performers gender

4.3.2. How are the domestic activities affected by the spatial layout of the condominium units?

Figure 4-6 & Figure 4-7, show the furnished plan, functional convex space, and justified graph of the 1-bedroom typology of E'1 & L'1 building respectively. In functional convex space, the spatial pattern of the activity in a home is studied instead of the pattern of space as it is usually done in traditional space syntax method.

As it can be seen in Figure 4-6, H2 & H4 have similar activity distribution with a presence of a ring. A ring signifies a higher case of permeability of activities. The dining activity in H2 and coffee brewing activity in H4 are the activity places with the rings to both the living and corridor spaces.

The graph also signifies the central role of the corridor in distributing activities with the activity places from H2 to H4 being one step away from the corridor and having a bush like structure with shallow distribution of activities. H1 has a linear and tree like graph due to a space which has been added to serve the function of a sleeping space and the small sitting area partitioning the function of the corridor into two. It is also important to note that H1 has eight household members which is double the amount of what H2 & H4 each having four members. H3 has three household members.

For the H1 household members, the house is so small for them that not all of them can sit in the living room together at once. The sofa table is put against the L-shaped sofa, so the main corridor is not blocked during the daytime. When the members gather to eat, the table is pushed back for them to access the sofa and the mother sits by the entrance of the 2nd bedroom (added room) to eat and brew coffee. When the children need to study, the parents and the mother's sister move into the bedroom to give them more space and comfort.

For the 1BR-B typology of building E'1, although there is the same spatial characteristics between H5 with H6 & H7 with H8, their graphs differ. This is due to a presence of a study table within the bedroom of H5 & the separation H6's living room into a sitting area and children playing area. Because of this H5 & H7 have an added level to their graph with 4 levels whole H6 & H8 have 3 leveled graphs.

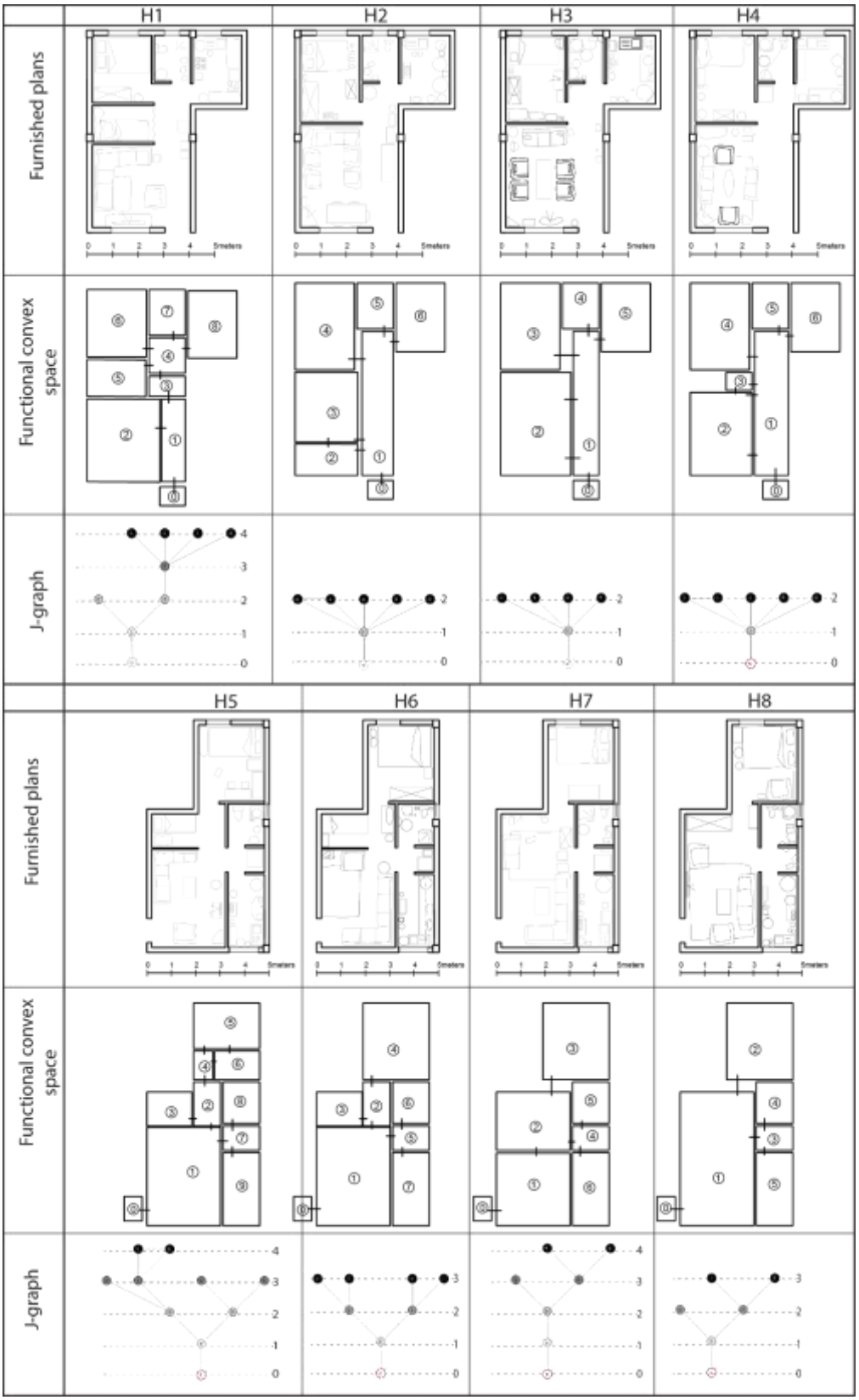


Figure 4-6 Space syntax analysis of 1-bedroom (A&B) typology of building E'1

The configuration of the typology of H5 to H8 does not have a corridor directly linking the entrance to the deeper places as in the previous typology (1BR-A), giving the living area has the role of the distributing spaces with all houses having linear and deep structure. H5 & H6 have five household members each and H7 & H8 have 4 members each.

In Figure 4-7, it is interesting to see all four households from H17-H20 had the same graph. All houses were rented from individuals and the respondents were not allowed to make any changes to the spatial properties of the house. They all had different furnishings but the movement pattern between rooms and furnishings were the same with no interruptions. The activities were distributed in a similar way resulting in the same J-graph. The corridor at the 2nd level of all the J-graphs had the role of distributing activities with the deeper activities the same distance from the corridor. H17 has 6 household members, H18 & H20 have 4 members each and H19, 3 members.

As for H21 to H24, all houses had distinct J-graphs with a ring in all excluding H23. The graphs start to differ from the point going onward from the level 1, the space that is main distributer. The reasoning behind this is spatial disruption of activities. First in H22 & 24 between the corridor and living room, a wall has been added to block direct view of the bathroom from the living room to give privacy and comfort for members of the household and visitors when coming in and out of the bathroom. Second, a furniture disruption in H23 with a coffee ceremony fixture separating the direct movement from entrance to corridor and to bedroom and a presence of a sofa leading to the balcony. Other than that, the houses have a similar distribution of activities and places especially in the last two levels of H23 & H24.

H21 has a shallow and bush like structure, and the other three have a deep and linear structure. H21 & H22 have 4 household members each and H23 & H24 have 6 members each. All four houses are rental units from the government which allowed the residents to make changes to the interior.

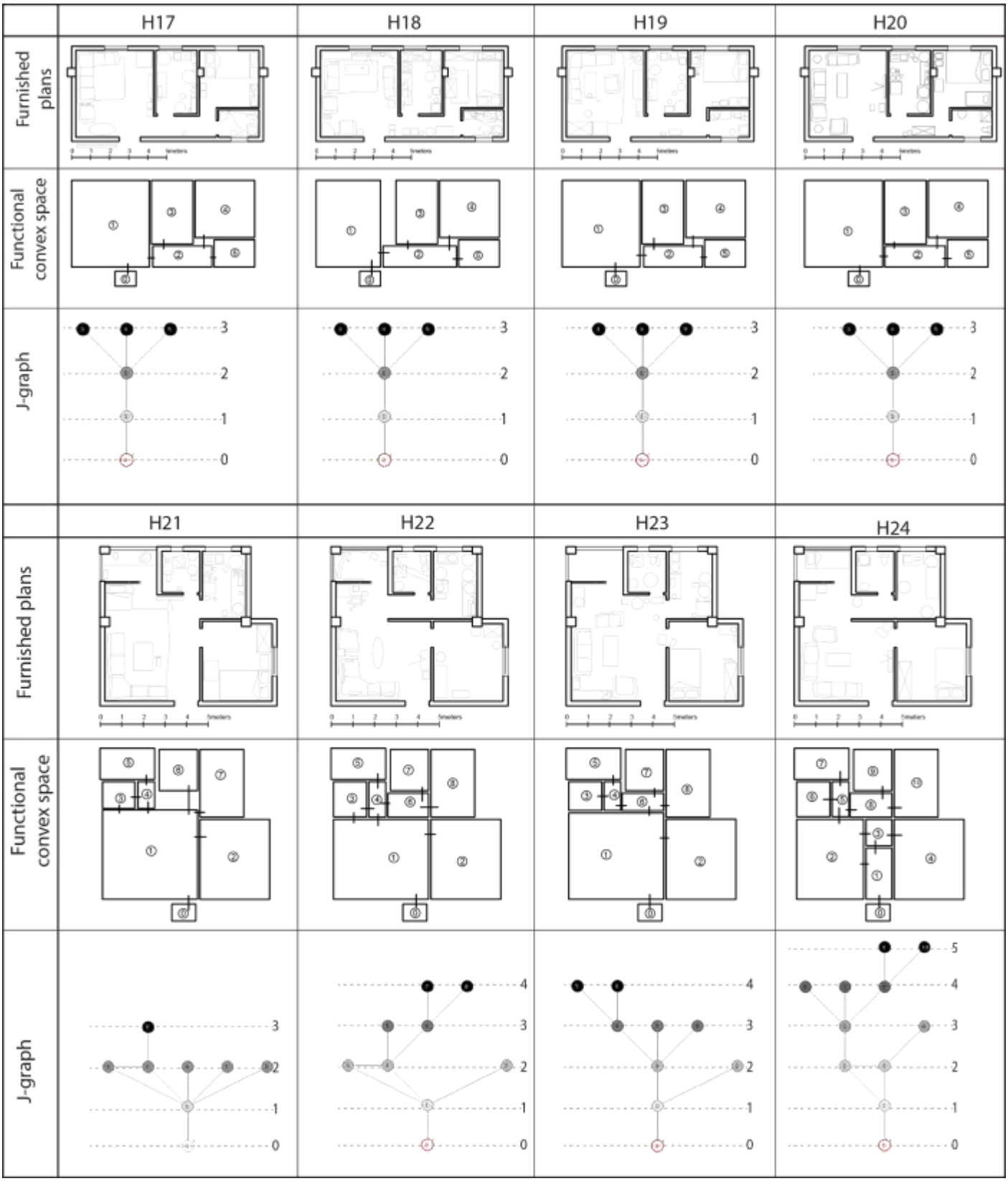


Figure 4-7 Space syntax analysis of 1-bedroom (A&B) typology of building L'1

In the H9 to H12, the 2-bedroom typologies illustrated in Figure 4-8, all graphs had the same number of levels (3) except for H11 which had one more (4). These three houses had the same number of activity nodes (8) with H10 having one more node due a laundry machine dividing the corridor. The living room and corridor had the role of distributing the spaces in the three houses.

H11 had a similar arrangement of activity space with an additional partition of the living space into two with semi-fixed boundary made for the kid's playing and the bedroom has an additional partition of sleeping area from watching TV & child sleeping area. The living room and corridors have the main role of distributing spaces. The graphs of all four houses are shallow and bush like. H9 to H12 households have 7, 11, 5, 6 members respectively.

H25 & H27 have the same graphs even with the spatial and functional differences of the two houses. The kitchen and bedroom have been exchanged in H25 yet both spaces are at the same level of integration and depth from the corridor. Both activities held at these spaces are at the most segregated part of the household. The houses have a shallow and bush like structure.

In H26, the activities are further partitioned into different functional spaces in the corridor. The corridor holds the functions of laundry, fridge and sitting area creating three functional spaces and the living room partitioned more by a dinning and movement spaces. The activities in H28 are distributed in a similar manner but with the living room partitioned by the coffee ceremony setting and the corridor by a laundry area. The houses have a linear and deep structure with the bedrooms at the deepest part of the house.

H25-H27 have 10, 4, 3, 7 household members respectively.

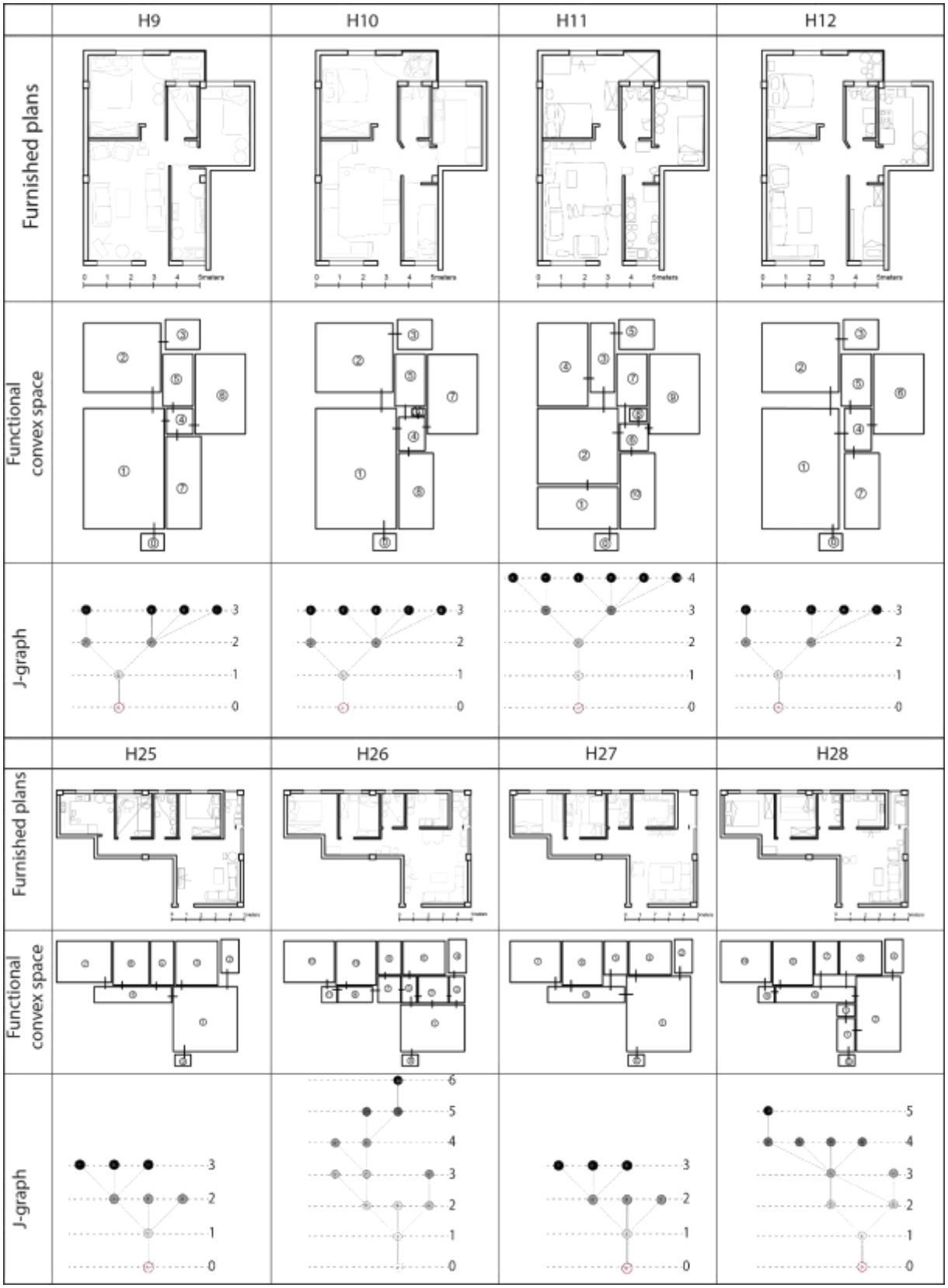


Figure 4-8 Space syntax analysis of 2-bedroom (A&B) typology of building E'1 & L'1

For the 3-bedroom typologies in Figure 4-9, H13 & H14 have the same spatial changes and graphs with four levels and ten nodes. The graph has two points of distribution of activities with the most integrated one being the living and the corridor at a deeper level. The graphs are linear and deep.

H15 & H16 have the same level spatial arrangement but different activity space distribution. They both have five levels. The difference in their activity distribution is found at the two corridor spaces with H15 having more functional distribution at the deeper corridor and H16 at the more integrated corridor. The activities at the corridor have rings indicating permeability. The graphs are linear and deep. H13 to H16 have 8, 7, 4, 2 households respectively.

In H29 to H32, all the graphs are different from each other. Similarities can be seen in H32 & H31 but the former one having one less node and level due the bathroom that has been separated at the initial design being turned into one. Other than that, the former household uses the balcony as a kitchen and the latter as a kitchen but both spaces have the same level of depth. Both houses have two points of distribution for activities at the living and corridor spaces and have shallow and bush like structure.

The living spaces are further subdivided by the functions of dinning and storing. The latter one is for divided by the coffee space. The bathroom in H32 has been turned into two different bathrooms with the second one being accessed form the master bedroom not creating bur replacing the existing node. Both houses have a ring linking the corridor to the dining and coffee spaces respectively and have deep and bush like structures. The households all have 7 members each except for H30 which has 10 members.

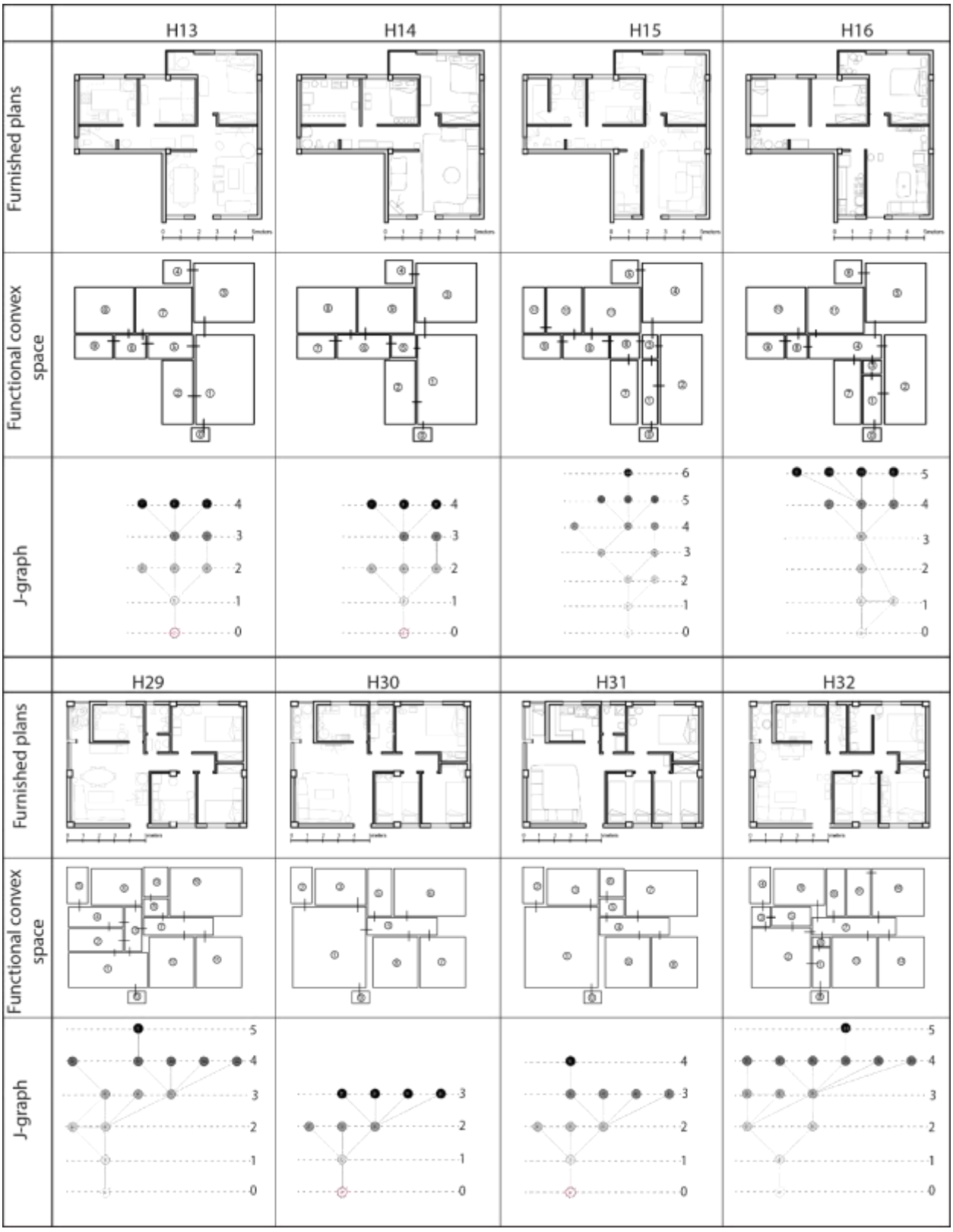


Figure 4-9 Space syntax analysis of 3-bedroom typology of building E'1 & L'1

For the 1-bedroom typologies from H1 to H8 (L'1 building Type A & B), the functional spaces that had the least control were the activities contained in the bedroom, bathroom, and kitchen. These spaces had the highest number for privacy. The spaces that had the highest control were the corridor in all houses with the addition of the living space for all houses except H1, dinning for H2, and coffee for H4. These spaces were the most public spaces for the members of the family.

