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Building Ethiopia Since 1954

INFLUENCE OF HOUSING DENSITY ON OPEN SPACE UTILIZATION

THE CASE OF CMC APARTMENTS, ADDIS ABABA, ETHIOPIA

This thesis is submitted to the Graduate Programs Director of the Ethiopian Institute of Architecture, Building Construction and City Development (EiABC), Addis Ababa University, in partial fulfillment of the requirements for the Masters of Science Degree in Housing and Sustainable Development.

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June, 2020
Addis Ababa

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Author: **AMANUEL ALEMU**

Date: May 2020

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DECLARATION

I, the undersigned, declare that this thesis is my own and original work and has not been presented for a degree in any other university, and that all sources of material used for the thesis have been duly acknowledged, following the scientific guidelines of the Institute.

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CERTIFICATION:

Here with, I state that AMANUEL ALEMU DESTA has carried out this research work on the topic entitled “INFLUENCE OF HOUSING DENSITY ON OPEN SPACE UTILIZATION, THE CASE OF CMC APARTMENTS, ADDIS ABABA, ETHIOPIA” under my supervision and it is sufficient for submission or defense.

Elias Yitbarek Alemayehu (PhD, Associate professor)

Signature _____

Date: _____

ABSTRACT

The primary focus of this thesis is studying housing density and its influence on open space utilization, interpreting the subject both conceptually and numerically. The researcher Purposively selected respondents from seven types of buildings which are found in CMC compound to study the implications of Housing Density with the residents' open space utilization. The analysis for this thesis is classified in to two broad sections. The first section being quantitative in its very nature, uses secondary sources to calculate density. The later section, links housing density with open space utilization of the residents by selecting two most common characteristics of density as reference. These are: Enclosure (Horizontal attribute) and Building height (Vertical attribute). These are further discussed by contextually defining and classifying the buildings in the compound for ease of relating density with the residents.

It was found that respondents with enclosed open space utilize open space more than those which are not enclosed. Highly enclosed neighborhood however, disconnects spaces resulting in introvert spaces. Additionally, building height increment is found to discourage residents in using open spaces. The study also discloses numbers regarding density by using the most common measurements such as Net and Gross housing density, FAR, BAR. The housing density, based on the results from gross housing density calculations the housing density of CMC apartment being 24.67 Hu/Ha is below the lowest bench mark set for gross housing density nationally. Hence low housing density. As far as the international standard for net housing density is concerned the net housing density being 88.85 Hu/Ha falls under medium density housing.

The thesis recommends that beyond for the needs for accommodation and density, it is essential to take in to account the ties these entities have with the residents. Along with the provision of open spaces building layouts of the compound both in cluster or building level are important. It is with such detailing that the interests of residents could be fulfilled.

Key words: housing density, housing density characteristics, open space utilization

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ABBREVIATIONS

BAR	Built Up to Area Ratio
CMC	Cooperativa Muratori e Cementisti
COV	Coverage
CSA	Central Statistics Agency
FAR	Floor Area Ratio
FHC	Federal Housing Corporation
HEI	stands for height index
HU	Housing Unit
MoWUD	Ministry of Work and Urban Development
SOP	Sense of Place
IHDP	Integrated Housing Development Program

CHAPTER – 1

1.1 Introduction

Addis Ababa, the capital of Ethiopia, is the densest city in the country(Abaynew and Wubalem, 2017). The city, on its early years (1800s) was characterized by constructions that were firmly based on vernacular mud and straw circular huts called tukuls (*Gojjo biet*) (Dirk & Anteneh, 2017). The architectural fabric was primarily featured with very few masonry buildings. The city's loose structure, including fields and zones of vegetation, had a rural quality with very low housing density(*ibid*).

During 1900s, however, new era of building emerged due to activities of foreign builders that came to the country (*ibid*). The builders introduced buildings characterized by simple volumes with more than single floors surrounded by finely crafted wooden verandahs. This type of construction unlike the traditional ones, had both horizontal and vertical increments paving its own way for new era of housing density in the city. The styles of "Addis vernacular", can still be seen in a number of preserved noblemen's palaces. It is beautifully exemplified by buildings like Ras Birru House, now the Addis Ababa Museum and by commercial buildings in and around the Arada area built by Armenian builders such as Moussie Minas and Artin Avakian. These buildings were built for noblemen of that time while the rest of the population proceeded building those traditional tukuls for long period of time(*ibid*). Years after this, the city's history of housing density has tremendously evolved in length, height and volume to this date. One of the outcomes of the evolution is the introduction of mass housing.

This thesis making housing density its primary concern, explores the quantitative aspects of housing density by selecting one of the gated communities in Addis, known as CMC apartments. Housing density is a fundamental measure of urban structure determining the efficiency of a city's urban footprint, underpinning economic productivity, environmental sustainably and social inclusion (Burdett et al, 2018). Parallel to quantifying the housing density, the study also investigates the influence of housing density on the residents' open space utilization. To do so, two most common characters of density viz, Building height (Vertical) and Enclosure (Horizontal) are employed. Open space utilization is one of the activities under the concept of sense of place attachment (SOP) which is sufficiently discussed later on the literature review.

1.2 Statement of the problem

Nationally, the preference for mode of housing development has been altered in recent times. Due to scarcity of available land dominantly, the government turned its focus to vertical developments. Meanwhile, it is important to have records of what has been replaced, and what came instead of the previous one. In this case, it is unquestionable to have numerical findings regarding the housing projects that has been executed so far. Moreover, while introducing such compact housing development it is important to study the influences of the new development on the residents since most of the residents are presumed to be highly attached to traditional neighborhoods. Identifying whether the attributes of housing density in a residential complex affect the level of the inhabitants' sense of place attachment is essential. Due to the population growth and delving in to the modern technological world, mass construction and mass housing settlements are inevitable. Along with the quantitative study, the importance of investigation of qualitative link of mass housing developments with residents' sense of place attachment is critical. As far as the inevitability of density is concerned, it is worth to study the change this entity brings on the residents.

1.3Research objectives

General objective

- ✓ The primary objective of this thesis is to examine the influence of housing density on residents' open space utilization.

Specific objectives

1. To calculate the housing density of CMC apartments.
2. To study the influence of building height of CMC apartments on residents' open space utilization.
3. To study the influence of enclosure in CMC apartments on residents' open space utilization.

1.4 Formulation of Research questions

Based on the scopes and objectives of the research, two research questions are formulated. The discussion of housing density is impossible without knowing the quantity regarding the subject. To come up with such numerical findings, various modes of measurement have to be employed. This is the foundation for the first research question which intends to reach at numbers concerning density. Density is not a sole concept, it in one way or another has a link with the residents. Densifying vertically or horizontally might bring changes residents' sense of place attachment. One of the dominant features that density defines is the type of open space. Densifying vertically opens more spaces up while densifying horizontally encloses spaces. The tangible links regarding the residents however, has to be empirically proven. Studying these entities is crucial along with quantifying density. The second research question stems from this rationale.

1.5 Research questions

1. What is the housing density of CMC apartments?
    a) What is the Net housing density of CMC apartments?
    b) What is the Gross housing density of CMC apartments?
    c) What is the FAR of the buildings in CMC apartments?
    d) What is the BAR of the buildings in CMC apartments?
2. How does density influence residents' open space utilization?
    a) How does building height of CMC apartments influence residents' open space utilization?
    b) How does enclosure influence residents' open space utilization?

1.6 Significance of the study

The need to residential densification is unambiguous. The IHDP was launched making density the driving concept (Ministry of Work and Urban Development (MoWUD), 2013). Mega housing projects including the Eagle hills which proposed to build 4,000 residential units on 3.6Ha land at La Gare (https://www.lagare.com/project/la-gare/), Addis Ababa, and the one launched by Federal Housing Corporation to build 16,173 public houses has one subject in common; achieving density (Reporter, 2019). Behind this rationale however, there should be an empirical evidence to

compare what existed and what to be achieved. This study has significance in filling the gaps of by unveiling data on housing density. Densifying only cannot be a goal as far as satisfaction of residents is concerned. There has to be sort of responsibility on the pitfalls of the introduction of mass housing development which are directly related to residents. The study in this regard, aims to alarm new housing projects to reconsider the design and attention to the types and extent of provision of open spaces in mass housing.

1.7 Limitations of the study

Similar to most researches, the common limitations that concern people's opinion is getting reliable responses about their feelings and experiences. Furthermore, the following are the limitations noticed while conducting this study.

I. The officials in FHC could not be able to provide written sources, maps, figures regarding the housing either because they claim they do not have them or they are not willing to do so. Such data are generated from different sources like line map and scaled pictures from web journals. The figures were found from a booklet that was published during inauguration of the housing project from the administrator of the compound.

II. The residents in the compound are of four classes. Diplomats and foreign tenants, Former and current Government officials and ordinary tenants. Half of the compound residents are ordinary tenants, while the diplomats and foreign tenants are only 10%, the rest are former and current government officials as the administrator said. During conducting questionnaire survey there was difficulties in knocking door to door that this embarrasses the residents. Getting respondents with this vibe was difficult that the residents are noticed to be introvert.

1.8 Scope of the study

The boundaries for the investigation are founded on the objectives and research questions raised and are presented as follows.

- **Thematic scope:** the thematic area of this study is residential density and open space utilization solely. As population density is often confused with residential density, the two are entirely different concepts and this study does not include population density hence it is out of the scope of the study.
- **Spatial scope:** the location selected for the case of this study is CMC apartments only.
- **Physical scope:** buildings of this compound are studied. Physical defining phenomenon like Enclosure and Building height are incorporated.
- **Social scope:** residents of the compound, local tenants in particular are the only targets regardless of age group, sex or class.