A similar thing is seen in the 1-bedroom typologies of building E'1 from H17 to H20 (L'1 building Type A & B), the functional spaces that had least control were the bedroom, bathroom, and kitchen with the addition of balcony for H22 & H24. The spaces that had the highest control were the corridor followed by the living room. As mentioned in the activity by place findings, the corridor held the movement, coffee making, and sometimes the cooking activities. The spaces with low control had the low integration and privacy and the ones with high control had high integration and less privacy.

In the 2-bedroom typologies from H9-H12 (L'1) & H25-H26 (E'1), it was also the bathroom and kitchen that had the lowest control and integration with high privacy. The second bedroom is also in this category with the addition of the laundry area for H10, H11 & H26 and the dinning for H13. The corridor and living had the highest control and integration, with the playing area of H11, fridge area in H26 & coffee area in H28 having more integration.

Lastly in the 3-bedroom typologies from H13-H16 (L'1) & H29-H32 (E'1), the bathrooms and 2nd bedrooms had the lowest control and integration with high privacy and the 3rd bedrooms that kept their original designs and the kitchens that were moved there for the houses that exchanged their spaces also in the group. The balconies also had low integration. As the previous typologies, the living and corridor had highest control and high integration along with the functions contained in them.

The numerical values of the functional convex spaces of all typologies can be found in the **Appendix 9: Functional convex space calculation** and the mean values in **Appendix 10: Functional convex space syntax calculations mean values for all typologies.**

Overall, spatial configurations and household roles played critical roles in determining the distribution and performance of domestic activities, with consistent patterns of gendered division of labor and spatially influenced activity distribution.

i. Categorization of changes in domestic activities

During the analysis of the data collected it was noticed that the way an activity was affected can be grouped into four types. These changes were activities that have been minimized, moved/extended out of designated space, disappeared, and changed in how it is performed. Thus, these changes and the reasoning behind them are presented based on the categories.

Coming to the activities that had to be minimized, the ones that were mentioned by many of the respondents were the activities of preparing traditional drinks for the holidays, large ceremonial cooking, and invitation of people for birthdays, holidays, and different celebration throughout the year. These are the activities the respondents mentioned need a large space, involve many people, and take a long time. The start to end process of preparing traditional drinks such as Tella (traditional Ethiopian beer) take a long time (up to 20 days) and require large spaces which the condominium kitchen does not have. The inhabitants don't have the space for the storage of the large barrels that are mainly taken out only for holidays and celebrations. The flat bread baked usually over firewood also can't be done in the condominium because it is fire hazard. The mixing process of the necessary ingredients also needs amble space.

The cooking activities for holidays and celebrations are traditionally done in large quantities using big cookware over charcoal with the involvement of many people. The communal building can be used for the purpose of preparing food and drinks, but the respondents thought it to be overtasking to transport all the material needed and bring back the end-product as they live in a multistory building. The households on the ground floor didn't have the problem of climbing the stairs but they still did not use the communal building nearby frequently. The households instead choose to perform the activities in a smaller scale and did not drop them fully. The traditional drinks are prepared in small water barrels and the bread baked over the Mitad (a traditional oven for making injera). Some respondents stated that they prepare kegeto (non-alcoholic barley & sugar drink) instead as the process is less time & space talking

The respondents also reported that they now invite less people for occasions decreasing the need for large quantities of food preparation extending out of the house. The fear of disturbing their neighbor's peace and the inability of the house to contain many people was also the other reasons for why they invite less people.

The activities that moved out of their designated space as can be seen in Appendix 7: Summary of all activities by place in all house typologies, were extended out due to the lack of enough space or the absence of the space they can be undertaken. The space that undertook the most activities that extended out of their designated space was the corridor with laundry and coffee ceremony at the top of the list. The cooking rarely extended out to the corridor on normal days but always did for the 1 & 2-bedroom typologies for celebrations.

The sleeping activity was moved out into the living room in 8 out of the 16 households for the 1-bedroom due to an absence of enough space for the household members. The other two households had a secondary bedroom added to their house. 3 of the households that had a balcony used the space for sleeping. That adds up to 15 out of the 16 households that were using a secondary sleeping area.

The activity that fully disappeared was the usage of firewood for cooking and injera. One respondent mentioned that this had impact her economically as she used to sell injera in her previous neighborhood as an income means but cannot longer do so. The communal is not used for business and the cost of electricity is not covered by the profit she can make.

The other activity that the households can't especially do is to let their children play in the house as the sound transmission between houses is very high and children run around a lot. Some of the households let their children go down to the ground to play with the neighborhood children but the ones with young children below the age of four or ones who have a fear of something happening to their child had to go down along with the kids to oversee that they did not get hurt. One respondent stated that she felt bad for her daughter that she can't run round and yell as she wants and tries to take her to a park at least once a month.

An activity that has not disappeared but has gotten harder to perform is the preparation of cooking powders such as shiro & berbere. The respondents answered the activity cannot be reduced or removed as it is an essential part of their food culture. The raw materials are sun dried over a long period, cleaned, mixed and taken to the mill house to be grinded. The preparation is exhausting, must be done in large quantities, 2-4 times a year and stored in barrels in the kitchen, balcony and in some cases the bedroom, living room and corridor based on the available space each household has.

If they are preparing the material in small quantity, they usually undertake it on the external corridor which cuts off the circulation of their neighbors creating problems nor does the products get enough sunlight due to the short wall of the corridor. The inhabitants found the process of preparation harder in a multi-story building compared to their previous houses. They need to take the raw materials up and down the building every day until it is fully dried and mixed.

Some activities have been mechanized for ease of performance like the usage of laundry machine for washing cloth and coffee grinder. Not all the households had a laundry but the ones that did said it is a necessity in a place that does not have the designated space for hand washing clothes or drying. The houses have to use a line on the external corridor that is not long and the households on the same floor have a schedule of which household can use the line on which day. The laundry machine makes both the washing and drying process short and easy.

As for the coffee grinder, many Ethiopian households grind their coffee using a traditional manual grinder which requires the household to go down to the ground to pound the coffee into powder. All the households interviewed had one in case the electricity goes out but use a mechanical grinder on daily bases to avoid going down to the ground.

The categorization of changes highlights the significant impact of spatial constraints on domestic activities in condominium living. Minimized activities reflect an adaptation to limited space and safety concerns, which affects cultural practices and social interactions. Extended activities indicate a workaround to spatial limitations, but they also create new challenges, such as blocking common areas and affecting neighborly relations.

The disappearance of certain activities points to a significant lifestyle shift and economic implications for some households. The difficulty in performing essential food preparations underscores the inadequacy of space and design in accommodating traditional practices. The introduction of mechanized solutions addresses some practical challenges but does not fully compensate for the lack of designated spaces.

ii. Satisfaction in the spatial aspects of the house

After the respondents were asked about how the activities they performed changed once they had started living in the condominium, they were asked about their satisfaction level with the house size, arrangement & furniture type in how they were able to perform the activities. They were asked to define these categories into bad, moderate, good, and very good.

Of the 16 household from the 1-bedroom typology, 6 (37.5%) found the room size bad and 8 (50%) moderately satisfactory for their needs is seen in Figure 4-10. 3 houses each in the 2-bedroom typologies found the room to be moderate and good which takes up 37.5% each. 4 (50%) households in the 3-bedroom typology found it good and 2(25%) found it very good. This indicates the inhabitants of the 1-bedroom typology found the size of the house to be less satisfactory than the other two typologies.

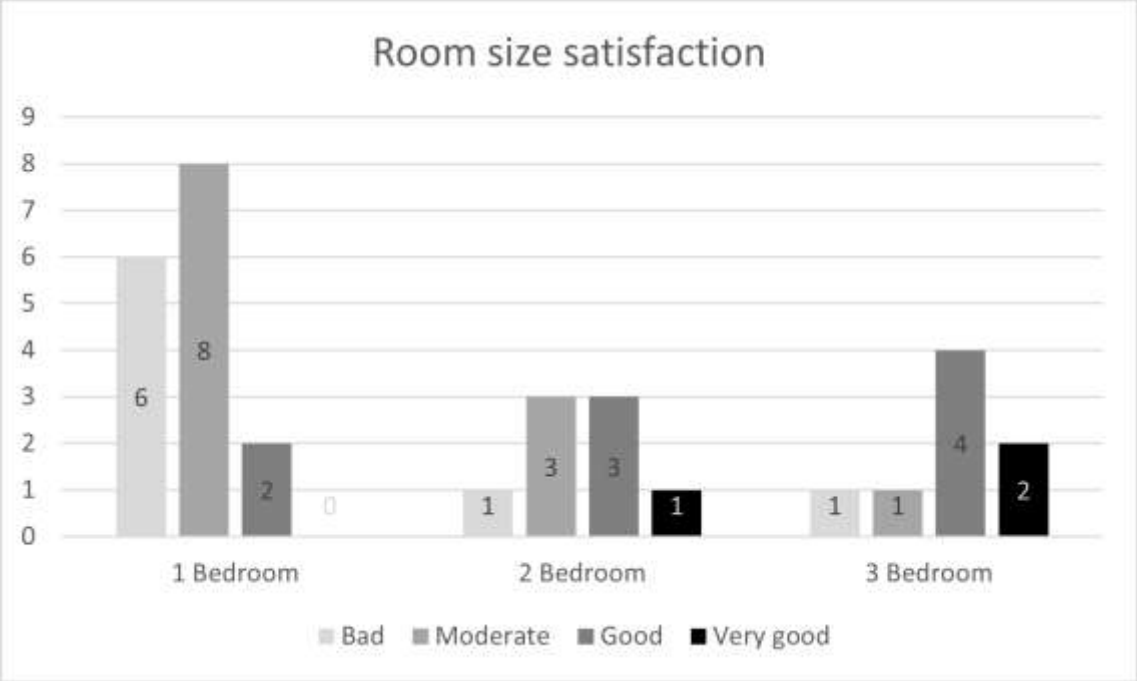


Figure 4-10 Room size satisfaction of all typologies

As for the room arrangement satisfaction shown in Figure 4-11 , the 1-bedroom typologies were more unsatisfied than the other households with 5 (31.25%) households each saying they were not satisfied or moderately satisfied and 6 (37.5%) households saying it was good. 75% of 2-bedroom & 50% of the 3-bedroom typologies found it to be good with 6 & 4 households respectively. 2 more households (25%) in the 3-bedroom said the arrangement was very good.

Figure 4-11 Room arrangement satisfaction of all typologies

When asked about their satisfaction level with the furniture type, 7 houses each from the 1 & 2-bedrooms said it was good. There were more people in the 1-bedroom typology that stated they found the furniture types bad and moderate with 4 (25%) & 5 (31.25%) respectively. In a similar case to the room arrangement satisfaction 4 households (50%) & 2 households (25%) in the 3-bedroom said the arrangement was good & very good respectively. The furniture type satisfaction is shown below in Figure 4-12.

Figure 4-12 Furniture type satisfaction of all typologies

It can be summarized from the graphs that inhabitants of the 1-bedroom typologies were the ones that were most dissatisfied with the situations of their house while the 3-bedroom inhabitants were the ones that were the most satisfied.

4.3.3. How is the spatial layout of the condominium units affected by the domestic activities performed?

The effects on the spatial aspects of the typologies can be summarized into four: added space, demolished space, functional change, and extension. The different affected housing typology are presented by the type of change they experienced with the help of storytelling and space syntax with the convex space for spatial pattern of all houses added in added in Appendix 9: Functional convex space calculation.

The households that experienced the added space change the most are the 1-bedroom typologies with H1, H5 & H6 Figure 4-13 having a bedroom space added and H22 & H24 Figure 4-14 having a wall added to separate the living room area from the corridor.

H1 is a privately owned household with 8 members. The parents sleep in the bedroom and their three children sleep in the added bedroom furnished with a bunk bed. The second bedroom is only 1.2m wide and with no direct sunlight or ventilation. The entrance is covered by a curtain and the cloths are stuffed on top of each other on the far end of the room. The mother's sister and her two young children sleep in the living room. To add the 2nd bedroom, they had to demolish wall and decrease the size the main bedroom so that the living room won't be too small.

Figure 4-13 Added space floor plan, convex space, and J-graph

As for H5 & H6, who are both teachers with 5 family members each, they also added the 2nd bedroom due to their family size. In H5, they only have one child who still sleeps with his parents, but the father's mother also lives with them. They wanted to give her a space where she can rest comfortably and get her privacy. The husband responded that it would not be respectful of him or his wife to make his mother sleep in the living room where their house help also sleeps.

As for H6, the respondents have three children aged 7 months, 2 years, and 13 years old. The two youngest still sleep with their parents but there was not enough space for their oldest to keep sleeping with them, so they added a second bedroom when their youngest was born. Both H5 & H6 used wooden partition wall as they can't add a permanent fixture in case, they were asked to leave the house by the government as it is a governmental rental housing. Both bedrooms had a top window, so they had more light than the H1 bedroom but still not well ventilated.

Figure 4-14 Added space floor plan, convex space, and J-graph

The other 1-bedroom typology houses with an added space are H22 & 24 Figure 4-14 which both added a partitioning wall to cover the direct view of the bathrooms entrance from the living room. Respondent from H22 said they get visitors from the rural area frequently and the wall allows them to use the toilet without being embarrassed.

In H15, a 3-bedroom house, the inhabitants added a 1.2m wide storage room for their food products and shoes in the 3rd bedroom because the kitchen was too small to store their annual food products. They have a top shelf for their shoes with large cookware on top and they store their food in large barrels on the floor. They believe the addition has made their storage process cleaner leaving the kitchen more spacious. The 3rd bedroom now holds only a bed, but this does not affect them as it is only used as a guest bedroom with the 2nd bedroom having a bunk bed for their two children.

As for H32, also a 3-bedroom house, the household had 7 family members. Their primary concern when they moved into the house was that they would have to wait for each other in the morning to use the bathroom. At that time the mother also used to work, and the children & relatives all went to school. So, they demolished the wall in between the bathroom and bedroom, took some space from each room and added a 2nd bathroom accessible from the bedroom. Both bathrooms are narrow with the 1st bathroom shower positioned behind the WC.

i. Functional change, demolition & extension

In Figure 4-15, for H10 to H14, their reasoning for the functional change was that the kitchen could not hold all the needed activities well. The four households found the kitchen narrow, couldn't hold two people together, and didn't have enough space for all the fixtures needed & the food storage. They all made the changes at the beginning when they moved into the houses.

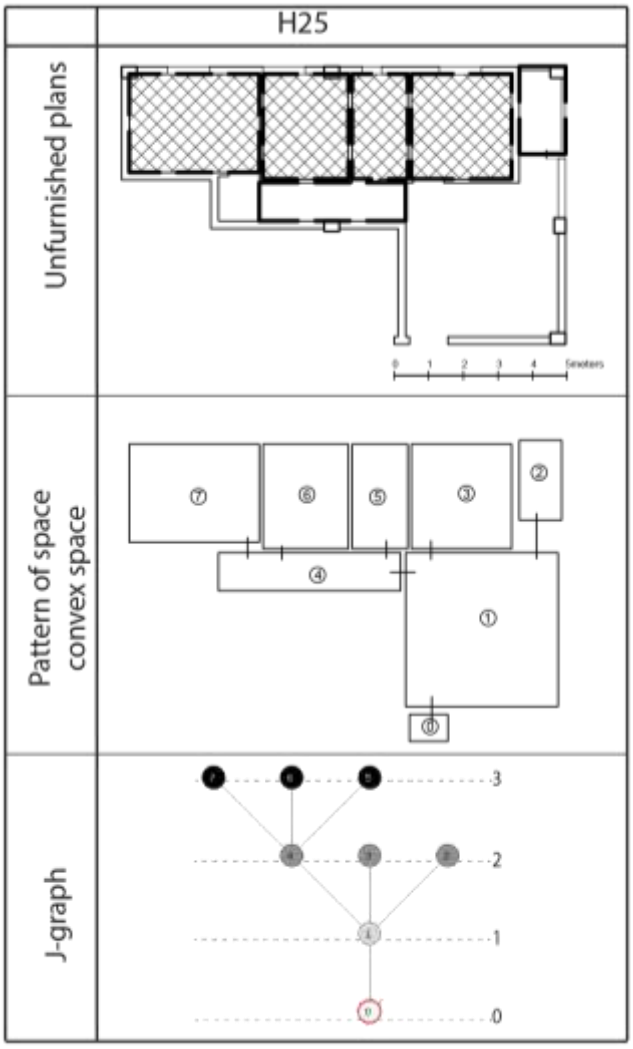
This exchanging of kitchen space with bedroom is not without its effects on other households. Respondent from H15, the house found in the floor between H13 & H14, stated that its very hard to sleep in the 3rd bedroom especially in the morning because they can hear every sound that is being made in the now kitchen space of the other households. They said since lots of time is spent in the kitchen and the walls and floors don't have good sound insulation, they can even hear the walking sounds while they are trying to sleep.

H10 & H12 both have exchanged their bedroom with the kitchen. In H10, the now 2nd bedroom space is not enough for the 9 children and relatives staying with them, so it is instead used to store the mattress and bedcovers. They all sleep in the living room which is very spacious as it is furnished with a mejlis arabia living the center open. As for H12, the daughters sleep on a bunk bed the niece on the floor in the new bedroom with the son sleeping in the living room.

Figure 4-15 Functional change and demolished floor plan, convex space, & J-graph

H13 & H14 both have exchanged their bedroom with their kitchen as H10 & H12 but, they demolished the kitchen space and included it into the living area and have converted the 3rd bedroom into a kitchen. For H14, they have had three children since the change with the mother of the wife and two house helps living with them. Due to this, the youngest child sleeps with his parents and the two oldest with their grandmother on a bunk bed in the 2nd bedroom. Their house helps sleep in the living room with their mattress stored in the 2nd bedroom.

For H30, they made a small demolition of a wall in the bathroom separating the HW from the shower and WC area to add in a laundry machine in the space between.



as for H25, the inhabitants demolished the wall of the original bathroom, kitchen and extended them towards the living room and corridor space. They also widened the then 1st bedroom which is now a kitchen into the 2nd bedroom. The 1st bedroom is now in the previous kitchen area. Even though they have ten household members, six of the children come and go due to work and they don't sleep at the house daily. The household head sleeps in the bedroom which was a kitchen with her grandson and the daughter sleeps on the sofa with her youngest son. There is a bed in the 2nd bedroom, but the room is full of other furniture which is not being used making the bed inaccessible. Due to economic difficulties, they have already sold some of their furniture and plan to sell the furniture in the 2nd bedroom.

Figure 4-16 Extended and function change floor plan, convex space, & J-graph

The other space that has had a functional change in all households save for one is the balcony (excluding the 1-bedroom typologies with no balcony). In the 1-bedroom typologies of L'1 building (H21 to H24), it is being used as a sleeping area with one house furnishing it with a bed and the other three with only a mattress for their children. The mattress is put against the wall during the day to create a space for studying for the children in these three houses. The reason H22 decided to furnish the balcony with a mattress even though they want a bunk bed is because they are afraid their children are still too young and like to jump down from higher ground for fun. The respondent added that he is planning on extending the balcony space into the living area to make a larger bedroom once the government rules to transfer the house to the teachers. Once he has done

that, he plans to furnish the room with the bunk bed for the children as they will be grown by then. He added upon being asked, if he is concerned about the natural light of the living room being blocked, that their need for a sleeping space is higher than the natural lighting and they turn on the electric lights all the time now too.

Five of the 2-bedrooms & six of the 3-bedroom types have converted the balcony into a storage space. The other two 3-bedroom types now use the balcony as a sleeping space (H31) and injera preparation and storage area (H32). As for the three 2-bedroom typologies, H27 & H28 are using it as a sleeping space and H11 have not made any changes as it's a governmental rental house and they don't want to invest on a house they fear might be asked to leave at any moment.

The balcony is the only way for the living room in 1-bedroom typologies of (E'1) and for the bathroom in the 2-bedroom (L'1) to get light and ventilation. The households in both typologies have installed a window covering the balcony for the functional change and it was noted during the data collection that this has left the living room and bathroom stuffy.

The change in space design in discussed household in comparison to the ones which experienced no change can be observed from the change in number of nodes (K). The ones who have added space have more nodes and the ones who have demolished spaces have less nodes than the ones with no change. The figure comparing the changes experienced in each household along with the houses who experienced no change is presented in Appendix 9: Functional convex space calculation.

4.4. Summary of findings

The category of the activities analyzed described the needs of the activities occurring in different housing types and it shed light onto how the activities are being experienced. There was a clear distinction between the activities the households' considered chores and leisure activities save for the choices of accepting visitors, coffee ceremony and non-school reading where some respondents considered it the prior and other the latter. The chores were mainly performed by the female members of the households indicating they have a large role in running the households.

The first general observation is that the analysis makes it possible to distinguish between the activities that require spaces for multiple people performing one activity in groups such as the cooking, laundry, eating, chatting, drinking coffee, watching TV and washing children. The other activities were predominantly done individually.

The other observation was that the living room and kitchen held the most activities in all housing typologies followed by the bathroom. The activities found in the kitchen, bathroom and also the bedroom had the least control over the other functional spaces and were the least integrated into the household making them the most private areas. This was due to the fact this rooms were reached through the corridor in most households.

The corridor which was the most integrated space in the households followed by the living room had the function of distributing spaces, controlling movement, and holding most of the extended activities that moved out of their designated spaces due to the fact that the designated space for a certain activity was not large enough or the activities did not have a space allocated to them in the first place. The other space that took the extended activities was the living room. In all typologies, these two spaces held the most integrated activities, had high control over the other spaces and were the most public.

The extended activities can be considered loose activities as they do not need special fixed furniture and can be moved around. It was documented that the households had the different energy sources such as traditional charcoal and gas cooking stoves for cooking which can be easily moved to undertake cooking and coffee ceremony in corridors and also the living rooms for coffee ceremony. The sleeping activity which required privacy was also extended to the living room, the most public area in all households, with a mattress stored in other areas of the house during the day.

Rapoport (1977) said that how an activity is distributed throughout the space indicates the extent to which a home allows people to fulfill their social and psychological needs befitting their lifestyle. Activities are affected by the characteristics of the space they are performed in coupled with the needs of the activity. The needs of the activity differ from one activity to another based on the families need based on the size, member's position, age, etc.

The need to minimize, extend, or completely alter domestic activities indicates that the original design of these units does not align with the cultural and practical needs of the residents but rather was based on cost minimization of the units by the usage of standardization to make them more affordable as stated by contextual literatures (Delz, 2015; Bisrat, 2008). This misalignment forces residents to find creative, yet often inconvenient, solutions to perform their daily activities.

But it was not only the activities that were affected in the households but also the physical. As noted in the literature review, both activity and space have the ability to shape each other which was also found in this research. People demand certain types of characteristics in their dwelling based on the criteria of their groupings, culture, and their membership in society. The type and combination of the activities they perform according to these criterions affect the spatial pattern (Rapoport, 1977).

The inhabitants have made changes to the units to accommodate their needs better most of which was done when they initially moved in based on their needs at that time. The changes experienced in the spatial were, additional rooms, demolishing, functional change and lastly extension.

In the 1-bedroom typologies, bedrooms were added, and the living room & balcony were used as additional sleeping areas which was mainly due to the family size, age and position of the family members and need for privacy. As for the 2 & 3-bedroom typologies, functional change was the leading effect documented. There was an exchanging of bedroom with the kitchen in three cases of 2-bedroom typologies and two cases of 3-bedroom typologies. This was because the original kitchen was too small to accommodate the activities and their storage need.

The 3-bedroom typologies used the method of demolishing to achieve the functional change. The condominium administrator stated that any extensive changes that need demolishing of walls, now need to be approved by AAHA. The inhabitants first must bring up their plans with the condominium administration who takes the issue to AAHA who then sends people to the

condominium unit to assess the required changes and give out a permit. If the change is deemed unnecessary, the inhabitants can't make the changes. So, any changes made by inhabitants at the beginning of their residence in the unit is most likely now permanent and any new changes due to the changes in their household's dynamics will be hard to do.

The balcony in all but one household also had a functional change to storage, cooking and sleeping areas. The smaller balconies mainly were used for storage and the larger ones in the 1 & 2-bedroom typologies for sleeping areas. This showed not only the family needs affected how a space is used but also the characteristics of the space itself, defines how it can be used. Some works of literature (Ingwani, et al., 2010; Delz, 2015) regarding usage of condominium space also assert the finding that balconies are most often used for other purposes and that the condominium units don't have a designated area for activities such as laundry, coffee ceremonies, and other ground level related activities such as spice drying, animal slaughtering, children playing. They also stated that the bedroom typology to household number is mismatched in especially the one-bedroom typologies. This can show why all 1-bedroom typologies have either an additional bedroom or use the balcony and living rooms as an additional sleeping area.

The modifications made by households to their living spaces reflect a need to adapt to inadequate original designs. The addition of space and functional changes indicate that the provided layouts do not meet the practical needs of the residents, leading to significant alterations. These changes can impact the overall functionality and aesthetics of the units, as well as relations with neighbors due to noise and other disturbances.

The trend of converting balconies into functional spaces highlights the lack of adequate storage and sleeping areas within the original design. This adaptation can negatively impact ventilation and natural lighting, reducing the overall livability of the units. The need for these modifications points to a gap between the design of the condominium units and the actual living requirements of the residents.

The satisfaction levels which are a result of the spatial layout conditions, reflect the varying adequacy of space in different housing typologies. Smaller 1-bedroom units fail to meet the needs of their occupants, leading to significant dissatisfaction. This inadequacy affects the performance of domestic activities and overall quality of life. In contrast, larger 2- and 3-bedroom units provide more space, which correlates with higher satisfaction levels.

The dissatisfaction with room arrangement and furniture type among 1-bedroom households suggests that these units are not well-designed to accommodate the needs of their residents. This misalignment between space and usage underscores the importance of thoughtful design in multi-family housing to ensure that all household types can perform their activities comfortably.

In conclusion, the findings underscore the importance of designing flexible and adequately sized living spaces that can accommodate a wide range of domestic activities and cultural practices. Addressing these design issues can improve resident satisfaction and reduce the need for disruptive modifications.

5. CHAPTER FIVE- CONCLUSION AND RECOMMENDATIONS

This study was an attempt to explore and describe the current practice of space usage in condominium housing units for domestic activities in the hopes of expanding the body of knowledge on the ability of a condominium housing unit to contain the activities that need to be performed by inhabitants. This chapter presents the conclusions drawn from the research. This is followed by suggestions for further studies.

5.1. Conclusion

At the outset of the research, four fundamental questions were posed to guide the investigation as shown in section 1.4. The initial question sought to identify domestic activities and understand how they were executed within different condominium housing unit types. Two additional questions aimed to explore the intricate relationship between domestic activities and the spatial layout of condominium units. Lastly, an inquiry delved into potential avenues for enhancing these units.

The findings of the study yielded several significant conclusions. Firstly, a clear differentiation emerged between chore-oriented and leisure activities. Tasks such as cooking, cleaning, laundry, and childcare were identified as communal chores, while personal activities like hygiene, cooking injera, burning coal, and coffee ceremonies fell into the individual chore category. Furthermore, an inverse correlation was observed between communal activities (such as chatting and watching TV) and individual activities (like resting and sleeping), shedding light on the spatial requirements for accommodating multiple individuals versus solitary pursuits.

Central to the functioning of households in all typologies were the living room, kitchen, and bathroom, each fulfilling essential roles. The bedrooms, balconies, and corridors served as supplementary spaces for specific activities, highlighting the varied spatial needs within different parts of the dwelling. Moreover, the study underscored the significant role played by women, particularly mothers, in undertaking household chores, with tasks such as cooking, laundry, and cleaning predominantly falling under their purview, while male members contributed minimally to these activities.

The second aim of the study concludes that spatial aspects significantly impact domestic activities, leading to the identification of four distinct groups. First, some activities are minimized due to space constraints and the involvement of many people, such as preparing traditional drinks, large

ceremonial cooking, and hosting occasions. Second, certain activities are relocated out of their designated space due to a lack of enough space, such as cooking, storage, sleeping, laundry, and the coffee ceremony. Third, some activities have disappeared, including children playing in the house and cooking or making injera using firewood, which affects those who sold injera for income. Fourth, some activities have become difficult to perform because they need to be done outside on the ground, such as preparing Shiro and berbere, which are essential to the food culture. Additionally, activities like cloth washing and coffee grinding have been mechanized for ease. The study also reveals that residents of three-bedroom condominium units are the most satisfied with room arrangements, size, and furniture type, while those in one-bedroom units are the least satisfied due to a mismatch between household and house size.

Regarding the third aim of the study, the effects of domestic activities on spatial elements can be categorized into four groups. First, additional spaces are created in one-bedroom units for sleeping, due to family size, age, the position of family members, and their need for privacy. This includes partitioning spaces for storage, extra bedrooms, and dividing corridors from living rooms to hide bathrooms for privacy. Second, functional changes occur when room sizes cannot accommodate activities, such as exchanging smaller kitchens for larger bedrooms in two and three-bedroom units, and turning balconies into sleeping areas, storage, or additional cooking spaces in one and two-bedroom units. Third, demolition and enlargement are used together to achieve functional changes and increase room sizes. These changes are made when inhabitants move in, but any new major changes must be approved by the AAHA, making it difficult to reverse or upgrade the modifications.

The functional space syntax findings revealed that the bathroom and kitchen in one and two-bedroom units, as well as the bathrooms and bedrooms in three-bedroom units, have the least control and integration but the highest privacy. The kitchens are located in the deepest, most private parts of the house, far from the dining area. The corridor plays a central role in accommodating and distributing activities to other spaces, followed by the living room. These two areas have the highest control and integration and are the most public activity spaces in the house.

In summary, it can be seen that both space and the domestic activities have an effect on each other based on the characteristics of the household members, the spatial need of the domestic activity itself and the ability of the space to contain those needs.

5.2. Recommendations

5.2.1. For policy makers and planners

- The initial designs of the housing units should include the participation of the end users.
- Policymakers and planners should develop housing policies that ensure affordable housing without compromising the spatial requirements of residents.
- Establish guidelines that ensure minimum space standards for different household sizes to avoid mismatches in different bedroom typology units.
- Promotion of designs that have adaptable and flexible living spaces that can be reconfigured to meet changing household needs.

5.2.2. For design practitioners and facilitators

- Housing typologies should be allocated based on the current size of the household and the dynamic nature of family structures.
- The arrangement of rooms should consider the activities they contain and their relation to other activities in adjacent rooms. For example, the kitchen should be positioned near the dining area to facilitate easy movement and efficiency in meal preparation and serving.
- The allocation of space in household rooms should be informed by vernacular studies of household activities. Utilizing Space Syntax can help identify the genotypes of traditional houses, which can then be incorporated into modern condominium designs to maintain cultural relevance while achieving the objectives of modern housing.
- Kitchens should be designed based on the specific needs of Ethiopian households, which differ from standard Western kitchens. This includes different fixtures and storage solutions to better accommodate local cooking practices.
- Kitchens should be spacious enough to accommodate at least two people working side by side. They should also include provisions for various loose cooking fixtures that use different energy sources, such as charcoal and gasoil stoves.
- One-bedroom typologies should include spaces that can be easily converted into additional sleeping areas to address the higher rate of adding sleeping spaces. Balconies, for instance, can provide flexibility in room function to meet the diverse needs of households.
- Balconies should be designed and positioned so they do not block natural light and ventilation to other rooms. This ensures that when balconies are repurposed, they do not negatively impact the living conditions of the adjacent spaces.

- Corridors should be designed to be wider to accommodate the extended activities of households in addition to their primary function as circulation spaces.
- Since the family unit is dynamic, the spaces allotted for functions such as sleeping, eating, studying should be able to change, partitioned or changed in size based on the changes in the family.
- Flexible partition wall systems which allow for reuse of walls and change in position easily should be considered. Walls using light gauge steel system is one example of this advantage.
- Future housing designs should identify and allocate space for all essential household activities, addressing any gaps in current housing units. This will ensure that all necessary activities have designated areas, improving the overall functionality and livability of the space.

5.2.3. For future study

- The scope of the study was only limited to how chosen activities are performed and the effects of space and activity on each other, thus it is advisable if future studies also include a detailed study of each activity found in a household and their requirement in space.
- Due to the design of the study, only a limited number of households were studied. However future studies should be done in a larger scale to identify and assess the issues in depth.
- This study only covered the internal space of the condominium units and the activities contained in it. It will also be valuable if activities that extend out of the households are also studied in depth.
- Further studies should be done to explore methods of achieving affordable housing without compromising the spatial requirements of residents.

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APPENDICES

Appendix 1: Publishable Manuscript

Space and domestic activity in a 20/80 condominium housing unit: The case of Gellan III condominium

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ABSTRACT

The Ethiopian government has implemented the Integrated Housing Development Program (IHDP) to tackle housing challenges in Addis Ababa amid rapid urbanization. Previous researches have shown that the IHDP has had problems regarding responsiveness of the units and urban design to occupants' needs and activities. This study examines how Gellan III condominium inhabitants utilize their housing units for domestic activities, the impact of spatial design on these activities and the vice versa. Using qualitative methods, including semi-structured interviews and space syntax analysis, the study reveals clear distinctions between chore and leisure activities, with communal and individual activities being inversely related. Women predominantly perform household chores, with most activities centered in the living room and kitchen.Domestic activities and spatial design mutually influence each other, depending on household characteristics, activity spatial needs, and space adaptability. Some domestic activities have been minimized, relocated, disappeared, or mechanized due to spatial constraints. Spatial modifications include adding rooms, functional changes, demolition, and enlargement due to rooms being smaller than the needs of the activity, lack of designated activity spaces, and household size mismatch with house typology, privacy needs, and storage issues. The study recommends designing typologies with end-user participation, incorporating Ethiopian vernacular housing studies, and considering the relationship between activity spaces. Allocation of house typologies, partition design and material selection of walls should consider the dynamism of household. Additionally, it suggests developing kitchen designs tailored to Ethiopian needs rather than European standards, creating wider corridors, and allocating space for all activities.

Keywords: *Condominium, domestic activities, spatial aspects*

INTRODUCTION

Addis Ababa like the other urban areas has had a rapid population growth due to high rates of natural increase and rural to urban migration. According to Cox (2012), the city has also been spreading out horizontally while becoming less dense since the 1970's as the spatial expansion exceeding the population growth rate by at least four times. This has been attributed to the dramatic surge of single-family units mainly witnessed in the western side of the city (Larsen, et al., 2019).

In 2005 the government of Ethiopia introduced the Integrated Housing Development Plan (IHDP) as one of the goals of the compact city development to address the housing problems caused by the scarcity of land, increased price of land as a result of the city's increasing population and the spatial expansion. According to Elias & Stark (2018), since the commencement of the project more than 160,000 units have been transferred and more than 100,000 are under construction.

PROBLEM STATEMENT

Since the beginning of the condominium project, several issues have arisen through time due to the lack of research into the vernacular housing use of the population at the start of the project, lack of participation of the end users at the design process and no monitoring and post evaluation of the project post occupation by the government (HABITAT, 2011). According to Alazar (2012), the project has been driven by the idea of affordability which has mainly been tried to be accomplished through standardization. This idea has been proven to leave little room for design variations in previous international projects where housing has been needed to be provided in large quantities (Delz, 2015).

In the Ethiopian condominiums case, one of the problems that have arisen in particular is the lack of responsiveness of units and urban design to the occupants' needs and activities (HABITAT, 2011). Even though the condominiums have provided many of the city's inhabitants with clean, healthy housings, the changes experience due to the move have not always been for the best. The social and economic lives of the inhabitants have been changed due to the locations of the condominium sites and they have had to learn to live in vertical spaces that do not respond to their lifestyles. Domestic activities, social interaction, and economic life are closely tied to the ground and carried out in spaces that allow for storage, interaction with family members and neighbors which the condominium has not been able to achieve (HABITAT, 2011).

Even though the problems have been stated in various research, the several building typologies that have been designed since the commencement of the project have not had any major alterations in relation to their appropriateness for the lifestyles of the people. Considering the lack of predesign research concerning the needs of Ethiopians households, post occupation evaluation of the condominium housings and the effect it has on the inhabitants, the problem of non-responsiveness of units will continue in the future projects without being rectified. To this effect, this study focuses on the post-occupation period and tries to draw findings about how inhabitants use their space, the effects of condominium units on domestic activities and the vice versa.

Objectives of the study

The primary objective of this research is to explore the relationship between indoor functional space and domestic activities in a multifamily buildings (condominiums) in Addis Ababa, Ethiopia, with a focus on understanding how the spatial layout and design of these housing unit impact domestic activities and the quality of life of residents.

Specific objectives

The specific objectives of this research are:

i. Identifying how activities in housing units of condominiums are performed.
ii. Identifying the relationship between the domestic activities and the spatial layout of the condominium housing units.
iii. To make recommendations for future projects based on the findings on how to provide an appropriate space according to the occupants need to perform the domestic activities.

SCOPE OF THE STUDY

The thematic scope of the research is limited to the study of domestic activities in relation to internal spaces of housing unit' of the Gellan III site which is a 20/80 condominium typology found in Akaki/Kality Sub city, Addis Ababa. The spatial aspects that were considered were room size, room arrangement/configuration, room amount, and furniture arrangement and size.

SIGNIFICANCE OF THE STUDY

With the growing population of the city, AACPPO (2017) estimates that there is a need for 1,172,195 housings in the coming ten years. But with the current situation of expensive land and

construction prices, the IHDP is the accessible way to housing for the city's low and middle-income inhabitants. Future condominium designs need to understand the significance of houses design on how people utilize the space and how it accommodates their lifestyle if the issue of appropriateness of housing design of the condominium units for the inhabitants is to be fixed.

REVIEW OF RELATED LITERATURE

According to Rapoport (1977), based on the success of a design of a house, the lives of the inhabitants can be restricted and manipulated or enhanced. It is because of this that the needs of the inhabitants must be first understood to ensure a good house design. To do this, spaces must be designed considering the criteria developed in man-environmental research (MER) which requires the understanding of actual space use which in turn can be used to assess the changing needs of the inhabitants (Asquith, 2006).

Space

Space, an integral part of designed environments along with meaning, communication, and time (Rapoport, 1980) is expressive of lifestyle of different societies and informs the transformations they have experienced (Y.Eid & Shehayeb, 2004). Its arrangements influence how it is used according to how the spaces are related to each other (Hillier & Hanson, 2005). Spatial relations exist where there is any type of link between two spaces and configuration exists when the spatial relations of two spaces are changed according to how we relate each to a third or more (Hanson, 1998). If one changes the arrangements of a space, its meaning, symbolic representation, influences, importance, and effect on behaviour changes. Its characteristics also affect who communicates with who, how, when, and where (Rapoport, 1977).

Form

In principle, environments are created to support the activities and lifestyles of people (Rapoport, 1990) and form is the response of these activities. Form is the creating and ordering of empty volumes of space into a pattern-ordering of space (Hillier & Hanson, 2005). The rules dictating the organizations of space are linked to culture (Kroeber & Kluckhohn, 1952) and affect the separation of objects and people to various criteria's like age, sex, status, roles, etc. (Rapoport, 1977). Dwellings, one part of space, are not static and take on a dynamic aspect constantly growing, partitioning, and eventually dividing and reforming repeatedly due to the evolving

composition of the domestic group. As this happens, the internal organizations of the space represent the social relations of the members of the household (Hanson, 1998). As the structure of the inhabitant's changes, rooms are accordingly added or deducted and their usage changes.