CHAPTER – 2
METHODOLOGY

2.1 Introduction

The process is equally important with the result. In types of researches incorporating both qualitative and quantitative modes of inquiry, the method tend to be mixed. The reason is multidisciplinary nature of the data required for analysis. Other than density, background disciplines existed while conducting this study. This phenomenon might sound this study should be handled holistically. Due to scope limitation however, depth is preferred over width. These background areas are left, for priority is given to the primary subject at hand. The following section discusses what methods are preferred and why they are opted over the others, how they help to gather the data to get the best results and how these multiple methods work together to execute and present the gathered data.

2.2 Choice of Methods

The selection for research method, study design and research design are based on the research questions raised, purpose and nature of the thesis. The two types of questions raised in this thesis are 'what' and 'How' respectively. The type of methods for these types of questions are descriptive and exploratory as far as objective is concerned. Descriptive method is selected for the housing density calculations. This is because this method is relevant to describe the situation as it is. Derbissa(2018) defined descriptive study design as follows:

> *Descriptive research is the type of research that is primarily concerned with describing the nature or conditions or the degree of intensity of a factor under investigation. The emphasis is on portrayal of the overall nature of the subject under study as it is rather than making deep judgement. (Derbissa, 2018: 49)*

The research comprising two related spatial studies, employs both qualitative and quantitative enquiry methods. The reason is, the thesis first explores numbers in density calculations, which leads it to quantitative approach and later studies the of housing density with residents' open space utilization, which leads to both qualitative

and quantitative approach. For the later section the design that is found appropriate is case study design.

In a case study design the selected 'case' becomes the basis of a thorough, holistic and in-depth exploration of the aspect(s) to find out about (Kumar, 2011). It is an approach 'in which a particular instance or a few carefully selected cases are studied intensively' (Gilbert, 2008). According to Burns (1997), 'to qualify as a case study, *it must be a bounded system,* an entity in itself. A case study should focus on a bounded subject/unit that is either very representative or extremely atypical.' A case study according to Grinnell (1981), 'is characterized by a very flexible and open-ended technique of data collection and analysis'.

2.3 Choice of case

CMC apartment is one of the most unstudied compound regarding housing that there is no satisfying reason for this. Up on data gathering of written and unwritten sources, the researcher couldn't find a single study conducted on the compound. Some authors has discussed it as sub-sections on their studies or mentioned CMC as photo labeling. Researches that are most common on housing modalities like that of kebele houses, condominiums or cooperative houses are repetitive leaving a least attention for this housing. Moreover, this housing unlike the other housing modalities, is exceptional of its kind as far as purpose and architectural quality is concerned. The compound also is the first low-rise gated housing from which rich lessons could be learned. It happened once in history and it is worth to be studied. This makes the researcher curious and interested to study this compound as a case.

2.4 Data collection techniques

The first section, which primarily focus on housing density, is entirely desktop study. Since the purpose of this section is to describe the existing phenomena of housing density of CMC compound, apart from secondary sources of data used, no primary sources are incorporated, no questionnaire employed and hence, no respondents involved. The approach of finally reaching at some numbers makes the section objective in type. This section is all about Housing density calculation. 'What' question is raised hence, the section deals with numbers concerning defined entities of housing density which makes it descriptive study.

The calculations for the housing density include BAR, FAR and HU/ha which are completed in reference with figures in National standard documents. For FAR, BAR and HU/Ha calculations, secondary sources of data such as Site Plan and Floor Plans are used. For Population/ Ha the 3.7 people/ HH benchmark from CSA(2012) is used.

The later section of this thesis is an exploration. It aims to link the influence of housing density with open space utilization. How attributes of housing density relate to the size, type and function of open spaces to be utilized.

In this case, formal interviews with residents by using closed structured questionnaire is employed. For ease and clarity for the respondents, the questionnaire was prepared in Amharic. Rather than leaving the questionnaire for the residents to respond, I used it as an interviewing medium. Discussion with key informants such as government Officials (FHC Special branch officer) and Administrator of the compound (Yirgalem) is also involved. Both the interview and discussions are held one to one. This was done in two approaches. Interviews on open spaces and door to door. People those are interviewed on open spaces are assumed to be potentially relevant for this study because they are found accessing open spaces at the moment of the data collection. This enabled to gather 'right attribute' since it is an approach purposefully conducted on respondents typical the subject in focus (Deribsa, 2018).

The later approach is door to door data collection based on purposefully selected adequate number of buildings and houses. The hours of interview are held after work hours in working days and afternoon in the weekends. Observations during different hours of the day are conducted, sketches of the existing open spaces and activities in the compound are taken, and photographs of the open spaces and the type of activities are captured.

2.5 Sources of Data

Both primary and secondary sources of data are employed in this thesis.

Primary sources of data

- The dominant primary data sources are from the interview conducted with the residents of the compound by using the Amharic version closed and structured interview.

- Apart from this, informal discussion with key informants in the compound, the compound administrator and the special branch office officer has been conducted.
- To manipulate the utilization of open spaces, the time of utilization, the activities held, the intended function of the open space when designed versus current use and the mostly used open spaces are identified by personal observation through the site. During this phase the visual mediums such as photography, sketches, mapping are used.

Secondary sources of Data

- For housing density calculation, site plan of CMC compound, generic floor plans, a tabular data of building height, which is later converted in to map are used. The number of households, the types and buildings with their quantity is also found from a tabular data published during inauguration of the CMC compound which was available from the compound administration.

  These data are also used to define the housing density variables used in this thesis namely – Enclosure and Building height.

2.6 Method of data Analysis

The manipulation, which incorporates housing density calculation, is executed by using AutoCAD, Google Sketch Up and ArcMap software. Here, the line map with dimensions is used to generate the floorplans and the improved version of the site plan. The site plan update is conducted by using the google map satellite version. Moreover, to bring them to the scale of visually explicable medium, they are illustrated as maps, volumes and graphical representations along with charts and tables.

2.7 Sample selection

The second section of the research is qualitative. On such kind of study, representation of the entire population is not the concern since the emphasis is looking for the relevance of the information that the case carry (Deribsa, 2018). Moreover, the size of the sample gives less sense since the focus of the analysis aims at cases that bear right attribute or quality than quantity of subjects to be consulted (*ibid*). Therefore, the researcher is supposed to comprehend the kind of information, attribute of subjects

of the study, size of sample and how the subjects of the inquiry are to be incorporated (*ibid*). In this regard, purposive sampling is found appropriate.

The foundation of this sampling as Derbisa (2018) described, is that 'with sound judgment about the purpose of an inquiry, researchers can strategically select adequate cases for a study and organize the information effectively'. In other terms, it is choosing subjects which are essential typical to the subject in focus (*ibid*). Based on these assumptions the researcher made the following strategic comprehensions.

Measuring Open space utilization unlike density calculation, requires knowing trends of the residents of the study area. To do so, two most common characteristics of density are selected as independent variables which have potentials of linking it with open space utilization.

I chose Enclosure (horizontal attribute) and building height (vertical attribute) for this case. This study incorporates both modes of enquiry viz; Qualitative and Quantitative. While selecting buildings, the researcher made his decision on the proportions of numbers of respondents. The decision was based on either point of data saturation or relevance they have for the study. Moreover, from the chosen buildings, the researcher took more portions of uppermost floors for these floors satisfy all the aforementioned required variables and less potions of ground and first floors for responses should also be included from residents in these floors too.

The number of houses selected from each building differs from building to building since there are seven type of buildings incorporating the different characters mentioned above as variables.

The qualitative nature of the sampling is due to the purposive selection of samples that are assumed to be potentially relevant for the study. In this case, samples are taken regardless of the house numbers.

Residents in all the seven typologies are involved in this section. The proportion of number of residents selected is based on the size of housing units the typologies have, building height and resemblance to other typologies. More number of residents are sampled from typologies with more number of houses. Buildings with similarities (building 1 & 2) are assumed as a single typology that studying both results in redundancy of data that studying one of them satisfies the required data. Generally 90 respondents are involved.

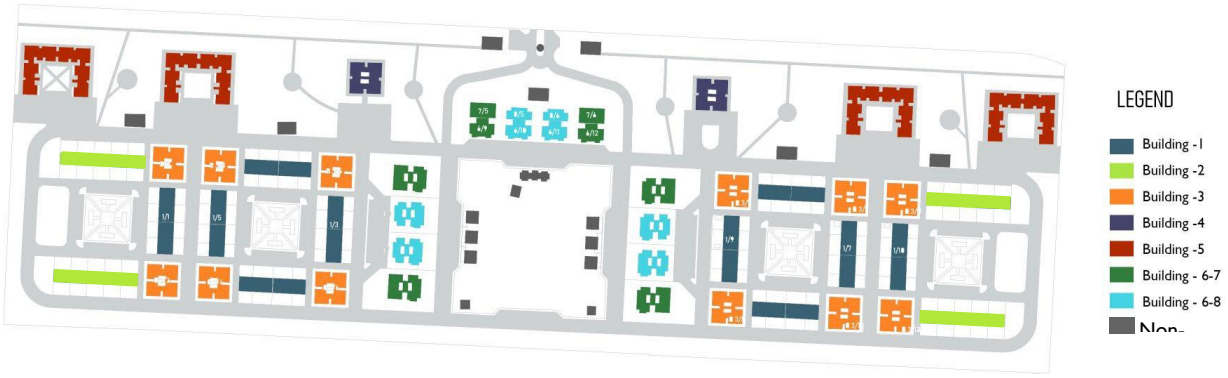
Table 1: *Summary of methodology used*

No	Research Objectives	Research Questions	Data required to answer your research questions			Method of data analysis
			Type of data	Source of data	Method of data collection	
1	Calculating the housing density of CMC apartments.	What is the housing density of CMC apartments? • What is the net housing density? • What is the gross housing density? • What is the FAR? • What is the BAR?	-*Site plan* -*Floor plan* *-3D model (Visual)* *-Section*	<u>Secondary sources:</u> -Written records from FHC* -Web journals -Base map of AA *[Generated by AA City Admin.]* -Microsoft Map [App.]	- Capturing and gathering pictures -generating 3D models of each building based on the line map of AA. -using the dimensions given on the line map(for site and building boundary)	-Density calculation -GIS analysis -Graphical Illustrations*[Floor plans, Figure-ground Maps, Diagrams, 3D]*
2	Exploring the influence of housing density on open space utilization.	How does housing density influence open space utilization of residents?	-Quantitative data -Qualitative data	<u>Primary sources:</u> -Unpublished data from discussion with officials. -Structured interview with key informants[tenants] -Observation*[sketches, Mapping, Photography]*	-Conducting Formal interview using questionnaire -Map manipulation	-*[Graphs, charts, tables]_SPSS,XL* Graphical Illustrations*[Figure-ground Maps, Diagrams, 3D]* -GIS, AutoCAD manipulation

*Federal Housing Corporation

Table 1: Number of respondents with their respective buildings

S.N	Building number	Number of respondents
1	1	12
2	3	27
3	4	12
4	5	18
5	6	9
6	7	12
Total		**90**



2.8 Organization of the Research

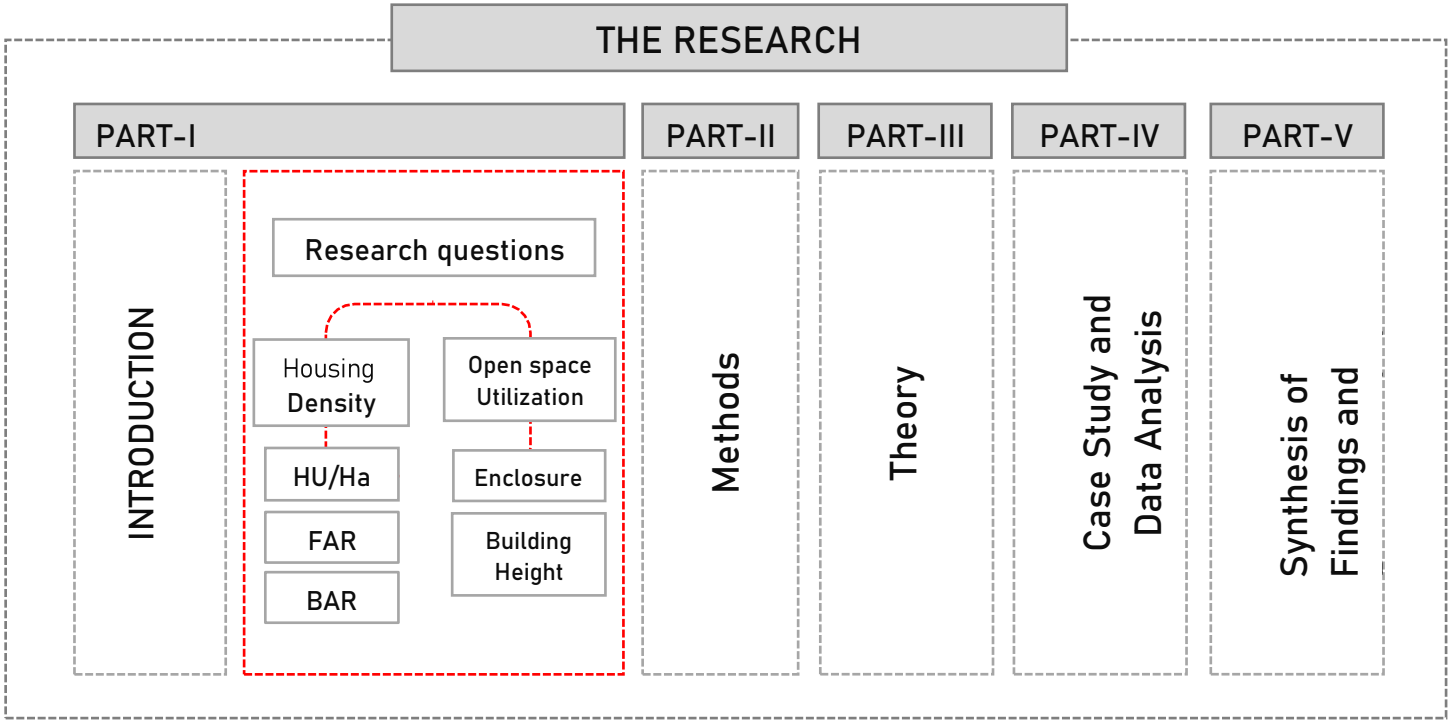


Figure 1 : *Organization of the Research*

CHAPTER - 3
LITERATURE REVIEW

3.1 Introduction

A city, one of the most remarkable innovations of humankind, has changed its form, pattern and setup tremendously in history. These changes result from various factors, which can be natural, social, political or manmade. One of them being the advancements in lifestyles of human beings stimulated different kinds of formal and informal urban settlements. This at early ages of urban development was primarily characterized by horizontal expansion, which created diversified patterns of urban forms. The incremental evolution of these patterns in times made one subject vitally important. Density. This marks the change in perceptions for human beings to think vertical developments in addition to horizontal increment of units. Among all urban growth patterns, compact and sprawl developments are the most common. In this review, the concepts of compact city, Density and its relation with the outdoor open spaces are discussed.

3.2 Sprawl Urban Development

The concept of sprawl development has various definitions. Bhatta (2010) defined urban sprawl as a situation where urban growth adversely affects an urban environment that is neither an appropriate rural area for agricultural purposes nor a comfortable urban condition. According to UN-Habitat (2012), urban sprawl is defined as ‘a spatial phenomenon where a city spreads outward, even beyond its suburbs to its outskirts. Urban sprawl is also referred to as irresponsible and, often, poorly planned development (often due to a lack of regulation) that destroys agricultural and natural land and systems.’

These spatial phenomena of uncontrolled urban expansion is a large consumer of land, resulting unmanaged consequences of physical growth located on urban peripheries. This is primarily the result ineffective and poorly planned development often due to a lack of regulation (UN-Habitat, 2012).

3.3 CONCEPT OF COMPACT CITY

Compact city is a high-density built-up area with proximity among various land-use types (Schwarz, 2010).

It is believed by Scholars that compact cities are one of the most sustainable urban forms, which exist because of their various urban sustainability characteristics, such as less car dependency, public transportation promotion, rural development containment, and natural environment preservation (Livingstone and Authority, 2003). Compact city preserves natural and rural environments, reduces private vehicle transportation, promotes public transportation, promotes walking and cycling, improves accessibility to community facilities, and increases urban vitality (Burton, 2002).

Some opponents, however, accused compact city of suppressing human freedom and lifestyle and creating problems, such as traffic congestion and air pollution. Newman and Kenworthy (1999) stated that most of the scholars agree that fuel consumption for traveling is reduced because of the proximity of various land-use types in a compact city.

The concept of compact city is related to the shape and pattern of urban features, such as spatial distribution, land use categories, and spatial pattern of road networks (Burton et al. 2003). This type of urban pattern has several advantages:

- Less car dependency, thus lower emissions,
- Reduced energy consumption,
- Better public transport services,
- Increased walking and cycling habits, thus healthy community,
- Increased overall accessibility,
- Reuse of infrastructure and previously developed land,
- Regeneration of existing urban areas and urban vitality,
- Higher quality of life,
- Preservation of green spaces,
- Creation of a proper environment for enhanced business activities, and so on.

Unlike sprawl development, the spatial containment strategies of a compact city have been viewed as a potential solution to the undesirable social and environmental effects, particularly when compact city is integrated with a suitable planning process (Neumann, 2005).

3.3.1 Objectives and benefits of compact city

The objective of urban compaction is to advance built area and housing population densities, intensifying urban economic, social and cultural activities, and manipulating urban size, form and structure and settlement systems. This promotes the search for the environmental, social and global benefits, derived from concentration of urban functions (UN-Habitat, 2012). In both the developed and the developing world, the benefits of a compact city have been proven to be:

- Greater efficiency in the use of land and so a positive impact on a city's spatial and ecological footprint, which also means
- Reduction in reliance on cars,
- Lower impacts of urban growth on rural and agricultural lands, and
- Lower non-renewable resource consumption per household.
- Higher population and economic thresholds, which also means
- Increased accessibility to services and amenities as higher economic thresholds are achieved within any given area,
- Viable and effective public transport provision based on sustainable population thresholds to support the service,
- Harnessing of agglomeration advantages (for example, shops benefiting from the customers generated by each other),
- Reduction of time and cost spent travelling due to shortened distances to destinations,
- Increased social inclusiveness and reduction in social segregation through designing quality mixed-use areas.

3.3.2 The characteristics of a compact city

Urban compaction is about density, diversity, design, destination and distance to transit – the so-called 5Ds (UN-Habitat, 2012).

- Increased densities appropriate to context,
- A fine grain of mixed uses (diversity) – in other words, the promotion of the work-home-services relationship, which includes varying housing typology options, economic opportunities, multi- functional green spaces and social facilities,

- Interconnected streets and transport corridors with a focus on pedestrian, bicycle and public transport orientated design – i.e. “a walkable city”,
- Concentrations of populations and/ or employment – creating destinations with high levels of accessibility to services to reap the benefits of urban agglomerations,
- Access and reduced distances (walkable) to public transport options, green systems and other public facilities.