Activity

Activities are the programs that are performed within a space and domestic activities are what people do in and around their houses (Monteiro, 1997). The activities that take place within the domestic space depend on the inhabitants, the household size, occupation, personal tastes, customs cultures, and the existence of children (Pultar & Baykan, 1995). Monteiro (1997) adds that daily domestic activities are also closely linked to social and cultural factors as well as the spatial dimensions of the inhabitant's dwellings. Different researchers have categorized activity using different methods. Rapaport (1977) categorizes activities into four components: the nature of the activity, how it is carried out, associated activities that are combined to create an activity system and the symbolic aspect an activity's purpose (e.g., for consumption, food for ritual, etc.). The difference between these four aspects of activities lead to specific forms of their settings, differences in their relative importance, the amount of time spent on them, who is involved and so on. When we come into the realm of the home, canter, 1983; Oseland and Donald, 1993; Ahrentzen, (1989) cited in (Monteiro, 1997) have refined and grouped the activities representing different sets of domestic activities: household chores and extended chores, active and passive leisure and, personal and communal needs. The list of activity categories goes on depending on the particular study being carried out.

The relationship between form and activity

The need for studying the relationship between form and activity has various reasons. The first common one is to analyze the extent to which the built environment affects behavior, guide it, and constrain it. Second is the idea that a built environment is created and should be created to support the desired behavior. This implies that architecture encloses behavior. Thus, activities shape architecture (Rapoport, 1990).

The man-environmental studies (MES), one approach to the study of environment concerned with the systematic study of the mutual interaction of people to their environment stresses the idea that the physical environment, it's design and why it is designed a specific way can help understand

three things. (i), how people shape their environment and which characteristics are relevant in shaping it: These characteristics of people are the people's groupings, cultures in a society which can affect how they use the environment and their roles in shaping it. (ii), how and to what extent does the physical environment affect people: considers the environment as a nonverbal communication system studied through studied through fixed feature space (walls, doors, etc.), semi-fixed feature space (furniture), and non-fixed feature elements (people) hall (1966) cited in Rapoport (1977) and analyses the effects they have on human behavior, mood or wellbeing (Rapoport, 1977). (iii), what mechanisms link people to their environment is answered by Culture, where people try to match their characteristics, values, expectations, and norms, behaviors and so on to the physical environment through design or migration (Rapoport, 1977).

CONTEXTUAL REVIEW

History of housing in Addis Ababa

The capital of Ethiopia since 1886 (Dawit, et al., 2017), Addis Ababa emerged without any formal planning as a garrison town (Elias, 2018) and the early development was spontaneous without any formal planning (Dawit, et al., 2017) affecting the housing characteristics and type of construction (Elias, 2018). The first real construction boom of the city happened after the introduction of the land charters in 1907 by Emperor Menelik ushering in a significant rural-urban migration (Delz, 2015). By the 1930, in the era of Emperor Haile Selassie, the city has expanded to the southern part and large open spaces between nodes started to be filled in with no plan (Elias, 2008).

The Italian occupation between 1935 to 1941 left a profound impact on the housing situation and the spatial structures of the city due to the proclamation to stop the maintenance of existing building and construction of new buildings, removal of centrally located precarious dwellings and replacing them with modern housing and office blocks (Elias, 2008), the introduction of a tax and tithe-based economy resulting in a doubling of the city's population. The rapid urbanization and population growth led to the first phase of housing shortage in the city with not much done to alleviate it (Delz, 2015). The housing problem was not addressed in the second part of Emperor Haile Selassie's reign and the feudal tenure was continued until 1974's overthrow by Derg (Larsen, et al., 2019). With the new government, all urban land and extra house was nationalized, private renting by individuals was prohibited (Delz, 2015). The housing that was nationalized were partitioned into two and rented out: the kebele houses and the Agency for the Rental Housing

Administration (ARHA). From 1970 to 1984 the housing market was put under pressure as the population rose to 1.4 million and the government put forward four different schemes (Delz, 2015). Yet by 1991 with the coming of the EPRDF, the housing situation was still not fixed.

In 1994, EPRDF started a 'market-oriented land and housing development system'. It was hoped that the mixed approach of state-owned land and free market land tenure policies would play a crucial role in meeting the demands for low-cost housing but was unsuccessful (Delz, 2015). The same year an urban land lease legislation issued, but the supply of land could not match the demand for land needed for housing. This contributed to the overcrowding of the inner-city settlements and the spread of informal settlements in the fringes of the city (Elias, 2008).

After a study known as 'Housing Sector Study' (HSS), three major deficits in housing policies were identified and the government started looking for solutions (Delz, 2016). This led to the introduction of the Low-Cost Housing (LCH) program which later evolved into the Integrated Housing Development Program (IHDP) (Delz, 2016). The main objectives of the project were to address the decaying center, construct affordable housing for low- and middle-income households, create job opportunities, develop the vocational and training through the construction industry, renew and upgrade the slum areas and secure efficient land use system through densification with vertical growth, strengthen the construction industry and improve vocational training systems, empower citizens through ownership of houses and create fair distribution of wealth (Bisrat, 2008).

A pilot site was launched at Gerji in 2004 by GTZ and after its success was followed by 102 infill sites and then expansion sites. The typologies have evolved from the initial stage with the main concern being the minimization of cost of each unit (Bisrat, 2008). The cost efficiency was achieved by technical methods like standardization of building elements, and prefabrication or by design driven schemes that use certain building elements in a dual way (Delz, 2015). The initial designs used grid structural layout, shared common wall, minimum circulation area, external staircases and kitchens and toilet which opened to the main corridor (Bisrat, 2008). Although the grid layout has potential adoptability, the houses are deliberately designed as a closed system leaving no space for appropriation freezing the ever-changing circumstances of the inhabitants into fixed walls, openings, volume, room sizes, appliances, and divisions (Delz, 2015). The infill sites typology designs were done through competition considering social, cultural, economic, and other

aspects in addition to the functional and adaptability of typologies to different sites and floor areas of each typology and composition of bedroom typologies by building were specified.

The cultural receptions of the condominium units have had different effects many of which are related directly to the housing typologies. Daily activities related to the ground floor, economic activities, laundry done by hand were affected. Lower floor residents and upper middle class seemed to adopt to these issues more easily (Delz, 2015). Other activities that were not considered are coffee grinding area, spice drying area, coffee ceremony space, children's playground (Ingwani, et al., 2010). Several modifications ranging from painting to changing of partitions, closing of balconies functional changes were done by the inhabitants. This has been due to the lack of public participation affected by many factors such as low public participation during the design of the projects, producer's lack of interest and lack of funds to involve the public, lack of awareness, technical problems, and limited time (Bisrat, 2008).

METHODOLOGICAL APPROACH

A research methodology contains the procedures and the techniques to be used for gathering information, the population to be studied and the methods to be used in the processing and analyzing data (Kothari, 2004). It is the blueprint for carrying out research (Abiy, et al., 2009).

Research approach: A qualitative mythological approach was used for this research due to the nature of this research which gave priority to the experiences and perspectives of the participants to get an in-depth understanding of the utilization of domestic space.

Study design: Based on the questions raised and the limited amount of existing data found to support the research, a case study method is used to explore and describe the situation within the events of the contextual environment. This method helped to take a detailed, accurate, and complete description of the situation.

Source of data: primary and secondary data sources were used for this study. The prior was collected through semi structured in-depth interviews with inhabitants and administration of the condominium. The latter was done through the review of literature works on the subject area and the history of the condominium within Ethiopia. The sources of literature review were books, journals, articles, reports, conference proceedings, websites, etc.

Data source selection/ sampling design: for the case study design used, a multi-stage sampling approach was used due to the large quantity of the sample group. A detail outline of the approach to develop the sample group was developed and the final sample site and group was chosen to be at Gellan III condominium found in the periphery of the city in Wereda 04 of Akaki/Kality sub-city.

Data source size: For a case study design type, there is no formula for defining the desired sample size (Yin, 2016) and the replication method is used where data collection process stops when enough data has been collected (Yin, 2014). Using this method, a total of 32 cases were carried out in this research. Two building typologies were undertaken where 1-, 2- & 3-bedroom typologies were studied.

Data analysis: The data collected was encoded using Microsoft excel for this research and the analysis was done starting from the research questions.

RESULT AND DISCUSSION

i. How are the housing units used?

a. What are the domestic activities performed?

A total of 23 activities were presented to the interviewees to categorize into four categories': communal chore (CC), communal leisure (CL), individual chore (IC), and individual leisure (IL). In the 32 households studied, there was a clear distinction between the activities the respondent's considered chore and leisure activities save for the choices of accepting visitors, coffee ceremony and non-school reading where some respondents considered it the prior and other the latter. The activities that were largely categorized as CC were cooking, cleaning house, laundry and washing children. These same activities also took up most of the IC category with the addition of personal hygiene, preparing injera, burning coal and coffee ceremony having more instances.

As for the leisure activities, the individual and communal are inversely related with the highest incidence of individual being the lowest for the communal and the vice versa. The activities with highest incidences in CL are chatting, watching TV, eating dinner and breakfast, and drinking coffee. The highest for the IL on the other hand are resting, sleeping, eating lunch, and reading (non-school).

b. Where are the domestic activities performed?

In the 16 1-bedroom typologies studied, the living room had the most incidence of activities followed by the kitchen and corridor. In the sense of an activity taking place in a certain room in more households, the living room and kitchen still have the larger number of activities appearing more regularly with the bathroom following at third place. The living room accommodated the eating, accepting visitors, sleeping for household members and visitors, resting, studying, reading and coffee ceremony. The kitchen accommodated the chores and storing activities such as food, water, cleaning products, energy source (charcoal, gasoil) storage, cooking, washing and injera preparation. The bathroom mainly accommodated the activities that can be regarded as hygiene and storage related. A line for cloth drying and wash basin for laundry were also found in the bathroom.

A second bedroom was also added in 3 households and where there was no room added, a mattress was stored in the main bedroom and outside corridor to be taken to living room at night for sleeping. 4 houses had a balcony, and, in all houses, the space was turned into storage and in three for also sleeping and resting.

In the 2-bedroom typology, the living room, kitchen, and bedroom 2 held the top places for the different types of activities. But, as in the case of the 1-bedroom typologies, it was the living room and kitchen that held the most activities consistently in all households with similar activities held in them as in the 1-bedroom typologies. The balcony mainly was used as a storage place for charcoal, cloth, cleaning materials and food. Three households also used the 2nd bedroom for a sleeping space for visitors and the rest of the households let them sleep in the living room. The outside space was mainly used for storing and burning charcoal. The respondent stated cooking in the outside space only happened during times when large quantities of food need to be prepared for celebrations.

Similar to the 1 & 2-bedroom typologies, in the 3-bedroom typologies, the spaces that had the most incidences of activities as well as the most activities occurring in all households are the living room and kitchen. The activity types appearing in the space are also similar to the previous typologies with the exception of if a 3rd bedroom being present in this new typology.

There were four cases of coffee ceremony and laundry each in the corridor. The other households held their coffee ceremony in the living room and laundry in the bathroom. Seven of the eight households had a laundry machine with four placing it in the corridor. There were also two cases of sleeping in the living room. This were a result of two households who demolished the kitchen and moved the function into the 3rd bedroom and hence making the house type a 2-bedroom typology. Because of this they did not have enough space for their house helps and visitors to sleep in resulting in the living room being used as a sleeping area. The activity of eating was also done in the dining area in addition to the living area. The 3-bedroom typology had the highest number of houses with a dinning level of all the typologies with the 1 & 2 bedroom only having one household with a dining table each.

There were two cases of burning coal in the kitchen and two cases of preparing injera in the balcony which didn't happen in the other typologies. The summary of activities by place in all the typologies is presented in the following figure.

c. By which members of the household are the activities performed?

The activities that were analyzed are mainly the ones that were considered a chore and it was found that the mothers of the households undertook most of the chores followed by the other female members (daughters, female relatives, house helps) indicating they have a large role in running the households. None of the male household heads/ fathers performed the activities that were undertaken in the kitchen. Only one father helped with the preparation of dinner from time to time. Some fathers contributed to the children washing (7), laundry (3), house cleaning (2) activities but not daily. Apart from three households, activities were performed simultaneously side by side. The chore activities that were performed in combination with other activities were the injera baking, cooking, cloth washing with laundry machine. These activities were the ones that do not require full time attention with intervals of free time in between while performing them and were combined with each other and other activities like cleaning the house and watching tv. The activities of eating with family members (lunch & dinner) and drinking coffee was also another activity that was combined with watching TV and chatting.

ii. How are the domestic activities affected by the spatial layout of the condominium units?

a. Categorization of changes in domestic activities

The changes in domestic activities were categorized into four groups: minimized, moved/extended out of designated space, disappeared, and changed in how it is performed. The evidence of the location of activities that were found out of their designated spaces, minimized, or disappeared indicates that the condominium units did not fully address the spatial needs of the activities and the inhabitants. This was perhaps due to the fact that the design of the units was not based on the vernacular day to day usage of domestic space but rather was based on cost minimization of the units by the usage of standardization to make them more affordable as stated by contextual literatures (Delz, 2015; Bisrat, 2008).

The activities that were minimized according to the respondents were the activities of preparing traditional drinks for holidays, large ceremonial cooking, invitation of people for occasions and different celebrations throughout the year. The reasoning behind this was the need for a large space, involvement of many people and the time it takes. For example, the inhabitants did not have the storage space for the large barrels that are used for making Tella (traditional Ethiopian beer). The cooking for holidays is also traditionally done in large quantities using big cookware over charcoal with many people involved. The households instead choose to perform the activities in a smaller scale and did not drop them fully.

The activities that moved out of their designated space were extended out due to the lack of enough space or the absence of a designated space they can be undertaken in. The space that undertook the most activities that extended out of their designated space was the corridor with laundry and coffee ceremony at the top of the list. The cooking rarely extended out to the corridor on normal days but always did for the 1 & 2-bedroom typologies for celebrations. In 15 out of the 16 households of the 1-bedroom typology, there are using a secondary sleeping area: living room, balcony, and added bedroom.

The activity that fully disappeared was the usage of firewood for cooking and injera and also parents restricting their children from playing inside the house to avoid noise pollution. An activity that has not disappeared but has gotten harder to perform is the preparation of cooking powders such as shiro & berbere. The respondents answered the activity cannot be reduced or removed as it is an essential part of their food culture. Some activities have been mechanized for ease of performance like the usage of laundry machine for washing cloth and coffee grinder. Not all the

households had a laundry but the ones that did said it is a necessity in a place that does not have the designated space for hand washing clothes or drying.

iii. How are the spatial layout of the condominium units affected by the domestic activities?

As noted in the literature review, both activity and space have the ability to shape each other which was also found in this research. People demand certain types of characteristics in their dwelling based on the criteria of their groupings, culture, and their membership in society. The type and combination of the activities they perform according to these criterions affect the spatial pattern (Rapoport, 1977).

The inhabitants have made changes to the units to accommodate their needs better most of which was done when they initially moved in based on their needs at that time. The changes experienced in the spatial were, addition of rooms, demolishing, functional change and lastly extension.

In the 1-bedroom typologies, bedrooms were added, and the living room & balcony were used as additional sleeping areas which was mainly due to the family size, age and position of the family members and need for privacy. As the children get older and when there is a relative living with the family, there is a need for an additional room. As for the 2 & 3-bedroom typologies, functional change was the leading outcome documented. There was an exchanging of bedroom with the kitchen in three cases of 2-bedroom typologies and two cases of 3-bedroom typologies. This was because the original kitchen was too small to accommodate the activities and their storage need.

The 3-bedroom typologies used the method of demolishing to achieve the functional change. The condominium administrator stated that any extensive changes that need demolishing of walls, now need to be approved by AAHA. The inhabitants first must bring up their plans with the condominium administration who takes the issue to AAHA who then sends people to the condominium unit to assess the required changes and give out a permit. If the change is deemed unnecessary, the inhabitants can't make the changes. So, any changes made by inhabitants at the beginning of their residence in the unit is most likely now permanent and any new changes due to the changes in their household's dynamics will be hard to do.

The balcony in all but one household also had a functional change to storage, cooking and sleeping areas. The smaller balconies mainly were used for storage and the larger ones in the 1 & 2-

bedroom typologies for sleeping areas. This showed not only the family needs affected how a space is used but also the characteristics of the space itself, defines how it can be used. Some works of literature (Ingwani, et al., 2010; Delz, 2015) regarding usage of condominium space also assert the finding that balconies are most often used for other purposes and that the condominium units don't have a designated area for activities such as laundry, coffee ceremonies, and other ground level related activities such as spice drying, animal slaughtering, children playing. They also stated that the bedroom typology to household number is mismatched in especially the one-bedroom typologies. This can show why all 1-bedroom typologies have either an additional bedroom or use the balcony and living rooms as an additional sleeping area.

Overall, the 1-bedroom typology inhabitants were the least satisfied with the conditions of the households such as, house size, room configuration and furniture types. The rooms were not enough for the number of household members they had and their needs for sleeping space, privacy or required space for cooking. The 3-bedroom typologies were more satisfied, and it can be seen in the fact that they changed the functions of the 3rd bedrooms to kitchens or left the room unused by the family members and instead used it for visitors sleeping area or storage.

CONCLUSIONS AND IMPLICATIONS/ RECOMMENDATIONS

Based on the results obtained from the first aim, it can be concluded that (i) there is a clear distinction between the activities the inhabitant's chore and leisure with the individual (resting, sleeping, eating lunch, non-school reading) and communal (chatting, watching TV, eating dinner and drinking coffee) leisure activities being inversely related. The distinction between communal and individual in activity categorization helps to distinguish which activities should be considered to provide enough space for multiple or not. (ii) The living room and kitchen held the most activities in all typologies along with the bathroom. The balcony was used for storage and sleeping. The corridor for extended activities and those without designated spaces. (iii) The female members of the household undertook the household chores with the mother taking the lead and the male members barely participating. The chores that do not require constant attention were done simultaneously side by side by side such as making injera, cooking, cloth washing by machine, etc.

From the second aim of the study, the domestic activities were affected by the spatial aspect of the condominium in four ways. (i) Minimizing of activities due to space constraints and involvement

of many people to undertake the activity. (ii) Activities that moved out of their designated space due to lack of enough space (cooking, storage, sleeping) or absence of a designated space (laundry, coffee ceremony). iii) Disappeared activities such as children playing in the house, cooking & injera making using firewood which has affected respondents who sold injera as an income means. (iv) activities that have become hard to perform due to the housings being multi story such as food product preparation (shiro, berbere) or activities that have been mechanized like coffee grinding and washing clothes for ease of performance.

There were also four effects on the spatial space due to the domestic activities concerning the third aim. (i) Added spaces in the 1-bedroom typologies for sleeping due to family size, age, position, and privacy. Separation of spaces for storage, extra bathrooms, and privacy of bathrooms from living area. (ii) functional change of rooms dure to rooms not being able to accommodate the needs of the activities such as exchange of smaller kitchens with bigger bedrooms, turning of balconies into storage or sleeping are. (iii) Demolition & enlarging in combination were used to achieve the functional changes and increasing room sizes. These changes were made when the inhabitants moved in, and any new major changes have to be approved by the AAHA making reversing or upgrading the changes hard.

In summary, it can be seen that both space and the domestic activities have had an effect on each other based on the characteristics of the household members, the spatial need of the domestic activity itself and the ability of the space to contain those needs.

For policy makers and planners

- The initial designs of the housing units should include the participation of the end users.
- Policymakers and planners should develop housing policies that ensure affordable housing without compromising the spatial requirements of residents.
- Establish guidelines that ensure minimum space standards for different household sizes to avoid mismatches in different bedroom typology units.
- Promotion of designs that have adaptable and flexible living spaces that can be reconfigured to meet changing household needs.