3.3.3 Factors that affect compact city

Among ambiguous influencing factors that affect the merit of the compact city notion when applied to the context of developed and developing worlds, three of them are discussed here. (UN-Habitat, 2012):

- Cultural factors influence the level of socially acceptable space consumption, which varies widely across the globe. For example, the perception of compact living in Hong Kong (as an extreme) or Barcelona is vastly different to those people living in the sprawling suburbs of Johannesburg.
- The way in which households use land also varies significantly.
- The cost of infrastructure provisioning might well decrease with increased density in the developed world, but it might not be the case in a developing country with limited capacity. The existence of infrastructure capacity is crucial in delivering cost-effective development.

3.4 THE DENSITY CONCEPT

The word density, a term that applies to different disciplines often leads to confusion, as it needs definition in our particular case. In this text, Density specifically refers to the phenomena of urban space.

Arguments still exist about universally accepted definition for density, yet there is unresolved concepts of perception on the subject and lack of universal means of measurement. Hence, it has numerous definitions and measurement methods. One may define density as number people living in an area, the size of buildings on a given site (floor area ratio/ FAR) or number of houses in an area (housing unit density).

Beside lack of universal means of measurement, vague definitions that lead to confusion are commonly used. For instance, High density is often confused with high-rise buildings. The rating like "High, medium and low" degrees of density significantly vary based on the technique of measurement (FAR, Housing unit) and in the level of measurement (150HU/ha may be "high" in one context yet it could be "medium" or "low" in another).

A concern of values is often implied while the concept density is raised. As the term “High density” is referred for instance, one may picture efficient land use, diverse communities, and active street life, yet some others might see slums, crime and poverty. The term “Low density” in similar sense, may give image of home ownership, pastoral landscapes, and families for some, and sprawl, isolation and weak homogeneity to others.

These values are outcomes of perceptions of places existing in reality. None of them however, are inherently related to actual density measurements, since it is difficult to omit these existing perceptions. In contrary to what some people think, it is possible to achieve home ownership and families in "high density” areas, and efficient land use and diverse communities in "low density” developments. This tells us the significance to separate values and qualitative ideas about density from quantitative measurements of density (http://densityatlas.org//).

3.4.1 UNDERSTANDING THE MEANING AND SCOPE OF DENSITY

What is residential density? Operational Definitions

Structure plan of Addis Ababa (2017) defines housing density as the number of residential housing units in a designated land area.

Density in this thesis refers to housing density/ residential density and primarily defined as number of dwelling units (numbers of houses or flats) per hectare (DU/ha) (Towers, 2000). Moreover, for clear and easier understanding of the concept, the classification by Cheng is used for elaboration.

Cheng(2005), attempted to untangle the intricate concepts of density according to two perspectives – namely, physical density and perceived density. A thorough comprehension of these two distinct concepts of density will serve as a basis for understanding the meaning and concept of density (Cheng, 2005). Though, the primary area of focus for this review is physical density, it is also important to have the highlights what perceived density also infers.

3.4.2 Physical density

Physical density numerically measures focusing on individuals or physical structures within given geographical unit (Cheng, 2005). It is an objective, quantitative and neutral spatial indicator. In practice, however, physical density takes on a real meaning only if it is applied to a specified scale of reference. The primary type of physical density selected here is residential density.

3.4.3 Types of Residential Density

The meaning of density cannot be wrapped up with a single statement; there are some important entities that help us understand housing density in-depth. They can be considered either as types of density or modes of measurement. Some of them are listed below.

3.4.4 Gross Residential Density

Gross density means the density of a given area, including infrastructures such as public roads, public open space and in some instances non-residential development such as schools and shops. The measure of gross residential density considers the residential area in its integrity (Towers, 2000). In addition to the area allocated for residence, it also takes into account nonresidential spaces such as internal roads, parks, schools, community centers and so on which are meant to serve the local community. Nevertheless, in practice, it is difficult to clearly define the extent of these residentially related areas. Some developments may take into account lands for purposes of serving a wider neighborhood and others may include no developable land such as steep slopes. This inconsistency of inclusion leads to great ambiguity in gross density measurement and, in turn, makes comparison difficult(Cheng, 2009).

3.4.5 Net residential density

Refers to the number of dwellings per hectare on land devoted solely to residential development(Towers, 2000).

Includes: Access roads within the site, Private garden space, Car parking areas, Incidental open space and landscaping, and Children's play areas where these are to be provided.

Excludes: Major and local distributor roads, Primary schools, churches, local shopping, Open spaces serving a wider area and Significant landscape buffer strips**.** (Fhoilsiú and Oifig, 1999)

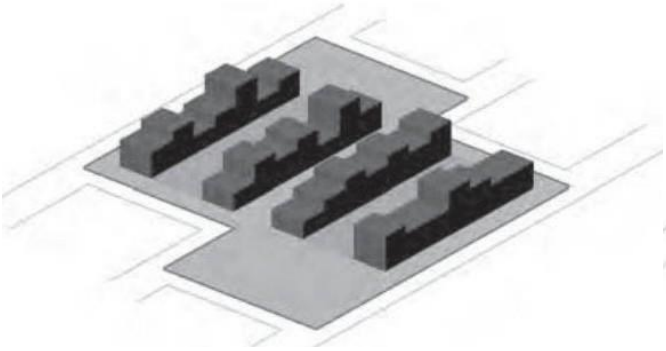


Figure 2: Gross residential density

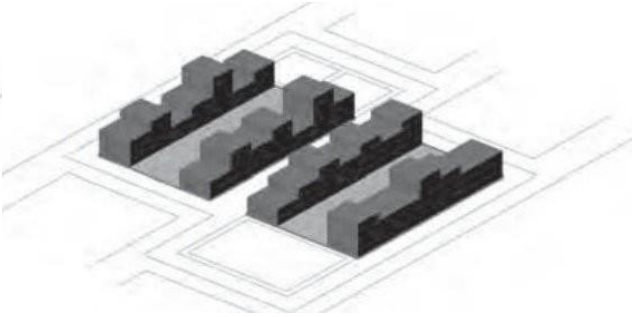


Figure 3: Net residential density

Source: Illustration redrawn by Vicky Cheng, adapted from Greater London Authority (2003, p11)

As compared to gross density, net density is accurately defined method of measurement that promotes ease of comparison between developments.

While gross density is more variable and is less accurate in comparisons in large-scale assessment such as urban areas or entire cities. (Towers, 2000)

- **Household density** – the total number of households per hectare (HH/ha).

Household – all the people a housing unit serves as their usual place of residence.

3.4.6 MEASURING DENSITY

Density measurement is a complex matter that makes a comparison of various developments difficult. The main concern while measuring density is that the volume and extent of the development to be assessed.

The three most commonly used types of measurement include

1) Housing units per hectare,
2) Population per hectare and
3) Floor area ratio (FAR).

Density greatly varies depending on the base land area used in the density calculation (parcel, block, neighborhood, sub-city and city level). Although these are common measurement methods in density calculation, without respect to the other measures,

they are often used solely. In order to get an accurate depiction, however, it is of great importance to incorporate all the three. (http://densityatlas.org/measuring/).

For the purpose of density depiction from different perspectives, these three commonly used measurements are important. This variety enables these

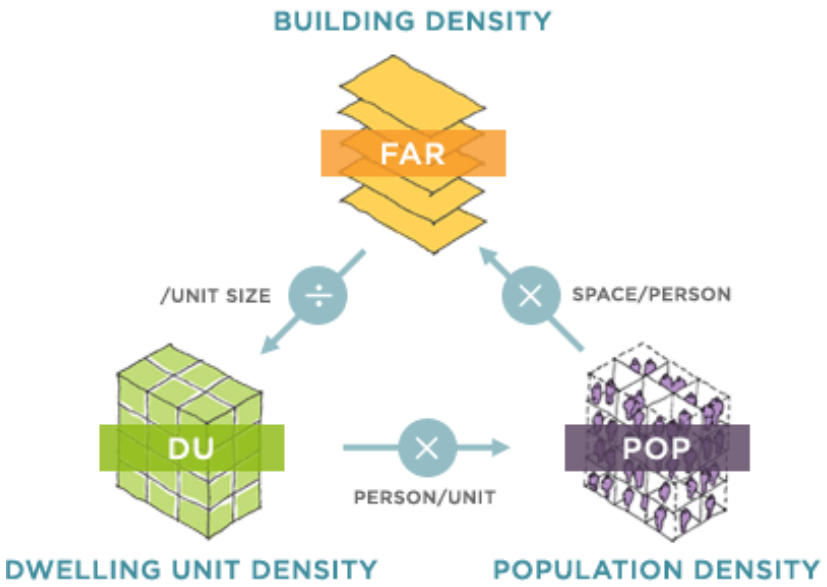


Figure 4:*The three common measures of density source:*http://densityatlas.org/measuring/

measurements to be used solely on their respective aspects and is crucial to plan a particular set of needs. FAR is the primary concern of urban planners as housing unit is for realtors. Similarly, government agencies care most about population numbers, which are linked to city services and infrastructure needs.

According to UN-habitat, Urban density is explained as the number of people in a given area or space. Measuring urban density consists of three components: Population, occupancy and residential density, which are interrelated and mutually dependent. Though it has similarities with the aforementioned three, it switches FAR with 'occupancy density', which measures People/dwelling unit, or m^2 per person. (*UN-Habitat*, 2012)

3.4.7 TOOLS FOR MEASURING DENSITY

In order to apply the aforementioned methods of density measurement, some tools are inherently important. Note that, the tools listed below are selected to meet the preferred measurement outcome of density in this thesis, and it does not imply these are the only tools.

3.4.8 Floor Area Ratio (FAR)

Floor Area Ratio (FAR) is the ratio of total gross floor area of a development to its site area. The gross floor area usually takes into account the entire area within the perimeter of the *exterior walls of the building*, which includes *the thickness of internal* and *external walls*, *stairs, service ducts, lift shafts, all circulation spaces,* and so on. Site area refers to the *total lot area* of the development.(Cheng, 2007). It is a measure used by planners, regulators, and developers to discern the intensity of a development. By itself, however, it is not adequate to define density. FAR conveys a sense of the bulk or mass of a structure, and is useful in measuring non-residential and mixed-use density. In planning practice, plot ratio is extensively adopted as a standard indicator for the regulation of land-use zoning and development control. Different plot ratios for different types of land uses are often specified in urban master plans as a provision of mixed land use. Furthermore, maximum plot ratio is often controlled in the master plan in order to govern the extent of build-up and to prevent overdevelopment (*ibid*).

In building design, plot ratio is widely used in design briefing and development budgeting as it reflects the amount of floor area to be built and, hence, can be used to estimate the quantity of resources required for construction; consequently, it can forecast the financial balance of investment and returns.

3.4.9 Coverage

Coverage is the relationship between the ground floor area of enclosed buildings and the site area(http://densityatlas.org/measuring/metrics.shtml). Development scenarios with similar FAR but different coverage will yield varying types of development: for example, low-rise or high-rise. The examples below are a typical case of varying perceptions of density for two different areas with similar FAR.

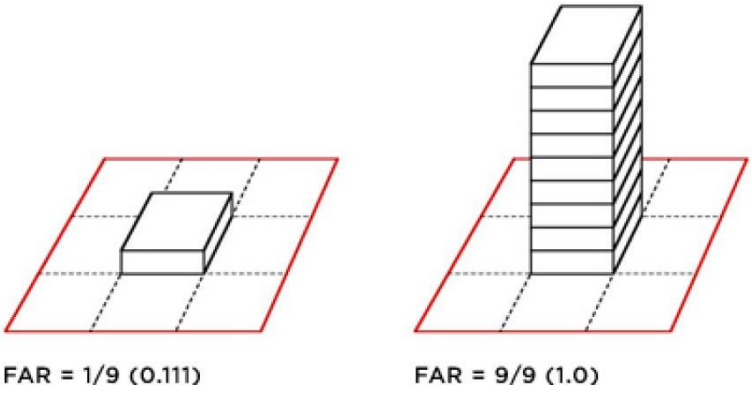


Figure 5: *Floor Area Ratio (FAR) source:*http://densityatlas.org/measuring/

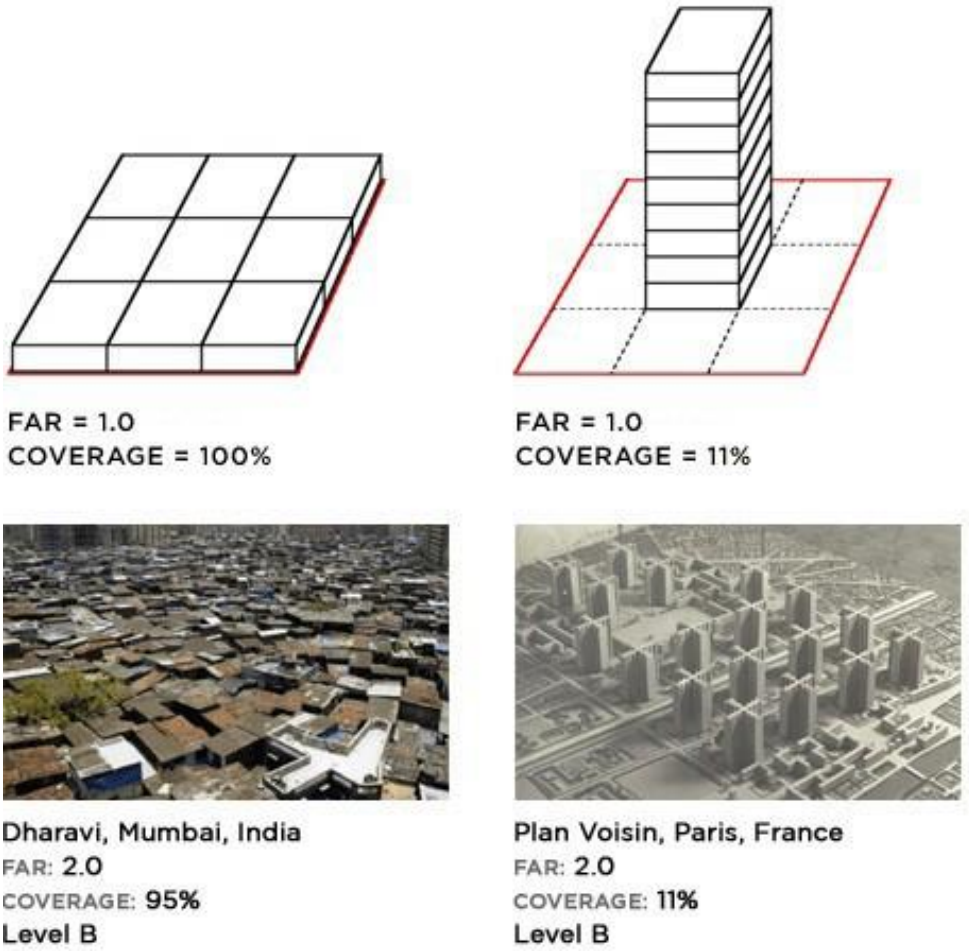


Figure 6 *:Coverage source:*http://densityatlas.org/measuring/

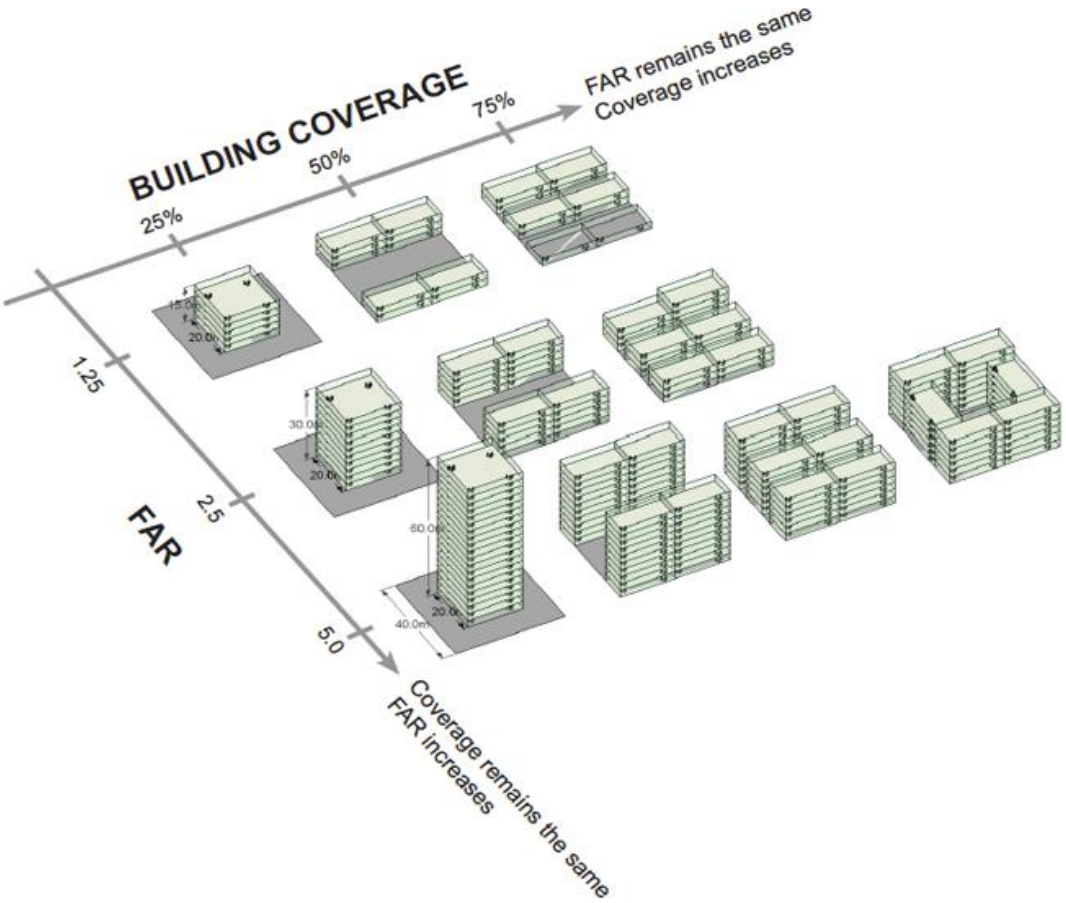


Fig. 7 *Relationship of FAR and Coverage source:*http://densityatlas.org/measuring/

3.4.10 Built Up to Area Ratio (BAR) - The total area of building footprint per site area.

3.4.11 DENSITY CALCULATION

The importance of scale

Understanding the three commonly used density measurement tools is crucial in actual measurement of spaces. For this thesis the selected units of measures for the above tools are housing unit per hectare (HU/ha), population per hectare, and Floor Area Ratio (FAR). To make comparisons easier and proper it is preferable to categorize developments based on their scale.

Scale, as the term density, has numerous meanings but for this thesis, it refers to the extent of land being measured. While classifying scales as block/ parcels and neighborhood, comparisons become difficult because of two reasons. First, there is no universally accepted definitions for these terms and Second developments reflect their geographical context, which means these entities vary from location to location or country to country. In this thesis however, to enable appropriate comparisons only two focus scales are employed (http://densityatlas.org/measuring/). [**A**] **Block and** [**B**] **Neighborhood.**

A. Block or development parcel

This level includes single block or few smaller blocks, which are primarily residential with few or no supporting services within its boundary. It is important to note that the as compared to level B, FAR is typically higher in level A. this is because of the existence of less non-residential space required for smaller sites.

B. Neighborhood

This level comprises a cluster of walkable blocks having local services. Most new developments in the developing countries are of this size. This clusters being mostly self-contained, consist some neighborhood services and open spaces.