For design practitioners and facilitators

- The arrangement of rooms should consider the activities they contain and their relation to other activities in adjacent rooms. For example, the kitchen should be positioned near the dining area.
- The allocation of space in household rooms should be informed by vernacular studies of household activities
- Kitchens should be designed based on the specific needs of Ethiopian households, which differ from standard Western kitchens. This includes different fixtures and storage solutions to better accommodate local cooking practices.
- Kitchens should be spacious enough to accommodate at least two people working side by side. They should also include provisions for various loose cooking fixtures that use different energy sources, such as charcoal and gasoil stoves.
- As there are some activities that were not allotted space in the housing units, the future designs should consider identifying and allocating space for all activities.
- As 1-bedroom typologies have a higher rate of adding bedroom/sleeping areas it is recommended that a space that could be turned into a sleeping area should be provided.
- Balconies should not be positioned in a way that they cut off the natural light and ventilation of other rooms as its function is always changed to something else.
- Corridors should be designed to be wider to accommodate the extended activities of households in addition to their primary function as circulation spaces.
- Since the family unit is dynamic, the spaces allotted for functions such as sleeping, eating, studying should be able to change, partitioned or changed in size based on the changes in the family.

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Appendix 2: Interview questionnaire

Ethiopian Institute of Architecture, Building construction, and City Development, (EiABC), Addis Ababa University

Department of Housing and Sustainable Development

Appendix 2.1-Interview for condominium inhabitants of Gellan III

This interview is prepared by a student at Addis Ababa University Ethiopian Institute of Architecture, Building Construction, and City Development to collect information for educational research on the relationship between space and activity in Gellan III condominium site. Thank you in advance for your cooperation.

Date and time_____ **Building no - _____**

Floor level – Ground/ 1st / 2nd / 3rd / 4th **House no -_____**

Unit type – Studio/ 1 BR /2 BR/ 3BR

I. General info

1. Name of interviewee _____
2. Household head name_____
3. Age and sex _____
4. Position in family_____
5. Work status
   A. Employed
   B. unemployed
   C. student
   D. Retired
6. Marital status
   A. Married
   B. Single
   C. Widowed
   D. Divorced
7. Mode of tenure
   A. Owner B. Rent C. custodian
8. Mode of acquisition
   A. Lottery from government
   B. Lease/ rental
   C. Purchase from individual
   D. Relocated for development
   E. Custodian

II. Household information

9. Household members list

No/code	Name	Relation	Sex	age	Work	Education status

10. No of households (if there is more than one) _____
11. Are there renters/ relatives living with you_____
12. If yes, who _____
13. Where do you use to live before? _____
14. In what type of house do you use to live in before?
    A. Kebele rental C. Private
    B. Private rental D. Condominium E. Others
15. When did you start living here? _____
16. Current number of bedrooms in the house_____

III. Activity and Space usage information

17. Please categorize the activities below under the chore, leisure, communal and private section in the table below

Cleaning the house	chatting	Reading (non-school)	Resting (sitting/nap)
Washing children	Accepting visitors	Studying	Sleeping
Personal hygiene keeping (washing face, brushing tooth, shower, cleaning hair	Drinking coffee	Cooking-breakfast	Eating-breakfast
	Coffee ceremony-washing, toasting, grinding, brewing	Cooking-lunch	Eating-lunch
	Watching tv-news, movies, drama, …	Cooking-dinner	Eating- dinner
Washing cloth	Washing dishes	Preparing injera	Burning coal
		Preparing traditional drinks	

Please add any activities that are not included in the table and categorize them onto the following groups.

Individual chore	Communal chore	Private Leisure	communal leisure

18. Based on the above category, please define who does what, where and when?

Performer	**Specific activity**	**Day**	**time**	**room**								
				Living	**Dinning**	**Kitchen**	**Toilet**	**Bedroom**			**corridor**	**Balcony**
								1	**2**	**3**		

19. Identify which activities are performed simultaneously (can also be different activities done by different people at the same time) and which are not?
20. How often do you get visitors?
21. What time of the day, week, and year do you get most of your visitors?
22. Who are your recurring visitors and how often do they spend the night?
23. Where do they sleep when they spend the night?
24. How many people can occupy one room at the same time to perform an activity
    A. Bedroom
    B. Bathroom
    C. Living room
    D. Kitchen
    E. Corridor
    F. Balcony
25. Where do you store your
    A. Cleaning materials
    B. Food
    C. Water
    D. Charcoal, gasoil, etc. (energy source)
    E. Cloth
    F. Others
26. When did you buy your furniture (bed, sofa, shelves, cooking materials, kitchen cabinets, closets, etc.)?
    A. In your previous residence B. When you moved here
27. If you answered B for the above question, please elaborate what considerations were taken to make your decision (economical, house size & type, aesthetics of the furniture, etc.)
28. What was your reasoning behind how you arranged your furniture and appliances?
29. What do you use to washcloths?
    A. Hands and plastic basin (safa) B. Washing machine C. Bathtub (if there is one)
30. What do you use to wash your dishes (eating and cooking materials)?
    A. Wall mounted sink B. Plastic basin (safa)
31. What do you use to grind your coffee?
    A. Traditional grinder B. Machine
32. What are the other traditional activities that you had to change how you performed to fit into the condominium space?

    _____

    _____
33. What are some of the problems that create problems when you perform your activities?
    A. Water, electricity, etc. B. Space arrangement

C. Room size
D. Floor level of the house
E. Furniture type and arrangement
F. Other, please specify

34. How sufficient are the rooms and furniture your needs?

	bad	moderate	good	great
Room size				
Room arrangement /partition				
Furniture types				

35. Has there been any form of changes done to the interior of your housing unit?
    A. Yes
    B. No
36. If yes, to the above question, which spaces were changed
    A. Bedroom
    B. Bathroom
    C. Living room
    D. Kitchen
    E. Corridor
    F. Balcony

37. What was changed (floor level, fixture arrangement, room partition, etc.)?

	Partition	Fixture (type, arrangement)	Floor level	Others
Bedroom				
Bathroom				
Kitchen				
Living room				
Corridor				
Balcony				

38. How many times have these spaces been changed?
39. What was the reason behind the transformation? Please elaborate
40. What has been the economic impact of these changes?
41. What would you suggest should be done in the house to further improve the way activities are carried out?

IV. For the researcher

42. Sketch the spatial layout including partition and furniture arrangement of the house

Ethiopian Institute of Architecture, Building Construction, and City Development, (EiABC), Addis Ababa University

Department of Housing and Sustainable Development

Appendix 2.2: Interview for condominium administration of Gellan III

1. Have all the buildings been distributed? If not, how many buildings are unoccupied now and why?
2. In how many periods was the condominium distributed to the inhabitants? Please specify the years of the distribution period
3. Who are the inhabitant types of the condominium? Lottery winners, development relocates, governmental workers, teachers, etc.?
4. Which neighborhoods did the development relocates come from?
5. When did the inhabitants move in?
6. In what stage of construction did the inhabitants receive the housing units and buildings?
7. How many housing units were distributed to teachers and other government workers?
8. Which housing typologies were they given?
9. Are there any rules and regulations set out by the condominium administration or the government regarding the design change of housing typologies by the inhabitants?
10. How are the communal areas (corridors, stairs, communal buildings, green area) of the condominium used? Are there any rules regarding their usage?
11. Are there any residential units found on the communal buildings?

Appendix 3: Criteria's for choosing Case study area location

A. Initially, all condominium sites within Addis Ababa were identified as candidates for the research.
B. Of the condominiums identified, the 20/80 condominium sites were selected as they are larger in number and represent the economic capabilities of the population.
C. Condominiums located in the periphery of the city were then chosen as the inhabitants had had to start over their lives from scratch in a new environment cut off from their previous lives.
D. A condominium that has been occupied for more than five years to give inhabitants enough time to adapt to their environment and feel a sense of place. This also gives the area time to be well connected to the rest of the city and the building typologies would have the latest modifications.
E. Based on this criteria's, the case study site chosen is the 20/80 condominium named Gellan III located in Wereda 04 Akaki/Kality sub-city, Addis Ababa. The site was distributed in 2015 giving inhabitants' time to develop a sense of place.

Currently, there are a total 208 building blocks of 5231 residential and office units within the Gelan III site. After analyzing the site, a multistage process was applied to further simplify the data sample. The criteria's which were followed are

A. A total of 40 blocks encompassing condominium buildings were identified and numbered
B. Using a random.org[34] sequence generator app, a total of three blocks with multiple buildings within were chosen. The first one is to select the main data source and the other two as a backup.
C. The building types in the chosen blocks are studied and it was found that there are four types of building typologies: A'1, L'1, E'1 and E'2.
D. A'1 & E'2 blocks were eliminated as both did not contain all four housing unit typologies (studio, 1 bedroom, 2 bedroom and 3 bedroom)
E. The building blocks that had shop units on the ground floor of L'1 and E'1 building blocks were eliminated to maximize the sample choice of the housing units per building.

[34] RANDOM.ORG was developed by Dr Mads Haahr of the School of Computer Science and Statistics at Trinity College, Dublin in Ireland. It offers true random numbers which can be used for holding drawings, lotteries and for scientific applications. The site can be found in https://www.random.org/ .

F. The buildings in the remaining blocks were all numbered and one block of type E'1 was selected using random.org sequence generator software. There was only one L'1 building typology in the compound block.

G. All housing typologies were numbered, and the order of interview was selected using random.org sequence generator software.

Building typology	Housing unit typology						
	Studio	1 bedroom - type A	1 bedroom - type B	2 bedroom - type A	2 bedroom -type B	3 bedroom	Total
E'1	5	5	10	5	0	5	30
L'1	5	4	8	2	4	5	28

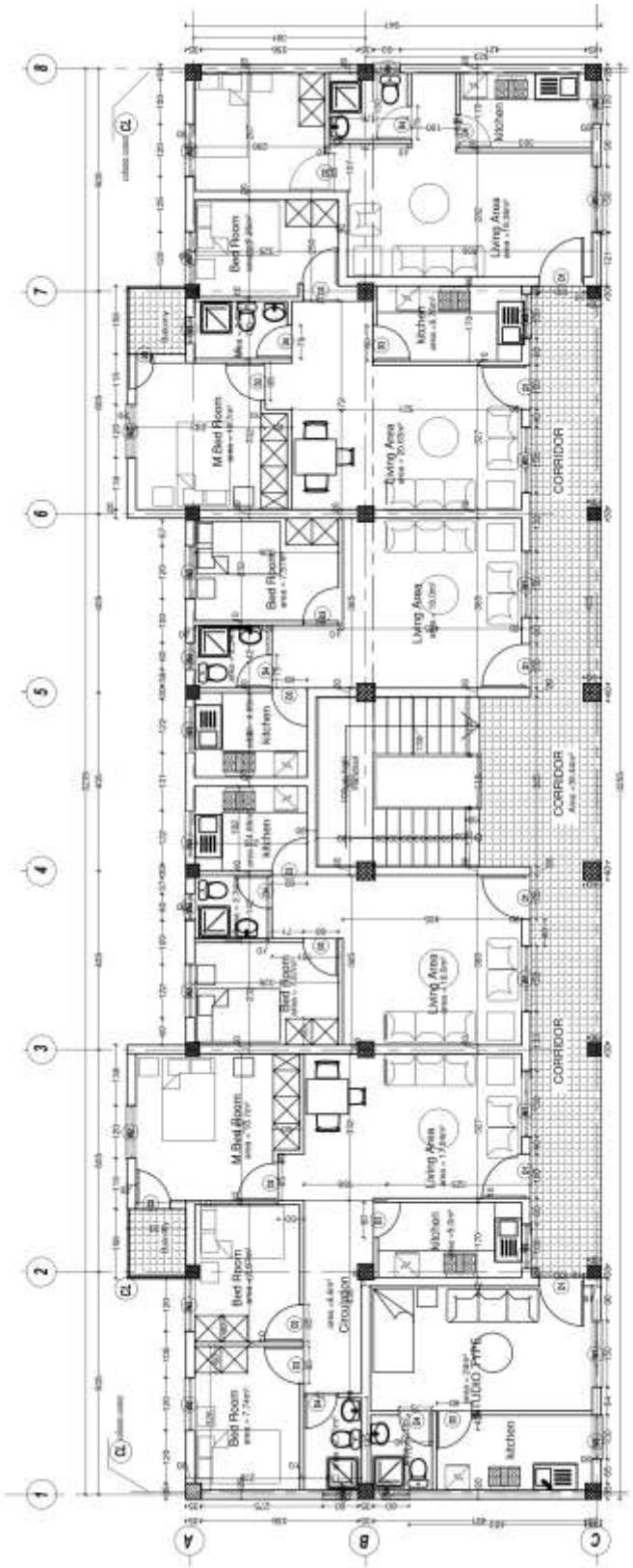
H. A pilot data collection was done to check the interview questions.

I. The studio units were eliminated as it was found out that the studied residents were all renters and it the researcher was not able to find a respondent that has lived in the unit for more than one year.

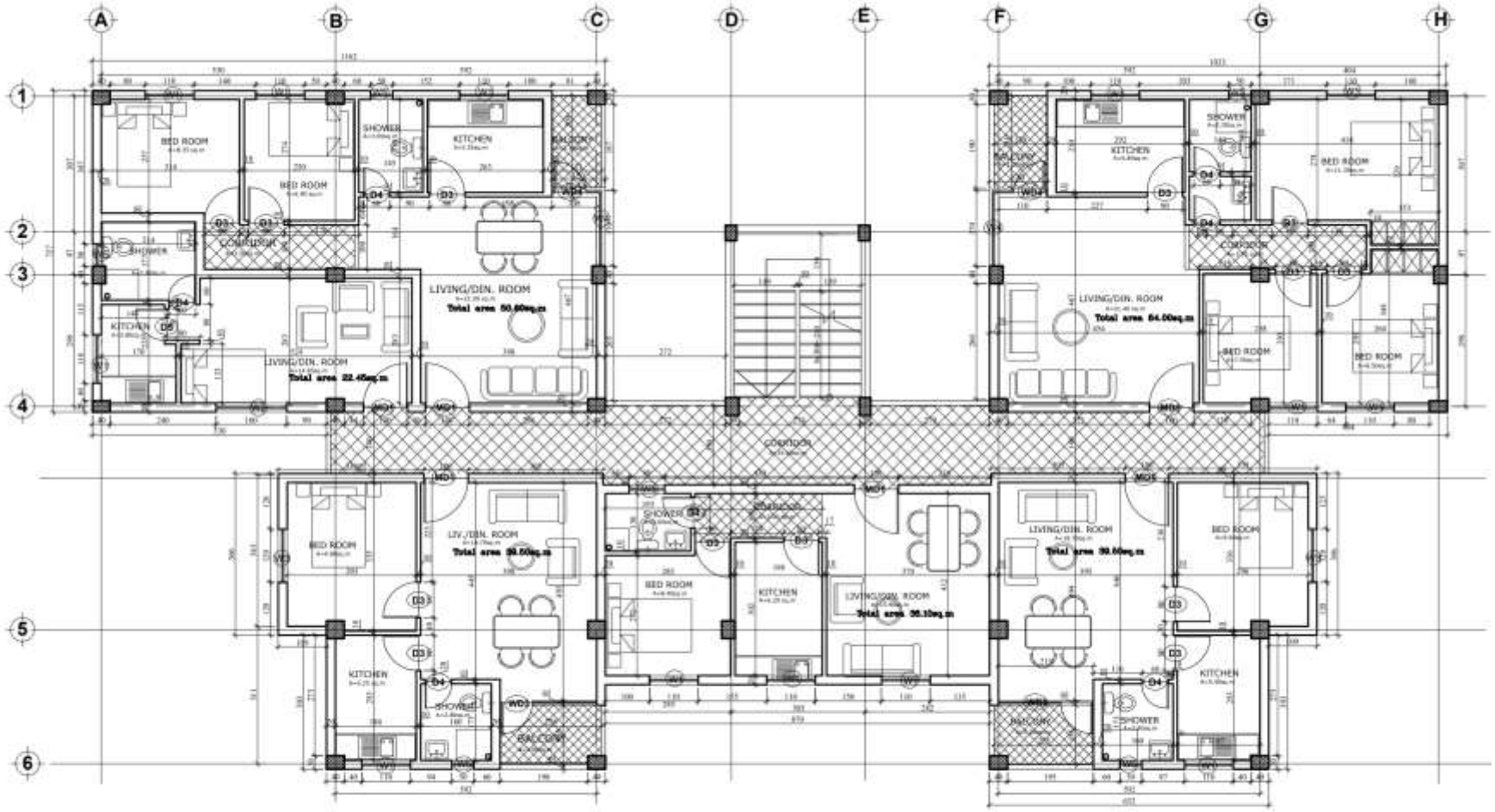
J. The 2 bedroom-Type A typology in L'1 building was eliminated considering as there were only 2 houses in the building with that design and there is only one L'1 building in the block. Only two houses would not have been able to provide all the necessary information.

K. The interview was conducted with the selected housing units until a repetition of data could be found.

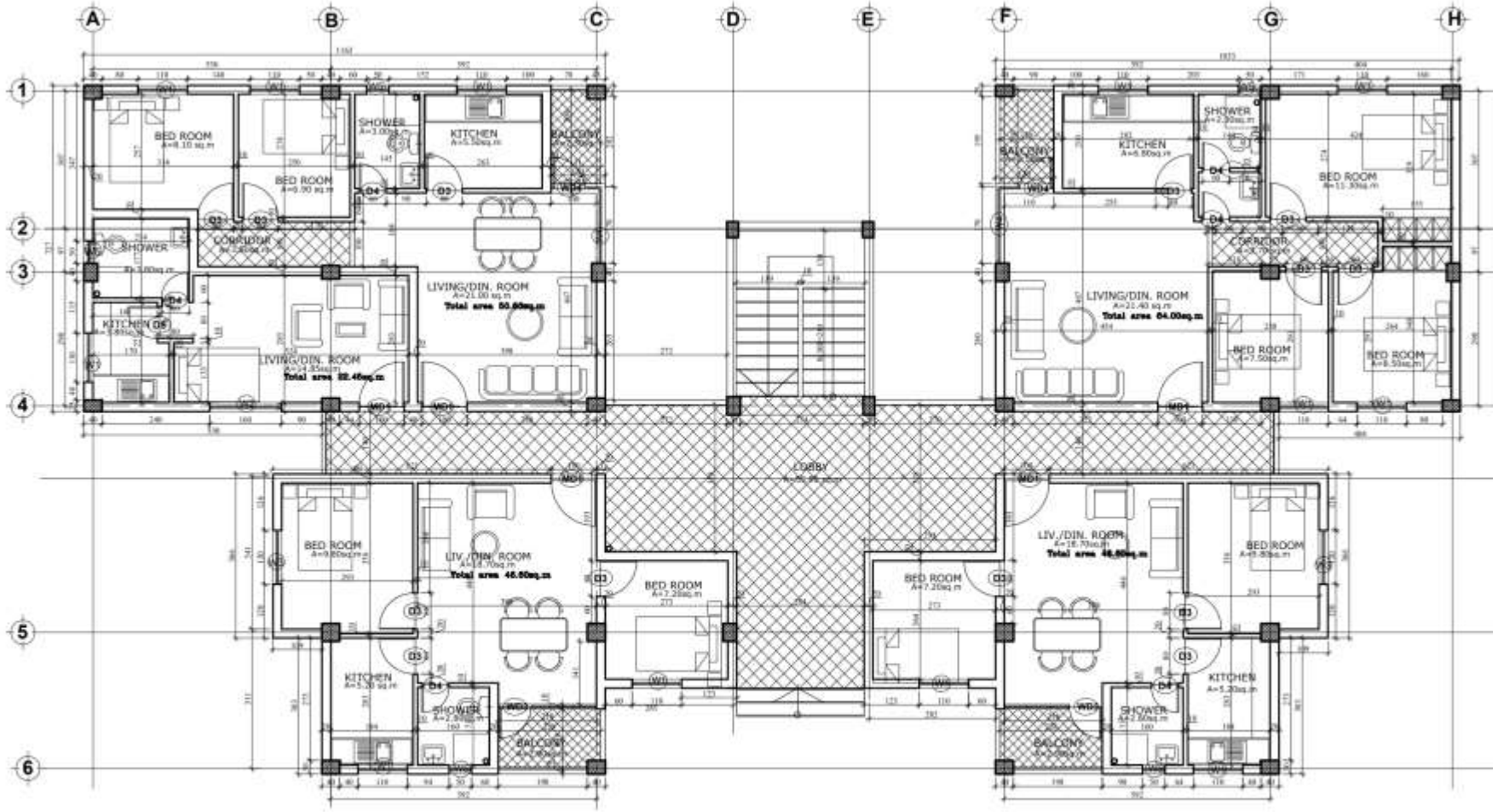
Appendix 4: Floor plan of chosen building typologies