Though not used in this thesis, another sort of large scale such as District, City or Region can be incorporated. At this scale, there is a dramatic increment in the elements that affect density, rendering macro level density measurement less meaningful. FAR is inapplicable at this level, as there is a massive scale difference across areas.

This defined scale is essential in comparisons of developments because the larger the land mass, the more non-residential space will exist in a given area - retail, parks, services, etc., this automatically lowers the housing units, population and FAR, and total density of an area. Density will usually be "higher" at the "block" scale, so it is important to make comparisons within their assigned scales.

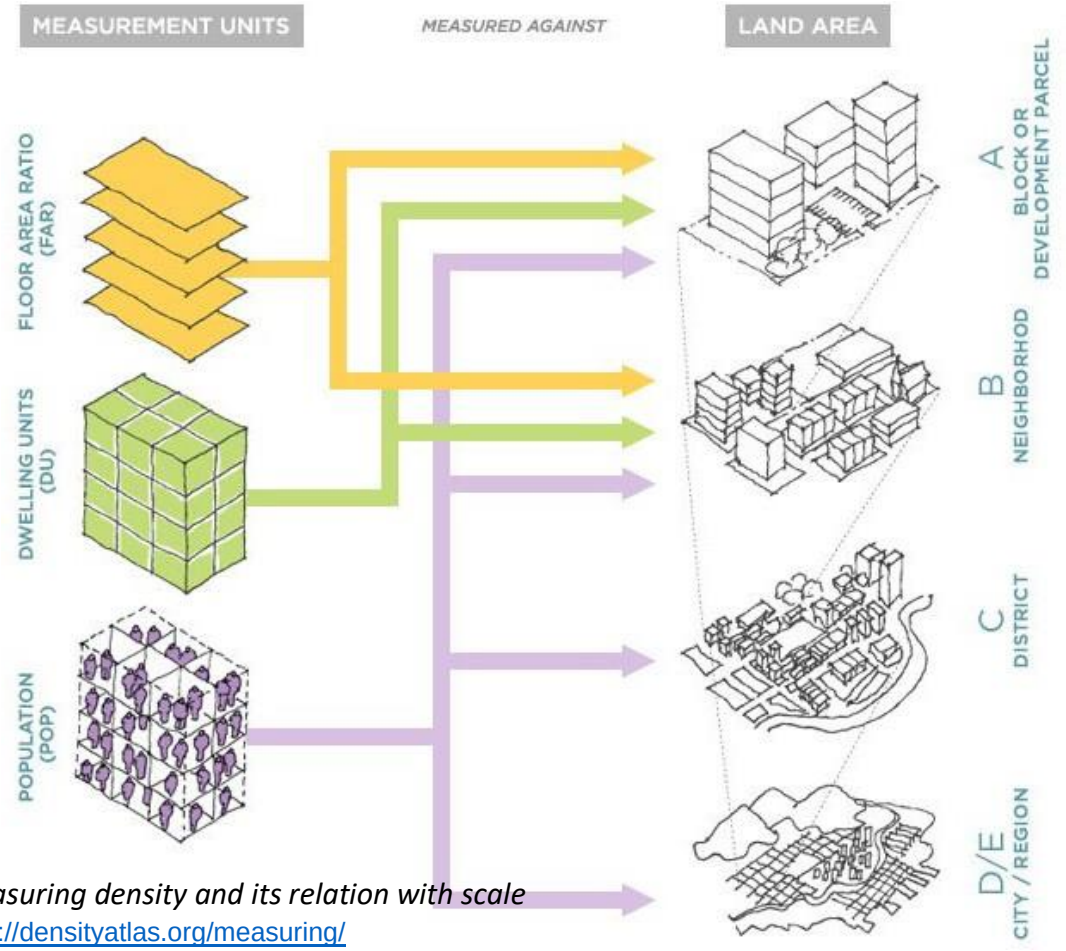


Fig. 8 *Measuring density and its relation with scale*
Source: http://densityatlas.org/measuring/

3.4.12 Local and international standards

Within the context of developing country cities, the following residential density ranges are proposed.

Table-3: UN-Habitat standards for housing density

Range	Residential density: dwelling units / ha (net)
Low	< 15
Low to medium	15 – 40
Medium	40 – 120
High	120 – 500
Very high	> 500

Source: UN Habitat: urban patterns for green economy_ Leveraging density, 2012

Table-4: Ethiopian standards for Gross housing density

Type of density	Min HU/Ha (Gross)	Max HU/Ha (Gross)
Low density mixed	50	
Medium density mixed	100	
High density mixed	150	

Source: structural plan of Addis Ababa, 2017

3.4.13 Spatial location criteria - density guidelines

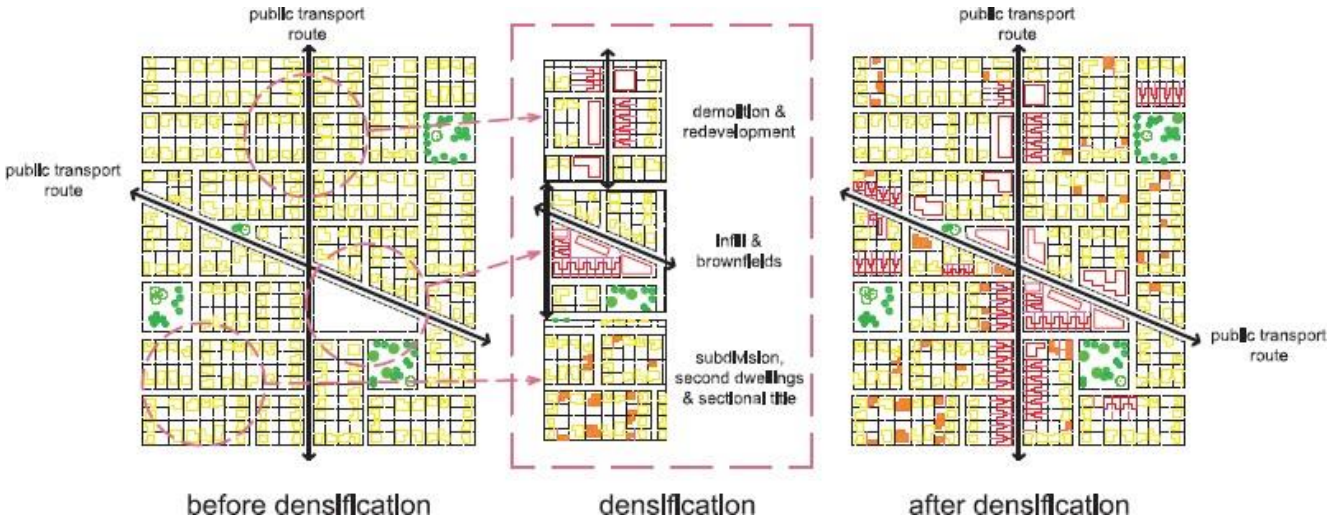


Fig. 9 Methods of densification

Source: MCA Urban and Environmental Planners. (2007). Settlement Restructuring: An explanatory manual in terms of the Western Cape Provincial Spatial Development Framework

Table-5: Spatial location criteria - density guidelines

Adapted from City of Cape Town. (2009) Cape Town Densification Strategy: Technical Report

Areas to be targeted	Specific locations	Density guidelines
Development / activity corridor	Particular points, namely: • Points of direct access • Transport intersections / interchanges • Places of intense mixed use development	High density e.g. 120 - 375 du/ha (net)
Activity route	At all points along the route, especially: • Public transport stops/stations • Route intersections • Mixed use areas • Commercial nodes	Medium to high density e.g. 100 - 375 du/ha (net)
Activity street	At all points along the route, especially: • Public transport stops/stations • Route intersections • Mixed use areas • Commercial nodes	Medium density e.g. 100 - 375 du/ha (net)
Urban core (major economic opportunity area)	Generally within and abutting the defined higher order node or central business district	High density e.g. 120 - 375 du/ha (net)
District and local nodes	Generally within and abutting the defined higher order node	Medium to high density e.g. 50 - 250 du/ha (net)
Metropolitan, district and local parks	Generally abutting parks, especially large and/or multifunctional parks	Medium to high density e.g. 50 - 250 du/ha (net)
Specific residential areas	Within areas of focused public sector investment, e.g. subsidized housing areas	Medium density e.g. 40 - 120 du/ha (net)
All single residential areas		Strive to increase existing average density through methods discussed in this section.

3.4.14 Density and Urban form

Density is a quantitative phenomenon of urban form. In our particular case, housing density is depicted in various building forms. Analysis conducted by a+t research group on nine different traditional urban forms gives a clear picture about density when it comes surface. All of them are however, theoretical examples which summarize the range of possibilities of stacking floor areas on a plot(Fernández P.,Javier s., 2003). HEI stands for height index, I.e. FAR/COV.

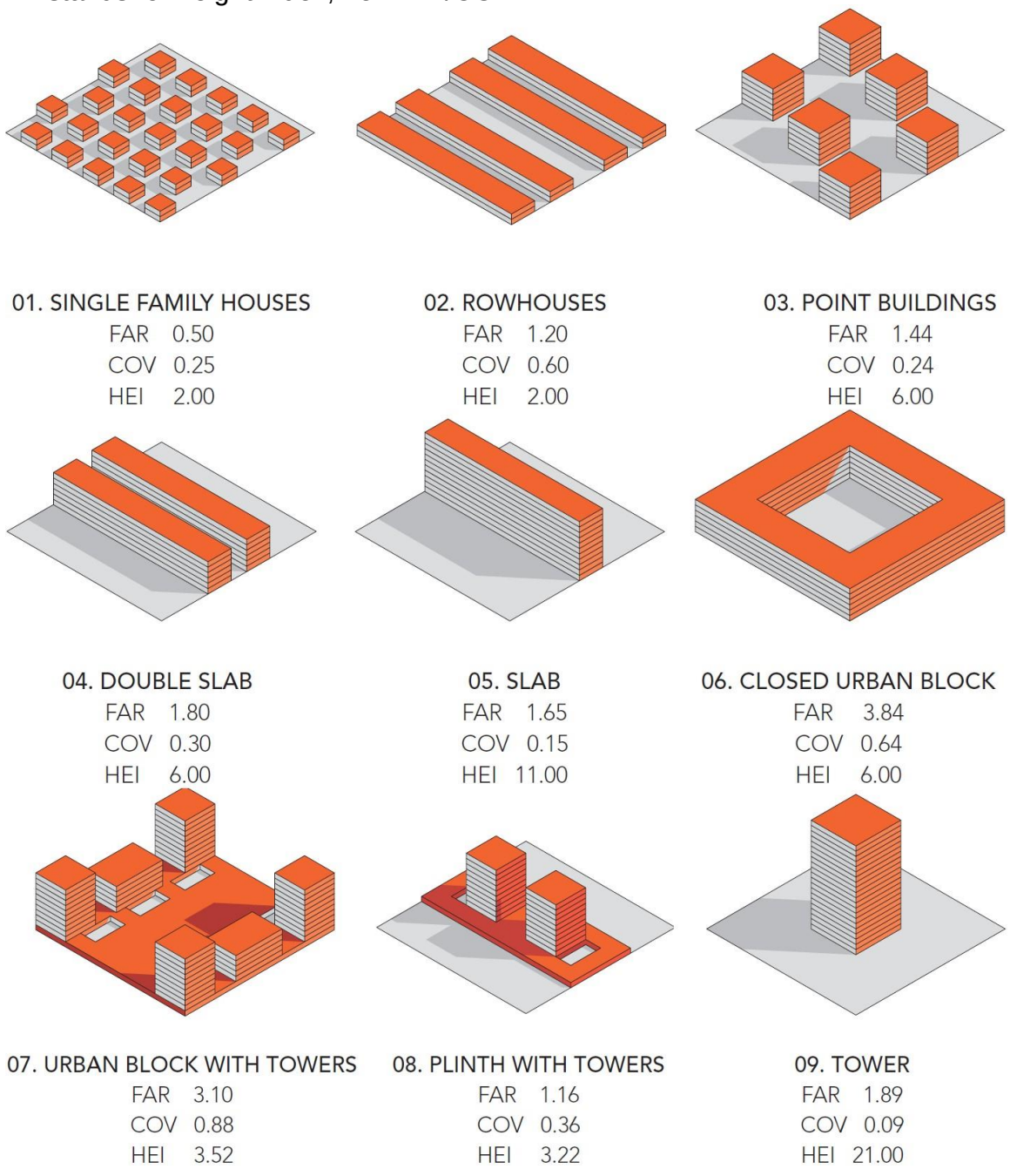


Figure 10: *Density of traditional building forms* Source: a+t research group

Table-6: Advantages and Disadvantages of density

	Increased densities	Lower densities
Advantages	• Decreased land consumption per capita • Reduced land acquisition costs by reducing land area requirements • Reduced development costs due to reduced servicing costs • Decreased infrastructure and servicing demands • Promotes non-motorized transport • More viable public infrastructure • Promotes efficient public transport • Encourages efficient natural resource consumption • Encourage efficient energy consumption • Reduce carbon emissions due to decreased travel distances • Protect agricultural land from infringement • Protect ecosystems from infringement • Protect biodiversity from infringement • Increased access to amenities • More public open space due to reduced area required for top structures	• Increased privacy • More public open space • Reduced land acquisition costs due to cheaper land on the periphery • More affordable for residents • due to decreased land costs • Greater appeal for residents • Reduces overcrowding
Disadvantages	• Traffic congestion due to increased traffic in a reduced total area • Reduced privacy due to proximity • Increased overcrowding due to proximity • Escalating crime rates due to intensification • Fewer public open spaces due to competition for land • Increased construction costs for top structures • Opposition by residents • Polluted ecosystems due to intensification • Inflated property prices due to increased • development costs and exclusivity • Increased number of cars parked on the street	• Traffic congestion due to increased need for private vehicles • Increased commuting times due to increased distances • Increased commuting costs due to increased distances • Increased land consumption per capita • Increased land acquisition costs due to increased land area requirements • Increased infrastructure and servicing demands • Increased development costs • Inflated property prices • Public transport inefficiency

Source: Towards more compact South African settlements through informal housing: (Lategan and Cilliers,2011)

Open Space and Housing density

3.5 Introduction

The schemes for density manipulation may vary as per the objective of a study to be conducted. One of the methods is studying density by using figure-ground relationship. This method is operated by considering the building layout as figure and open spaces as ground. Here, beyond the need to study the quantitative aspect of these two spatial entities, there rises an interest to identify the qualitative interrelation between them. This interest being the one of the primary objectives of this thesis is to explore the implication of the built environment on the outdoor natural space. I.e. The impact of housing density on open space utilization. Moreover, this section focuses on the need to perceive density as a holistic approach of achieving natural habitat along with the concrete structure. This section aims to give picture on open space within the mass dwelling compound and its fundamental connection with housing density.

3.6 Definition of open spaces in residential complex

According to Mohamedzadeh (2012), open Space area has been defined as a place without residences, personal ownership, that is managed by the joint management of the units (Mohamedzadeh, 2012). It is also defined as any Land with the minimum of building structure which has been reserved for either passive or active recreation and provides major or minor recreational facilities, which may be of local or district significance, which is for the use and enjoyment of the general public (Chaparro & Daurelio, 2014).

Open space in residential complex includes side spaces in the open fields, pathways for pedestrians and vehicles, green space, communal spaces, parking, landscapes, furniture, and directional boards (Sun & Nashmira, 2005).

3.6.1 What types of spaces are included?

The emphasis of the above definition is on both the surrounded and not surrounded areas and describes open space without building form. Therefore, the primary purpose of open space in a residential complex is creating an adjustment between the construction and human density, providing appropriate means of the necessary framework which allows some activities (Mohamedzadeh, 2012).

Open spaces are designed to meet the needs of the residents, activities, and human communication, where its elements include access to routes for pedestrians and

vehicles, green space, children's playgrounds, places for sitting and rest temporarily (*ibid*).

3.6.2 TYPES OF OPEN SPACES

Based on the scale, functions served, restriction and provision of access open spaces are classified in to Public space, Semi-Public space, Private space and Semi private space (Chaparro & Daurelio, 2014).

PUBLIC SPACE

Can be defined as an area where everyone can enter without pre-requisite, such as an entry fee. Typical examples include public squares, parks, streets, public libraries, street markets, and country parks, etc(*ibid*)..

SEMI-PUBLIC SPACE

Refers to places that appear to be Public spaces but they are in fact privatized spaces. Despite a Iot of social interactions and even public life are going on in these pseudo-public space, they are not truly public spaces as they do not always fulfil one fundamental spirit of public space, that the entry be free for everyone(*ibid*)..

PRIVATE SPACE

It is defined as a space which is owned by particular groups or individuals but not the community, and is meant for private use. The entry of certain people can theoretically be restricted by their owners.

SEMI - PRIVATE SPACE

It is defined as a space that is access controlled and accessible to residents and associated people only. These spaces are not really private since they' re shared, but because they're usually inaccessible to outsiders, they're not really public either (*ibid*).

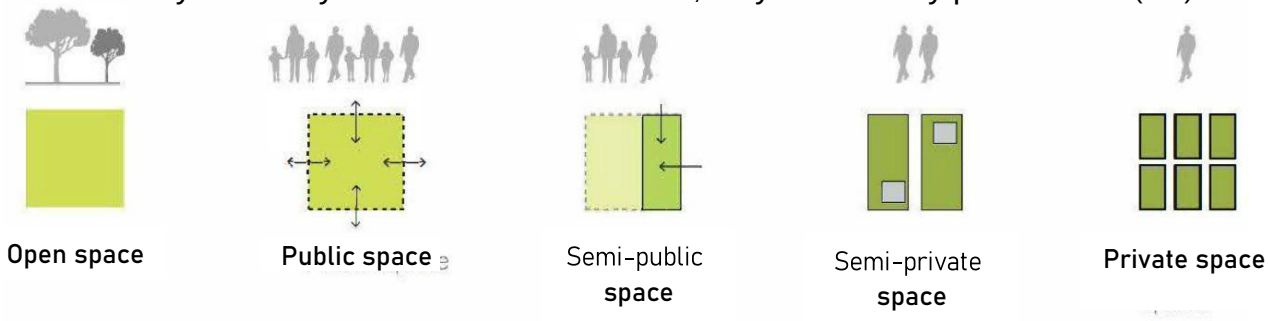


Figure 11: *Types of open Spaces* Source: Chaparro & Daurelio, 2014adaptable Morphodynamics

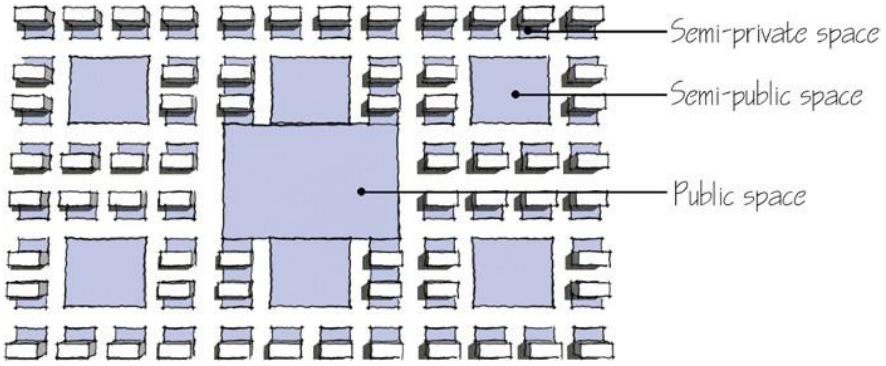


Figure 12: *Types of open space.*

3.6.3 Constituent elements of place in neighborhood Open Spaces

So far, according to studies conducted on open spaces by various theorists and authors, open spaces have their own features from which they are constituted.