Typical floor plan of E'1 building typology

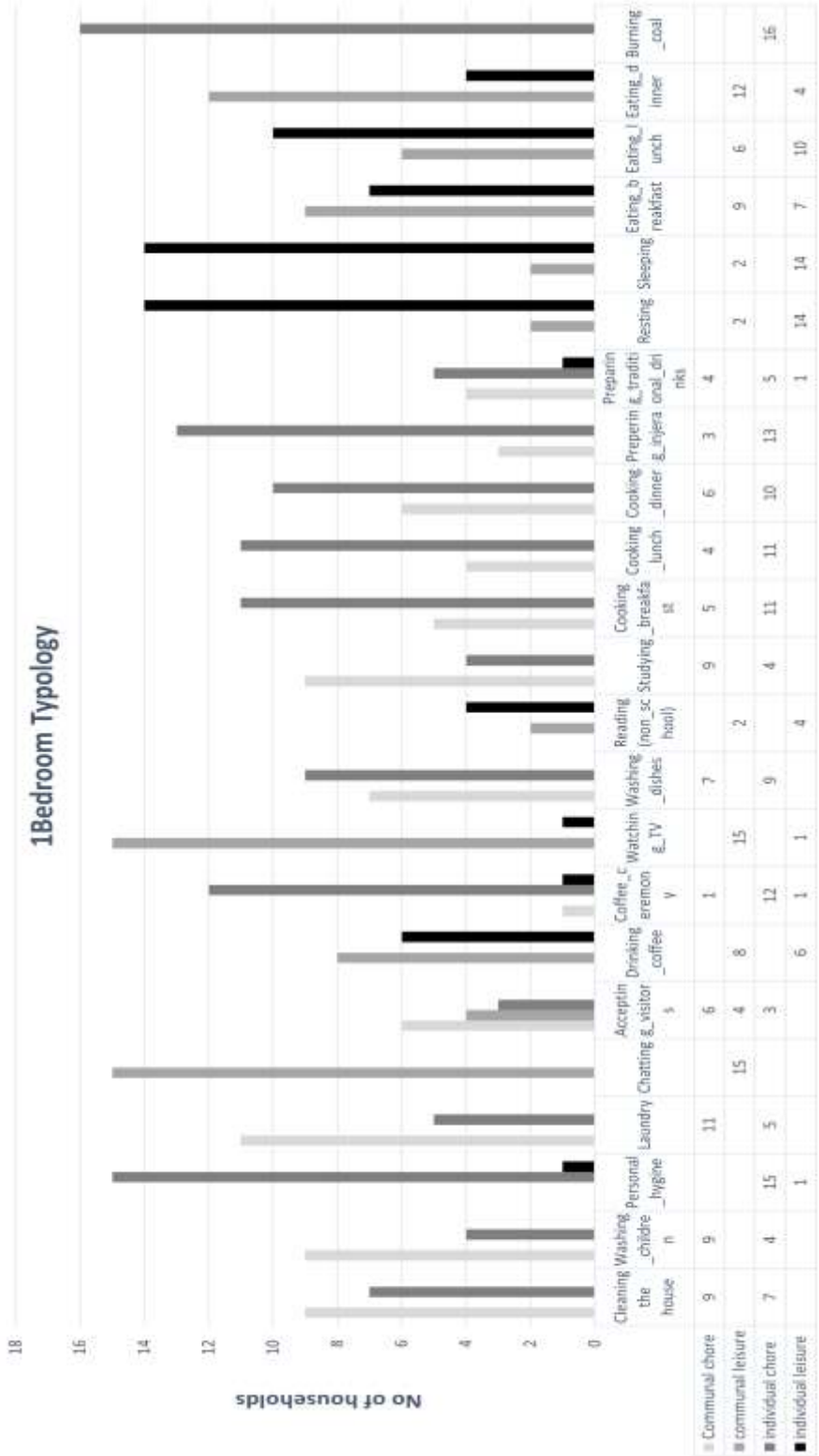


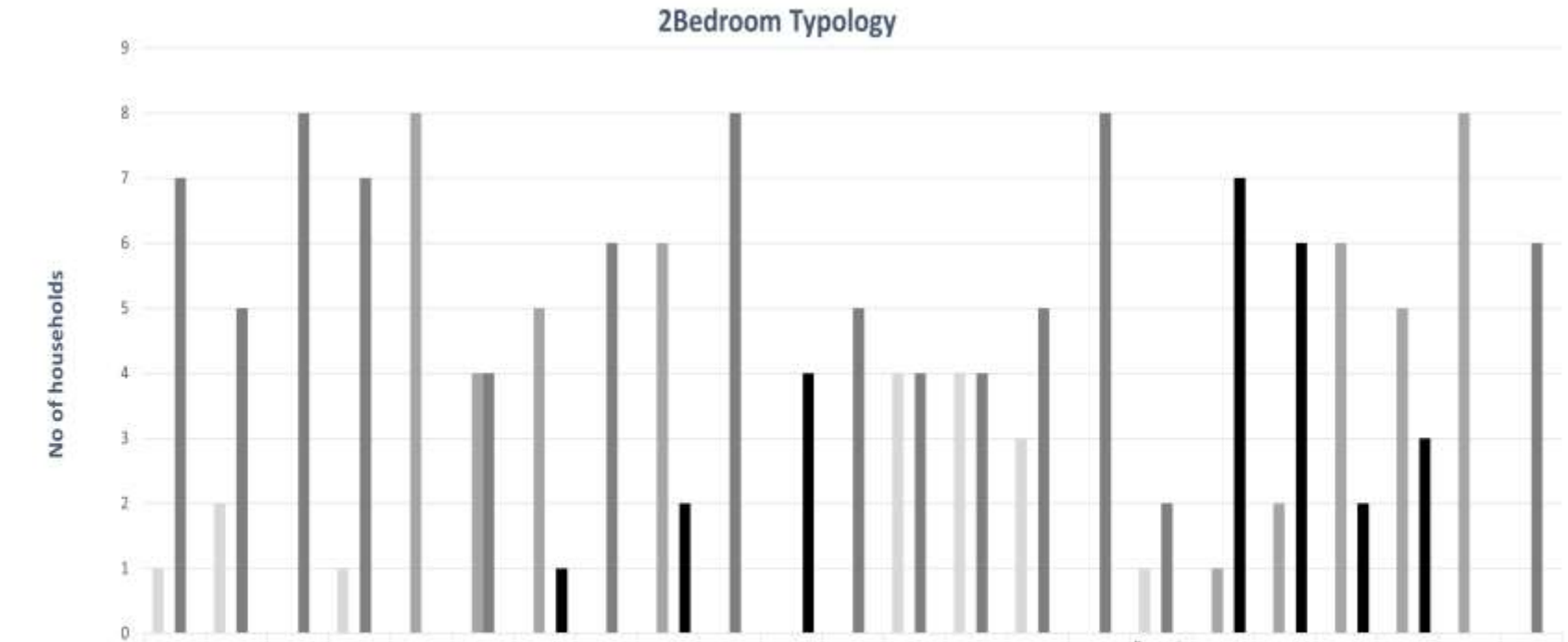
Typical 1st-4th floor plan of L'1 typology



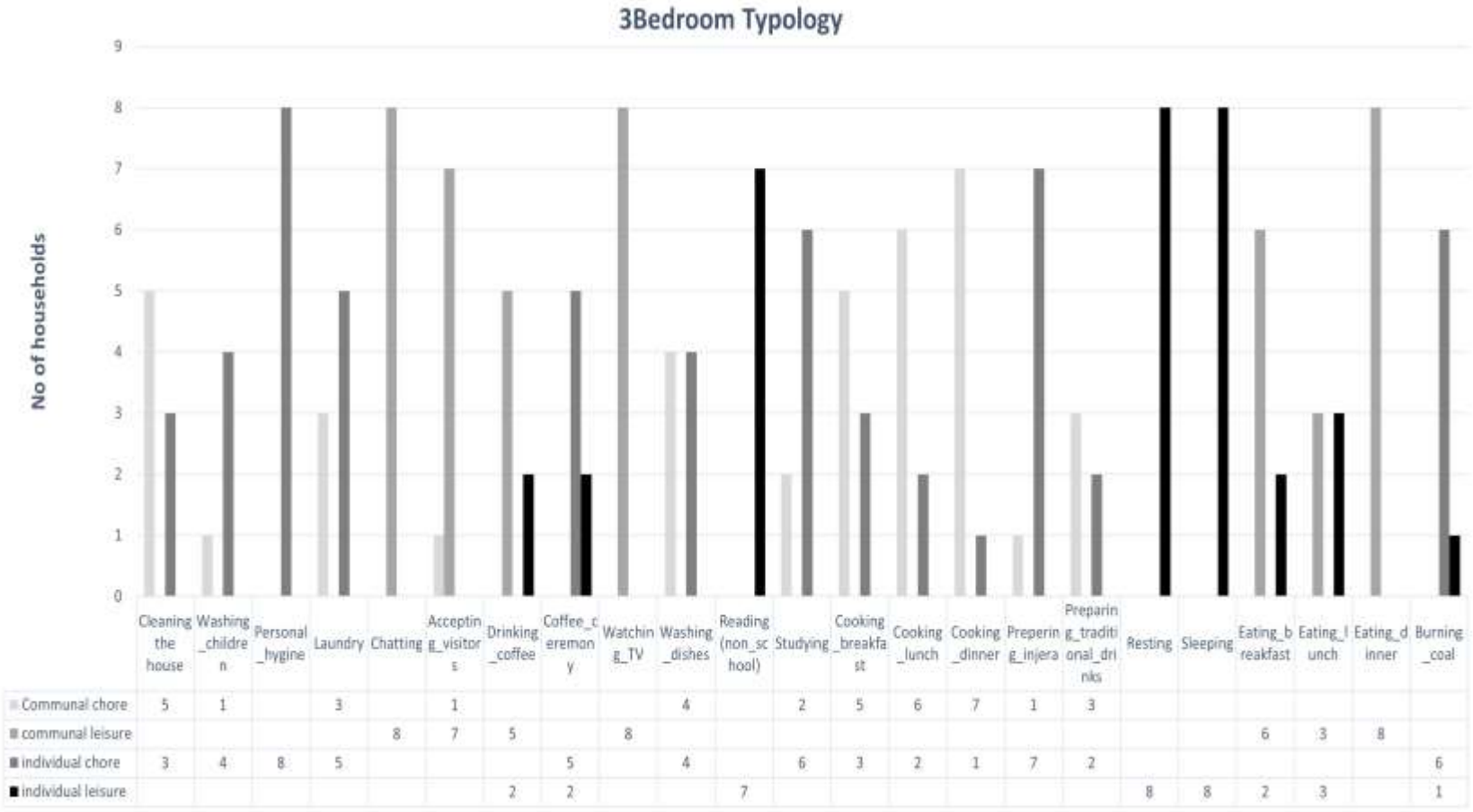
GROUND FLOOR PLAN of L'1 typology

Appendix 5: Summary of activities by type categorization in 1-, 2- & 3-bedroom typologies

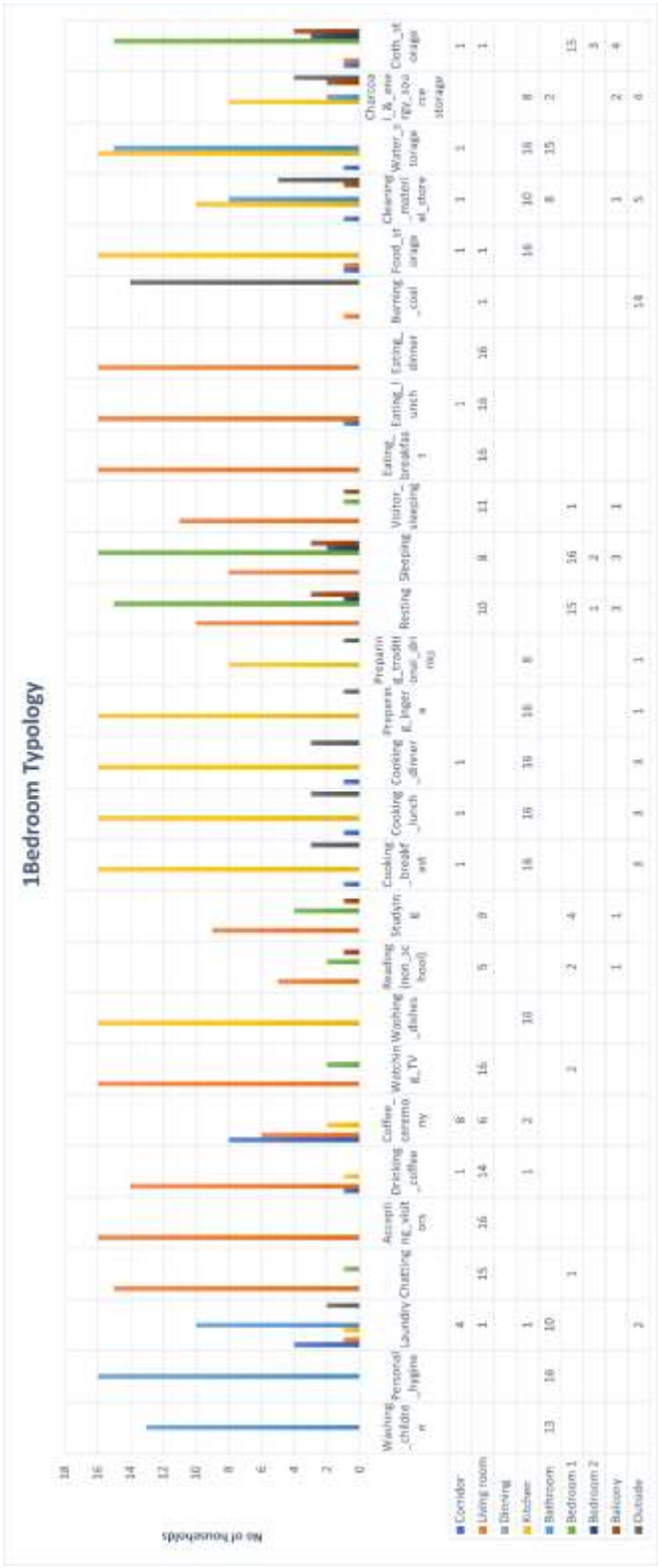




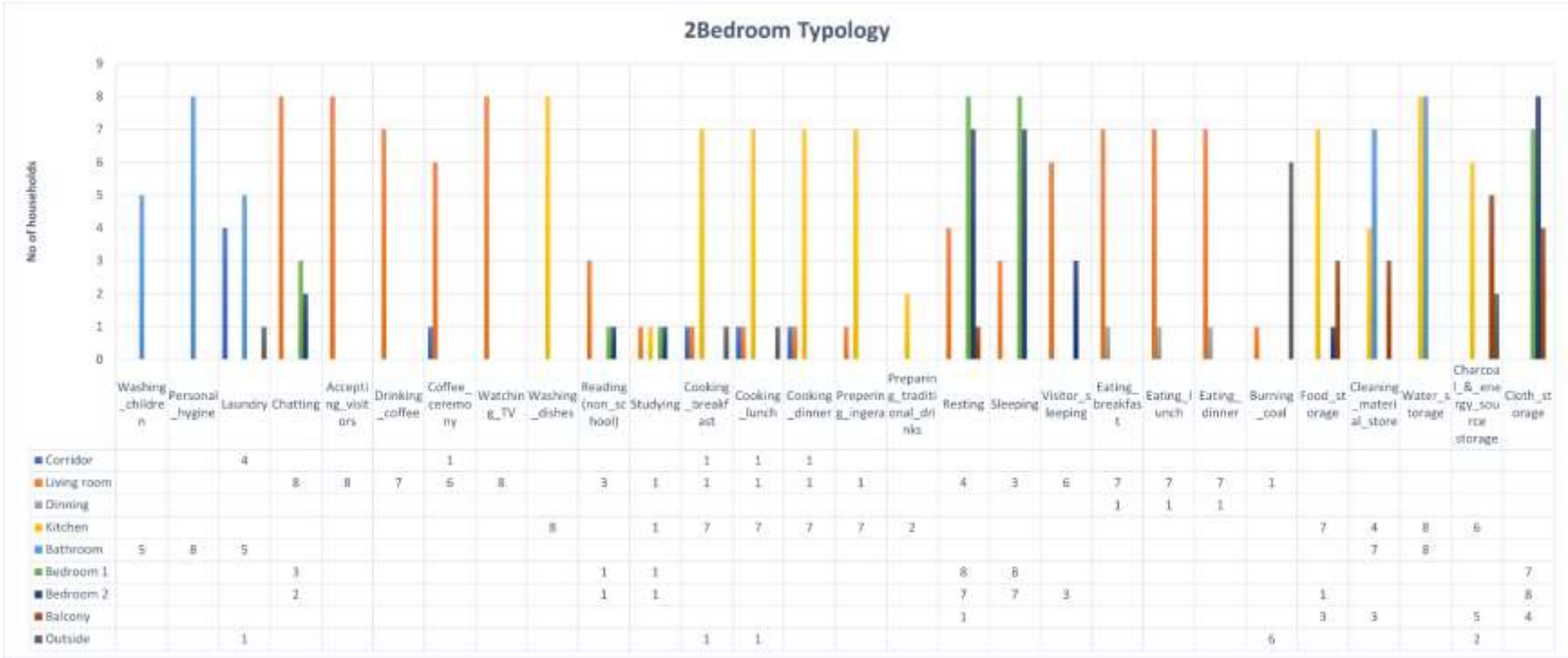
	Cleaning the house	Washing_children	Personal_hygine	Laundry	Chatting	Accepting_visitors	Drinking_coffee	Coffee_ceremony	Watching_TV	Washing_dishes	Reading (non_school)	Studying	Cooking_breakfast	Cooking_lunch	Cooking_dinner	Preparing_injera	Preparing_traditional_drinks	Resting	Sleeping	Eating_breakfast	Eating_lunch	Eating_dinner	Burning_coal
Communal chore	1	2		1									4	4	3		1						
communal leisure					8	4	5		6									1	2	6	5	8	
individual chore	7	5	8	7		4		6		8		5	4	4	5	8	2						6
individual leisure							1		2		4							7	6	2	3		

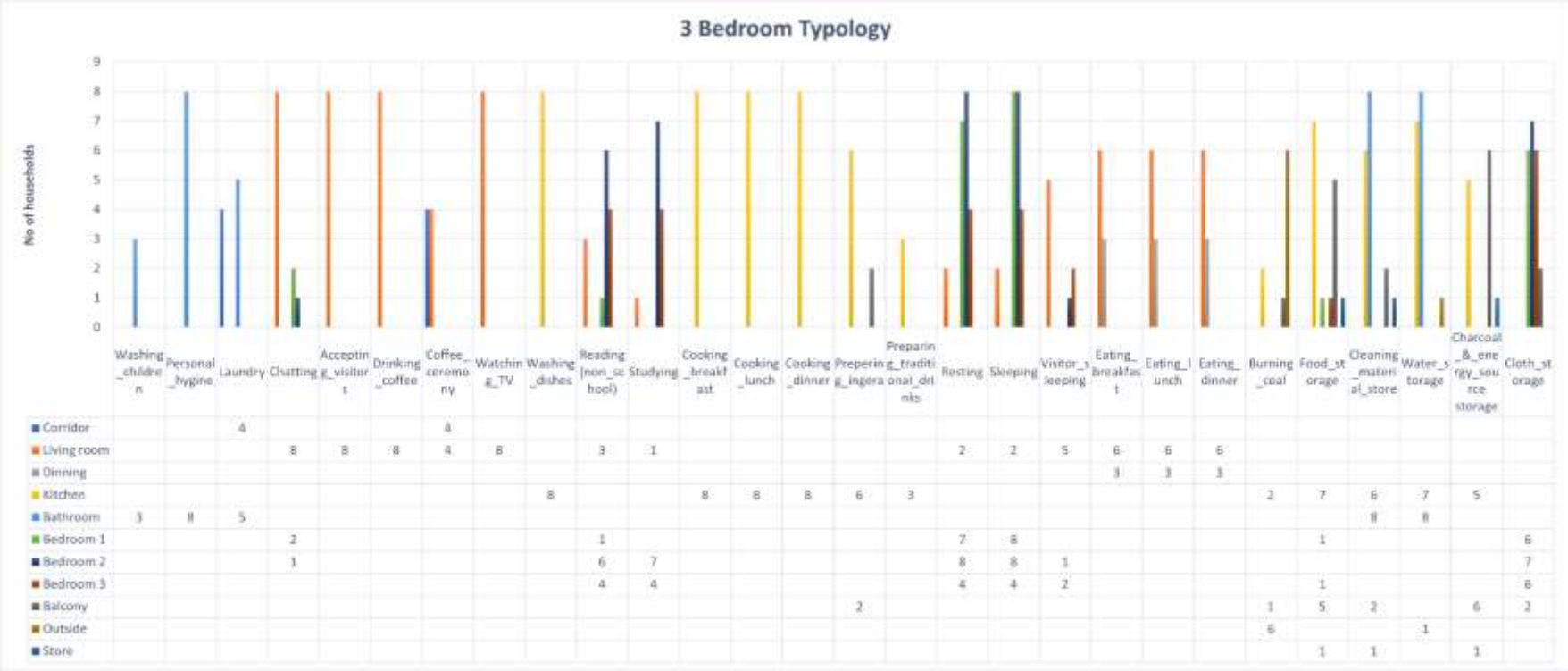

3Bedroom Typology
No of households
0
1
2
3
4
5
6
7
8
9
Cleaning the house
Washing _children
Personal _hygine
Laundry
Chatting
Accepting_visitors
Drinking_coffee
Coffee_ceremony
Watching_TV
Washing_dishes
Reading (non_school)
Studying
Cooking_breakfast
Cooking_lunch
Cooking_dinner
Preparing_injera
Preparing_traditional_drinks
Resting
Sleeping
Eating_breakfast
Eating_lunch
Eating_dinner
Burning_coal
Communal chore 5 1 3 1 4 2 5 6 7 1 3
communal leisure 8 7 5 8 6 3 8
individual chore 3 4 8 5 5 4 6 3 2 1 7 2 6
individual leisure 2 2 7 8 8 2 3 1

Appendix 6: Activities location by bedroom type

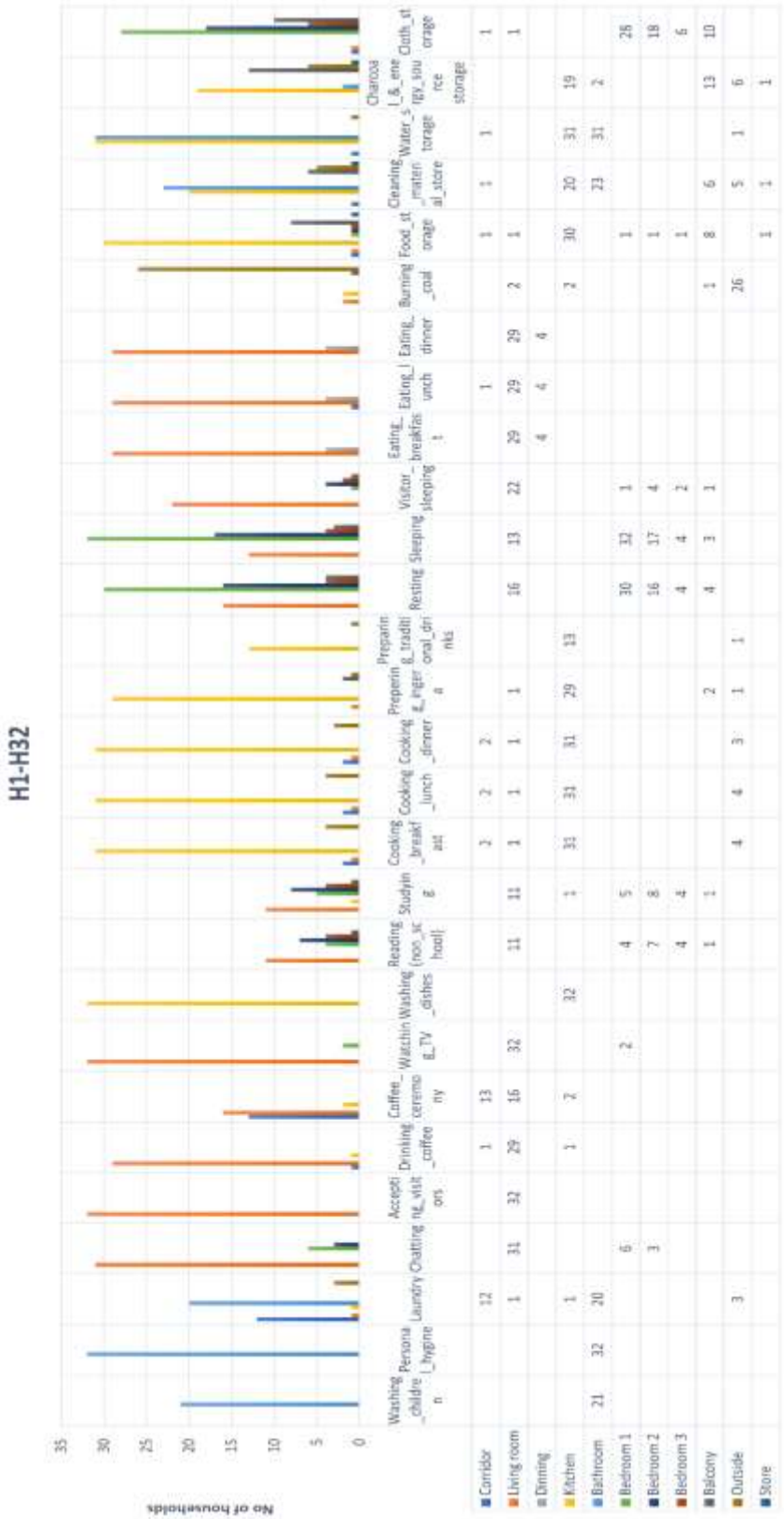


XX

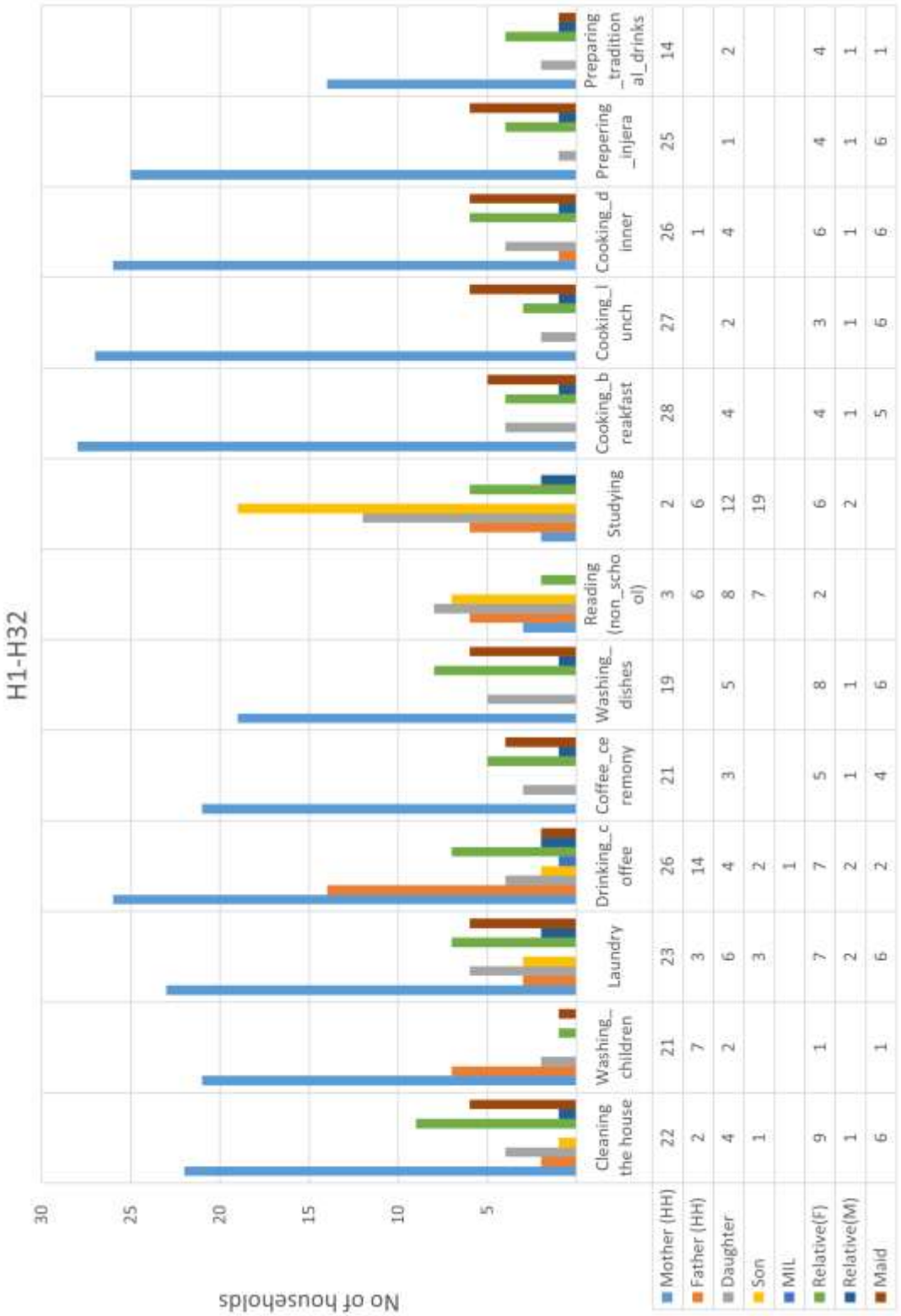

2Bedroom Typology
No of households
0
1
2
3
4
5
6
7
8
9
Washing_children
Personal_hygine
Laundry
Chatting
Accepting_visitors
Drinking_coffee
Coffee_ceremony
Watching_TV
Washing_dishes
Reading (non_school)
Studying
Cooking_breakfast
Cooking_lunch
Cooking_dinner
Preparing_ingera
Preparing_traditional_drinks
Resting
Sleeping
Visitor_sleeping
Eating_breakfast
Eating_lunch
Eating_dinner
Burning_coal
Food_storage
Cleaning_material_store
Water_storage
Charcoal_&_energy_source storage
Cloth_storage
Corridor 4 1 1 1 1
Living room 8 8 7 6 8 3 1 1 1 1 4 3 6 7 7 7 1
Dinning 1 1 1
Kitchen 8 1 7 7 7 7 2 7 4 8 6
Bathroom 5 8 5 7 8
Bedroom 1 3 1 1 8 8 7
Bedroom 2 2 1 1 7 7 3 1 8
Balcony 1 3 3 5 4
Outside 1 1 1 6 2


3 Bedroom Typology
No of households
0
1
2
3
4
5
6
7
8
9
Washing_children
Personal_hygine
Laundry
Chatting
Acceptin g_visitor s
Drinking_coffee
Coffee_ ceremo ny
Watchin g_TV
Washing_dishes
Reading (non_sc hool)
Studying
Cooking_breakf ast
Cooking_lunch
Cooking_dinner
Prepering_ingera
Preparin g_traditi onal_dri nks
Resting
Sleeping
Visitor_s leeping
Eating_ breakfas t
Eating_l unch
Eating_ dinner
Burning_coal
Food_st orage
Cleaning _materi al_store
Water_s torage
Charcoal _&_ene rgy_sou rce storage
Cloth_st orage
Corridor 4 4
Living room 8 8 8 4 8 3 1 2 2 5 6 6 6
Dinning 3 3 3
Kitchen 8 8 8 8 6 3 2 7 6 7 5
Bathroom 3 8 5 8 8
Bedroom 1 2 1 7 8 1 6
Bedroom 2 1 6 7 8 8 1 7
Bedroom 3 4 4 4 4 2 1 6
Balcony 2 1 5 2 6 2
Outside 6 1
Store 1 1 1

Appendix 7: Summary of all activities by place in all house typologies



Appendix 8: Summary of activities by performer



Appendix 9: Functional convex space calculation

1-bedroom typologies

H1							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.33	0.55	3.00	9	0.57	1.80	24
1	2.50	0.99	2.13	9	0.32	1.01	17
2	0.33	0.55	3.00	9	0.57	1.80	24
3	0.53	1.48	1.75	9	0.21	0.68	14
4	4.50	1.77	1.63	9	0.18	0.56	13
5	0.20	0.74	2.50	9	0.43	1.35	20
6	0.20	0.74	2.50	9	0.43	1.35	20
7	0.20	0.74	2.50	9	0.43	1.35	20
8	0.20	0.74	2.50	9	0.43	1.35	20
Mean	1.00	0.92	2.39	9	0.40	1.25	19.111

H2							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.167	1.019	1.833	7	0.333	0.981	11
1	5.000	1.000	1.000	7	1.000	1.000	1
2	0.667	1.274	1.667	7	0.267	0.785	10
3	0.667	1.274	1.667	7	0.267	0.785	10
4	0.167	1.019	1.833	7	0.333	0.981	11
5	0.167	1.019	1.833	7	0.333	0.981	11
6	0.167	1.019	1.833	7	0.333	0.981	11
Mean	1	1.089	1.667	7	0.410	0.928	9

H3							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.200	0.873	1.800	6	0.400	1.146	9
1	5.000	1.000	1.000	6	1.000	1.000	1
2	0.200	0.873	1.800	6	0.400	1.146	9
3	0.200	0.873	1.800	6	0.400	1.146	9
4	0.200	0.873	1.800	6	0.400	1.146	9
5	0.200	0.873	1.800	6	0.400	1.146	9
Mean	1.000	0.894	1.667	6	0.500	1.122	8

H4							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.17	1.02	1.83	7	0.33	0.98	11
1	5.00	1.00	1.00	7	1.00	1.00	1
2	0.67	1.27	1.67	7	0.27	0.79	10
3	0.67	1.27	1.67	7	0.27	0.79	10
4	0.17	1.02	1.83	7	0.33	0.98	11
5	0.17	1.02	1.83	7	0.33	0.98	11
6	0.17	1.02	1.83	7	0.33	0.98	11
Mean	1.00	1.09	1.67	7	0.41	0.93	9

H5							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.688	2.778	10	0.444	1.455	25
1	1.667	1.375	1.889	10	0.222	0.727	17
2	1.667	1.375	1.889	10	0.222	0.727	17
3	0.333	0.688	2.778	10	0.444	1.455	25
4	2.333	0.917	2.333	10	0.333	1.091	21
5	0.333	0.550	3.222	10	0.556	1.818	29
6	0.333	0.550	3.222	10	0.556	1.818	29
7	2.333	0.917	2.333	10	0.333	1.091	21
8	0.333	0.550	3.222	10	0.556	1.818	29
9	0.333	0.550	3.222	10	0.556	1.818	29
mean	1.000	0.816	2.689	10	0.422	1.382	24

H6							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.690	2.429	8	0.476	1.450	17
1	1.667	1.724	1.571	8	0.190	0.580	11
2	2.333	1.149	1.857	8	0.286	0.870	13
3	0.333	0.575	2.714	8	0.571	1.740	19
4	0.333	0.575	2.714	8	0.571	1.740	19
5	2.333	1.149	1.857	8	0.286	0.870	13
6	0.333	0.575	2.714	8	0.571	1.740	19
7	0.333	0.575	2.714	8	0.571	1.740	19
mean	1	0.876	2.321	8	0.440	1.341	16

H7							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.500	0.463	2.833	7.000	0.733	2.159	17
1	1.333	0.849	2.000	7.000	0.400	1.178	12
2	1.833	1.698	1.500	7.000	0.200	0.589	9
3	0.333	0.637	2.333	7.000	0.533	1.570	14
4	2.333	1.274	1.667	7.000	0.267	0.785	10
5	0.333	0.566	2.500	7.000	0.600	1.767	15
6	0.333	0.566	2.500	7.000	0.600	1.767	15
mean	1	0.865	2.190	7.000	0.476	1.402	13

H8						
Ref	Control	Integration [HH]	Mean Depth	RA	RRA	Total Depth
0	0.333	0.582	2.200	0.600	1.719	11
1	2.333	1.745	1.400	0.200	0.573	7
2	0.333	0.582	2.200	0.600	1.719	11
3	2.333	1.745	1.400	0.200	0.573	7
4	0.333	0.582	2.200	0.600	1.719	11
5	0.333	0.582	2.200	0.600	1.719	11
mean	1	0.970	1.933	0.467	1.337	9.7

H17 to H20							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.50	0.499	2.40	6	0.700	2.006	12
1	1.25	1.163	1.60	6	0.300	0.860	8
2	3.50	3.490	1.20	6	0.100	0.287	6
3	0.25	0.698	2.00	6	0.500	1.433	10
4	0.25	0.698	2.00	6	0.500	1.433	10
5	0.25	0.698	2.00	6	0.500	1.433	10
mean	1	1.208	1.867	6	0.433	1.242	9

H21							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.167	0.985	2.000	8	0.333	1.015	14
1	4.833	6.896	1.143	8	0.048	0.145	8
2	0.167	0.985	2.000	8	0.333	1.015	14
3	0.500	1.379	1.714	8	0.238	0.725	12
4	1.667	1.724	1.571	8	0.190	0.580	11
5	0.333	0.690	2.429	8	0.476	1.450	17
6	0.167	0.985	2.000	8	0.333	1.015	14
7	0.167	0.985	2.000	8	0.333	1.015	14
mean	1	1.829	1.857	8	0.286	0.870	13

H22							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.250	0.682	2.63	9	0.464	1.466	21
1	2.750	1.478	1.75	9	0.214	0.676	14
2	0.250	0.682	2.63	9	0.464	1.466	21
3	0.500	1.109	2.00	9	0.286	0.902	16
4	2.083	2.218	1.50	9	0.143	0.451	12
5	0.250	0.806	2.38	9	0.393	1.240	19
6	2.250	1.267	1.88	9	0.250	0.789	15
7	0.333	0.634	2.75	9	0.500	1.578	22
8	0.333	0.634	2.75	9	0.500	1.578	22
mean	1	1.057	2.25	9	0.357	1.127	18

H23							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.634	2.750	9	0.500	1.578	22
1	2.250	1.267	1.875	9	0.250	0.789	15
2	0.333	0.634	2.750	9	0.500	1.578	22
3	2.667	2.218	1.500	9	0.143	0.451	12
4	2.250	1.267	1.875	9	0.250	0.789	15
5	0.333	0.634	2.750	9	0.500	1.578	22
6	0.333	0.634	2.750	9	0.500	1.578	22
7	0.250	0.806	2.375	9	0.393	1.240	19
8	0.250	0.806	2.375	9	0.393	1.240	19
mean	1.000	0.989	2.333	9.000	0.381	1.203	19

H24							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.577	3.300	11	0.511	1.733	33
1	1.667	0.948	2.400	11	0.311	1.055	24
2	0.917	1.474	1.900	11	0.200	0.678	19
3	1.667	0.948	2.400	11	0.311	1.055	24
4	0.333	0.577	3.300	11	0.511	1.733	33
5	2.667	1.659	1.800	11	0.178	0.603	18
6	0.250	0.781	2.700	11	0.378	1.281	27
7	0.250	0.781	2.700	11	0.378	1.281	27
8	2.250	1.021	2.300	11	0.289	0.980	23
9	0.333	0.603	3.200	11	0.489	1.658	32
10	0.333	0.603	3.200	11	0.489	1.658	32
mean	1.000	0.906	2.655	11	0.368	1.247	27

2-bedroom typology

H9							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.690	2.429	8	0.476	1.450	17
1	1.750	1.724	1.571	8	0.190	0.580	11
2	1.333	0.862	2.143	8	0.381	1.160	15
3	0.500	0.493	3.000	8	0.667	2.030	21
4	3.333	1.724	1.571	8	0.190	0.580	11
5	0.250	0.690	2.429	8	0.476	1.450	17
6	0.250	0.690	2.429	8	0.476	1.450	17
7	0.250	0.690	2.429	8	0.476	1.450	17
mean	1	0.945	2.250	8	0.417	1.269	16

H10							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.739	2.500	9	0.429	1.353	20
1	1.700	1.774	1.625	9	0.179	0.564	13
2	1.333	0.887	2.250	9	0.357	1.127	18
3	0.500	0.522	3.125	9	0.607	1.917	25
4	4.333	2.218	1.500	9	0.143	0.451	12
5	0.200	0.806	2.375	9	0.393	1.240	19
6	0.200	0.806	2.375	9	0.393	1.240	19
7	0.200	0.806	2.375	9	0.393	1.240	19
8	0.200	0.806	2.375	9	0.393	1.240	19
mean	1	1.041	2.278	9	0.365	1.152	18

H11							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.500	0.577	3.300	11	0.511	1.733	33
1	1.333	0.948	2.400	11	0.311	1.055	24
2	1.033	1.896	1.700	11	0.156	0.527	17
3	2.333	1.106	2.200	11	0.267	0.904	22
4	0.333	0.632	3.100	11	0.467	1.582	31
5	0.333	0.632	3.100	11	0.467	1.582	31
6	4.333	1.659	1.800	11	0.178	0.603	18
7	0.200	0.781	2.700	11	0.378	1.281	27
8	0.200	0.781	2.700	11	0.378	1.281	27
9	0.200	0.781	2.700	11	0.378	1.281	27
10	0.200	0.781	2.700	11	0.378	1.281	27
mean	1.000	0.961	2.582	11	0.352	1.192	26

H12							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.690	2.429	8	0.476	1.450	17
1	1.750	1.724	1.571	8	0.190	0.580	11
2	1.333	0.862	2.143	8	0.381	1.160	15
3	0.500	0.493	3.000	8	0.667	2.030	21
4	3.333	1.724	1.571	8	0.190	0.580	11
5	0.250	0.690	2.429	8	0.476	1.450	17
6	0.250	0.690	2.429	8	0.476	1.450	17
7	0.250	0.690	2.429	8	0.476	1.450	17
mean	1	0.945	2.250	8	0.417	1.269	16

H25							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.637	2.333	7	0.533	1.570	14
1	2.250	1.698	1.500	7	0.200	0.589	9
2	1.000	1.000	1.000	1	1.000	1.000	1
3	0.333	0.637	2.333	7	0.533	1.570	14
4	3.333	2.547	1.333	7	0.133	0.393	8
5	0.250	0.728	2.167	7	0.467	1.374	13
6	0.250	0.728	2.167	7	0.467	1.374	13
7	0.250	0.728	2.167	7	0.467	1.374	13
mean	1	1.088	1.875000013	6	0.475	1.155	11

H26							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.250	0.649	3.333	13	0.424	1.540	40
1	1.917	1.070	2.417	13	0.258	0.935	29
2	0.833	1.010	2.500	13	0.273	0.990	30
3	1.583	0.727	3.083	13	0.379	1.375	37
4	0.333	0.505	4.000	13	0.545	1.980	48
5	1.917	1.399	2.083	13	0.197	0.715	25
6	0.250	0.758	3.000	13	0.364	1.320	36
7	1.583	1.299	2.167	13	0.212	0.770	26
8	0.333	0.727	3.083	13	0.379	1.375	37
9	1.833	0.957	2.583	13	0.288	1.045	31
10	0.333	0.606	3.500	13	0.455	1.650	42
11	1.333	0.649	3.333	13	0.424	1.540	40
12	0.500	0.466	4.250	13	0.591	2.145	51
mean	1	0.833	3.026	13	0.368	1.337	36

H27							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.637	2.333	7	0.533	1.570	14
1	2.250	1.698	1.500	7	0.200	0.589	9
2	1.000	1.000	1.000	1	1.000	1.000	1
3	0.333	0.637	2.333	7	0.533	1.570	14
4	3.333	2.547	1.333	7	0.133	0.393	8
5	0.250	0.728	2.167	7	0.467	1.374	13
6	0.250	0.728	2.167	7	0.467	1.374	13
7	0.250	0.728	2.167	7	0.467	1.374	13
mean	1	1.088	1.875000013	6	0.475	1.155	11

H28							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.603	3.200	11	0.489	1.658	32
1	2.000	1.021	2.300	11	0.289	0.980	23
2	1.333	0.664	3.000	11	0.444	1.507	30
3	0.533	1.327	2.000	11	0.222	0.754	20
4	0.500	0.458	3.900	11	0.644	2.185	39
5	4.000	1.474	1.900	11	0.200	0.678	19
6	0.200	0.737	2.800	11	0.400	1.356	28
7	0.200	0.737	2.800	11	0.400	1.356	28
8	0.200	0.737	2.800	11	0.400	1.356	28
9	1.200	0.829	2.600	11	0.356	1.206	26
10	0.500	0.531	3.500	11	0.556	1.884	35
mean	1	0.829	2.800	11	0.400	1.356	28

3-bedroom typology

H13							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.250	0.688	2.778	10	0.444	1.455	25
1	3.000	1.375	1.889	10	0.222	0.727	17
2	0.250	0.688	2.778	10	0.444	1.455	25
3	1.250	0.786	2.556	10	0.389	1.273	23
4	0.500	0.500	3.444	10	0.611	2.000	31
5	0.500	1.375	1.889	10	0.222	0.727	17
6	3.500	1.100	2.111	10	0.278	0.909	19
7	0.250	0.611	3.000	10	0.500	1.636	27
8	0.250	0.611	3.000	10	0.500	1.636	27
9	0.250	0.611	3.000	10	0.500	1.636	27
mean	1	0.834	2.644	10	0.411	1.345	24

H14							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.250	0.688	2.778	10	0.444	1.455	25
1	3.000	1.375	1.889	10	0.222	0.727	17
2	0.250	0.688	2.778	10	0.444	1.455	25
3	1.250	0.786	2.556	10	0.389	1.273	23
4	0.500	0.500	3.444	10	0.611	2.000	31
5	0.500	1.375	1.889	10	0.222	0.727	17
6	3.500	1.100	2.111	10	0.278	0.909	19
7	0.250	0.611	3.000	10	0.500	1.636	27
8	0.250	0.611	3.000	10	0.500	1.636	27
9	0.250	0.611	3.000	10	0.500	1.636	27
mean	1	0.834	2.644	10	0.411	1.345	24

H15							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.568	3.667	13	0.485	1.760	44
1	1.750	0.866	2.750	13	0.318	1.155	33
2	0.583	0.827	2.833	13	0.333	1.210	34
3	1.667	1.399	2.083	13	0.197	0.715	25
4	1.250	0.827	2.833	13	0.333	1.210	34
5	0.500	0.551	3.750	13	0.500	1.815	45
6	1.500	1.515	2.000	13	0.182	0.660	24
7	0.333	0.791	2.917	13	0.348	1.265	35
8	2.833	1.212	2.250	13	0.227	0.825	27
9	0.250	0.699	3.167	13	0.394	1.430	38
10	1.250	0.758	3.000	13	0.364	1.320	36
11	0.250	0.699	3.167	13	0.394	1.430	38
12	0.500	0.520	3.917	13	0.530	1.925	47
mean	1	0.864	2.949	13	0.354	1.286	35

H16							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.560	3.545	12	0.509	1.787	39
1	2.000	0.870	2.636	12	0.327	1.149	29
2	0.500	1.306	2.091	12	0.218	0.766	23
3	0.500	1.306	2.091	12	0.218	0.766	23
4	3.833	2.611	1.545	12	0.109	0.383	17
5	1.167	1.119	2.273	12	0.255	0.894	25
6	0.500	0.653	3.182	12	0.436	1.532	35
7	0.167	0.979	2.455	12	0.291	1.021	27
8	2.167	1.306	2.091	12	0.218	0.766	23
9	0.333	0.712	3.000	12	0.400	1.404	33
10	0.333	0.712	3.000	12	0.400	1.404	33
11	0.167	0.979	2.455	12	0.291	1.021	27
mean	1	1.093	2.530	12	0.306	1.074	28

H29							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.674	3.250	13	0.409	1.485	39
1	1.533	1.137	2.333	13	0.242	0.880	28
2	0.867	1.212	2.250	13	0.227	0.825	27
3	2.200	2.273	1.667	13	0.121	0.440	20
4	1.533	1.137	2.333	13	0.242	0.880	28
5	0.333	0.674	3.250	13	0.409	1.485	39
6	0.200	0.957	2.583	13	0.288	1.045	31
7	3.700	2.021	1.750	13	0.136	0.495	21
8	1.200	1.010	2.500	13	0.273	0.990	30
9	0.500	0.627	3.417	13	0.439	1.595	41
10	0.200	0.909	2.667	13	0.303	1.100	32
11	0.200	0.909	2.667	13	0.303	1.100	32
12	0.200	0.909	2.667	13	0.303	1.100	32
mean	1	1.111	2.564	13	0.284	1.032	31

H30							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.250	0.806	2.375	9	0.393	1.240	19
1	3.200	2.218	1.500	9	0.143	0.451	12
2	0.250	0.806	2.375	9	0.393	1.240	19
3	0.250	0.806	2.375	9	0.393	1.240	19
4	4.250	2.957	1.375	9	0.107	0.338	11
5	0.200	0.887	2.250	9	0.357	1.127	18
6	0.200	0.887	2.250	9	0.357	1.127	18
7	0.200	0.887	2.250	9	0.357	1.127	18
8	0.200	0.887	2.250	9	0.357	1.127	18
mean	1	1.238	2.111	9	0.317	1.002	17

H31							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.250	0.786	2.556	10	0.389	1.273	23
1	3.200	1.833	1.667	10	0.167	0.545	15
2	0.250	0.786	2.556	10	0.389	1.273	23
3	0.250	0.786	2.556	10	0.389	1.273	23
4	3.750	2.750	1.444	10	0.111	0.364	13
5	1.200	1.100	2.111	10	0.278	0.909	19
6	0.500	0.611	3.000	10	0.500	1.636	27
7	0.200	0.917	2.333	10	0.333	1.091	21
8	0.200	0.917	2.333	10	0.333	1.091	21
9	0.200	0.917	2.333	10	0.333	1.091	21
mean	1	1.140	2.289	10	0.322	1.055	21

H32							
Ref	Control	Integration [HH]	Mean Depth	Node Count	RA	RRA	Total Depth
0	0.333	0.694	3.308	14	0.385	1.442	43
1	1.750	1.156	2.385	14	0.231	0.865	31
2	1.310	2.081	1.769	14	0.128	0.481	23
3	1.750	1.095	2.462	14	0.244	0.913	32
4	0.333	0.671	3.385	14	0.397	1.490	44
5	0.583	1.041	2.538	14	0.256	0.961	33
6	0.476	1.301	2.231	14	0.205	0.769	29
7	5.250	2.601	1.615	14	0.103	0.384	21
8	0.143	1.041	2.538	14	0.256	0.961	33
9	0.143	1.041	2.538	14	0.256	0.961	33
10	1.143	1.156	2.385	14	0.231	0.865	31
11	0.500	0.694	3.308	14	0.385	1.442	43
12	0.143	1.041	2.538	14	0.256	0.961	33
13	0.143	1.041	2.538	14	0.256	0.961	33
mean	1	1.189	2.538	14	0.256	0.961	33

Appendix 10: Functional convex space syntax calculations mean values for all typologies

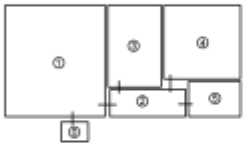
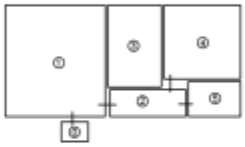
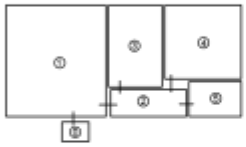
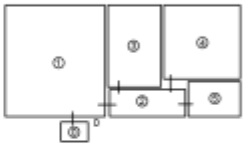
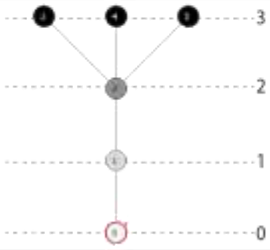
1-bedroom typology (TYPE A & B) of building E'1								
	Mean Ref	Mean Control	Mean Integration [HH]	Mean Depth	Mean Node Count	Mean RA	Mean RRA	Mean Total Depth
TYPE A	H1	1	0.92	2.39	9	0.40	1.25	19
	H2	1	1.09	1.67	7	0.41	0.93	9
	H3	1	0.89	1.67	6	0.50	1.12	8
	H4	1	1.09	1.67	7	0.41	0.93	9
TYPE B	H5	1	0.82	2.69	10	0.42	1.38	24
	H6	1	0.88	2.32	8	0.44	1.34	16
	H7	1	0.86	2.19	7	0.48	1.40	13
	H8	1	0.97	1.93	6	0.47	1.34	10

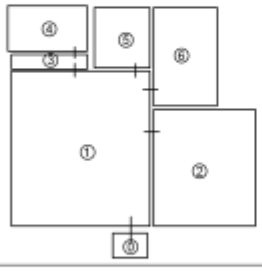
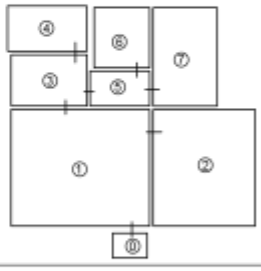
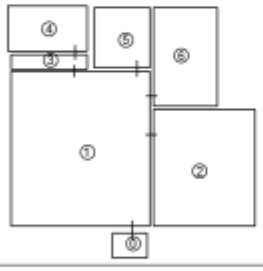
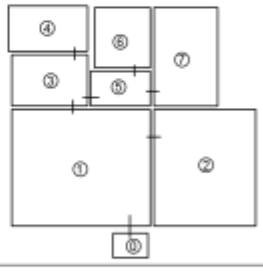
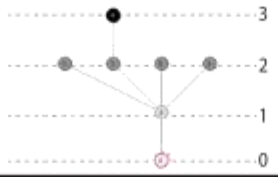
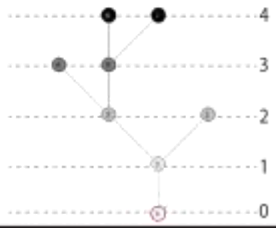
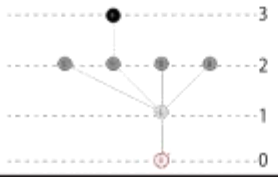
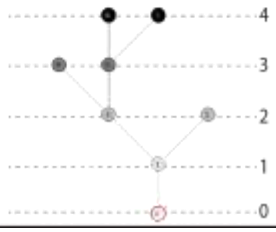
1-bedroom typology (TYPE A & B) of building L'1								
	Mean Ref	Mean Control	Mean Integration [HH]	Mean Depth	Mean Node Count	Mean RA	Mean RRA	Mean Total Depth
TYPE A	H17	1	1.21	1.87	6	0.43	1.24	9
	H18	1	1.21	1.87	6	0.43	1.24	9
	H19	1	1.21	1.87	6	0.43	1.24	9
	H20	1	1.21	1.87	6	0.43	1.24	9
TYPE B	H21	1	1.83	1.86	8	0.29	0.87	13
	H22	1	1.06	2.25	9	0.36	1.13	18
	H23	1	0.99	2.33	9	0.38	1.20	19
	H24	1	0.91	2.65	11	0.37	1.25	27

2-bedroom typology of building E'1(H9-H12) & L'1 (H25-H26)							
Mean Ref	Mean Control	Mean Integration [HH]	Mean Depth	Mean Node Count	Mean RA	Mean RRA	Mean Total Depth
H9	1	0.95	2.25	8	0.42	1.27	16
H10	1	1.04	2.28	9	0.37	1.15	18
H11	1	0.96	2.58	11	0.35	1.19	26
H12	1	0.95	2.25	8	0.42	1.27	16
H25	1	1.09	1.88	6	0.48	1.16	11
H26	1	0.83	3.03	13	0.37	1.34	36
H27	1	1.09	1.88	6	0.48	1.16	11
H28	1	0.83	2.80	11	0.40	1.36	28

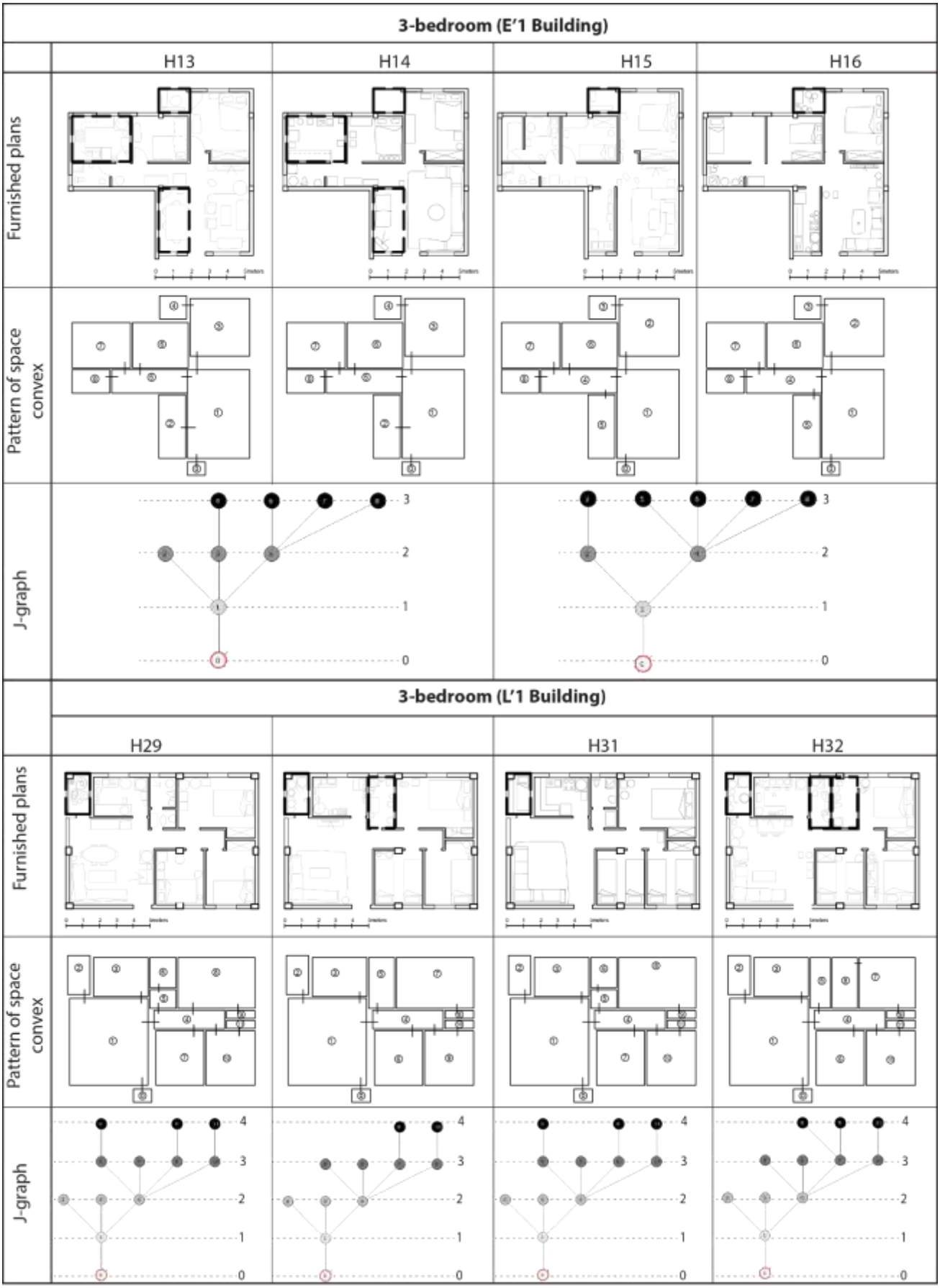
3-bedroom typology of building E'1(H13-H16) & L'1 (H29-H32)							
Mean Ref	Mean Control	Mean Integration [HH]	Mean Depth	Mean Node Count	Mean RA	Mean RRA	Mean Total Depth
H13	1	0.83	2.64	10	0.41	1.35	24
H14	1	0.83	2.64	10	0.41	1.35	24
H15	1	0.86	2.95	13	0.35	1.29	35
H16	1	1.09	2.53	12	0.31	1.07	28
H29	1	1.11	2.56	13	0.28	1.03	31
H30	1	1.24	2.11	9	0.32	1.00	17
H31	1	1.14	2.29	10	0.32	1.05	21
H32	1	1.19	2.54	14	0.26	0.96	33

Appendix 11: Space syntax of spatial pattern of space for 1, 2, & 3 bedrooms

	1-Bedroom-Type A (L'1 building)			
	H17	H18	H19	H20
Furnished plans				
Pattern of space convex				
J-graph				

	1-Bedroom-Type B (L'1 building)			
	H21	H22	H23	H24
Furnished plans				
Pattern of space convex				
J-graph				


2-Bedroom (E'1 building)
H9
H10
H11
H12
Furnished plans
Pattern of space convex
J-graph
2-Bedroom (L'1 building)
H25
H26
H27
H28
Furnished plans
Pattern of space convex
J-graph


3-bedroom (E'1 Building)
H13
H14
H15
H16
Furnished plans
Pattern of space convex
J-graph
3-bedroom (L'1 Building)
H29
H31
H32

Appendix 12: Pictures of the condominium units