3.6.4 Physical setting

Researchers and designers have often been interested on open spaces and their physical attributes (Bonaiuto et al., 1999, 2006; Abu Ghazzeh, 1999). Table 5 constructed below, based on Norberg-Schulz's model, represents the physical setting in neighborhood open spaces. Consequently, four elements of physical setting are determined as: building architecture (BA) including aesthetic aspect, density and volume of buildings; extent of open space (EOS) including shape, form and arrangement of buildings; connection (C) including internal and external, and; green area (GA) including type of plants used.

3.6.5 Activities

Among number of factors that influence outdoor activities in residential areas, physical environment influences the activities to varying degrees and in different ways (Abu Ghazzeh, 1999). According to Gehl, outdoor activities in public spaces, can be divided into three categories of necessary activities, optional activities, and social activities each of which exerting different demand on the physical environment (Gehl, 1980).

- ✓ **Necessary activities** refer to functional application,
- ✓ **Optional activities** refer to recreational interaction and
- ✓ **Social activities** refer to environmental interaction which has no determined specific space and is current in daily life of neighborhood; it is considered as a kind of passive contact in human environment life.

Table-7: Architectural Elements of open spaces in neighborhood

Elements / Approaches	Open Space				
	Building Architecture	Extent of open spaces	Connections		Green Area
			Internal	External	
Morphology	-Building Density (Perceptual and quantitative) (Einifar,2000) - Building shape and volume - Building Height - Housing Layout(Abu-Ghazzeh,1999)	- Shape of open spaces -Extent of open spaces -Balance of Building and open spaces -Legibility of edges(Lynch,1981) -Confined spaces(Lynch,1981)	-Path defining elements -Pedestrian way -Street way	-open space position in town -Town position in city -Street Way -Pedestrian Way	-Type of plants used -Color and height of plans -Type of tress
Topology	-Building Geometry -Building Confining	-Open space's position in town	-Street's position in open space -Street's position with building		-Indicator Residential Plants
Typology	- symbol of residential blocks -Building Aesthetic	-Environmental silence -Open space Up-keep and care -Open space's security	-Street's up-keep -pedestrian and street distinctiveness -Silence		-Security in Green Area -Green symbol of residential area

Morphology: deals with the way of arrangement and inside and outside oneness,

Topology: deals with spatial arrangement through designer's emphasis on order and environmental features. It also deals with adjacency, approach routes, centralism, etc.

Typology: deals with conceptual and meaningful part of space and refers to residence or existence originating from the nature of human beings.

Table-8: Activities in open spaces Source: Gehl, J(1980). Life between buildings

Activity		Open space	
Necessary		-School services –Commercial services -Health care services	
Optional		-Sport services -Cultural services -Religious services	
Social	Personal motivation	-Social security and culture – social interaction	-Public meeting places -Assembling places
	Social similarity	-Social identity -Social Attachment	
	Time	-Length of residence	

3.7. Sense of place attachment, what is it?

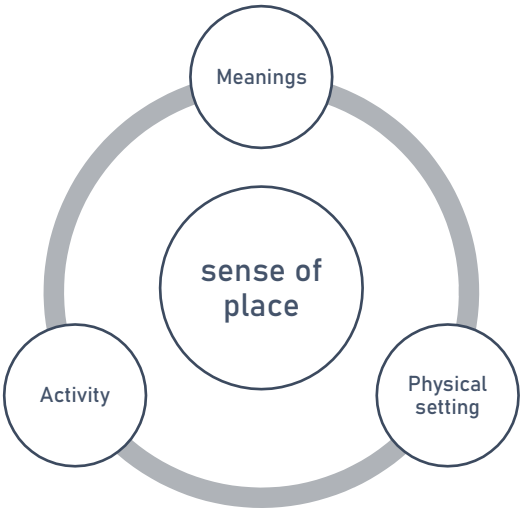


Figure 13: Diagram of sense of place proposed by Punter and Montgomery

Reference: Carmona,2006:99

The sense of place is a mixture of conscious and unconscious emotions and perceptions. It is a rich concept that reveals the individuals' method of perception, experience and expression and imparts meaning to a location (Kashi & Bonyadi, 2013). A physical space does not cause a sense of place per se, but this sensation is created through interaction between the individual and the place, and among the individuals (Pretty et al., 2003). In the Gustafson's model of the meaning of location (2001), the individual, environment, and others are the main pillars of imparting meaning to space. The environment and its physical features as a third aspect of the model of meaning of location, plays the intermediary role in constructing a meaning for the sense of attachment (Forozandeh & Matlabi, 2011). The factors which form the sense of place attachment are personal cognitive factors, social factors, and environmental- physical factors. The sense of attachment is one of the criteria to assess high-quality environments; and in the architecture and environment design scope, physical characteristics such as form (color, size, shape, scale) and the relationship of physical components with provision and emphasis on the social environment activities, play an important and effective role in constructing the sense of attachment (Ibid).

Definitions

Several definitions and opinions have been given regarding the meaning of the sense of place. Norberg-Schultz argues that the sense of place is found in places that have a specified and distinctive character and this distinctive character draws from tangible things that are characterized by materials, shape, texture and color (Schultz, 1997). Lynch holds that the sense of place connects between the humans and the locations and brings about the unity (Lynch, 1981).

According to Shamai, the sense of place persuades the individual to participate in the location-related activities (Shamai, 1991). Punter divides the factors that generate a sense of place into three

- ✓ **General categories:** physical structure consisting of urban landscape, scenery, permeability, the shape of construction and urban furniture;
- ✓ **Activity** including usages, pedestrian traffic volume, motor vehicle traffic volume, patterns of behavior, artificial environment, and
- ✓ **Legibility;** conceptual including cultural relations, cognitive functions, and quality evaluation (Punter, 1991).

Sircus argues that the quality of the location, sustainability of the location, and reliability are the factors that shape the sense of place attachment (Sircus, 1002). With the growth and development of the world of communications and the progress of technology and welfare facilities and also upgrading the mankind's general thinking level, the intellectuals started to introduce new criteria for the sense of place attachment.

3.7.1 Open space utilization as sense of place attachment

The theories and disciplines concerning sense of place are numerous. While defining this concept in way that makes sense on the subject we are dealing, open space utilization fulfills the characteristics studied by popular theorists. As discussed earlier, the constituents of open space such as activities, physical setting and scale makes open space utilization under the category of sense of place attachment.

3.7.2 Characteristics of open space and open space utilization.

On cape town densification policy density has been defined as the increased use of space both horizontally and vertically, within existing areas/ properties and new

developments accompanied by an increased number of units and/or population thresholds. Two types of increments of space are discussed here vertical (Building height) and horizontal (Enclosure). The alteration of these attributes in one way or another defines the type of open space, having its own effect on the open space utilization of residents. The following section clearly describes this phenomenon.

3.7.3 Enclosure and open space utilization

One of the principles of organizing the urban spaces is enclosing the space. Tavasoli holds that enclosing the space is the first principle of designing urban places (Tavasoli, 1986). Observing the space hierarchy and taking note of the principles of organizing the space (and the enclosure issue in particular) are effective in creating and boosting the sense of place attachment (Matlabi, 2006).

Enclosure means enclosing the space in a physical or symbolic manner that affect the quality and quantity of the level of enclosure.

D.K. Ching believes that the four vertical planes that fully enclose a space, probably create the most common and certainly the most powerful kind of space definition in architecture (Ching, 2004). He holds that the space characteristics of the architecture depend on the characteristics of the space walls (Ibid).

Trancik, in his famous book Finding Lost Spaces, states that the mental image of the people and their reaction to the space is influenced by the amount of its enclosure (Trancik, 1986).

Zucker believes that the urban space is an organized, disciplined, and adorned structure and it is physically based on the human activities and distinct and clear rules such as: the relationship between the shape of the body of the surrounding buildings, similarity or diversity of their shapes, the absolute dimensions of these bodies relative to the width and length of the enclosed space, the passage angle of the streets that end at a square, and finally the position and location of historical monuments, pools, fountains or other 3D elements (Tavasoli & Bonyadi, 1993).

Tuan also holds that open space implies freedom and public realm while the enclosed space, suggests coziness, security and privacy of the location (Tuan, 1974).

Fritz Steel (1981), argues that the level of enclosure - besides the size of the location, contrast, proportion, human scale, distance, texture, color, smell, sound and visual variety- is the most important physical factor affecting sense of place attachment

(Steel, 1981). In the urban spaces, enclosure is one of the factors that lead to reinforcement of the sense of place attachment and the sense of place attachment in turn creates the identity of the location (Seamon & Jacob, 2008).

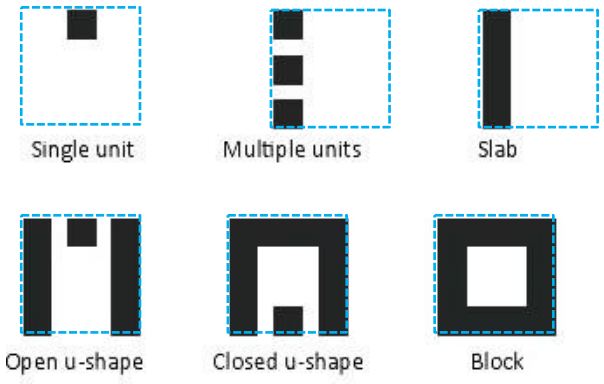
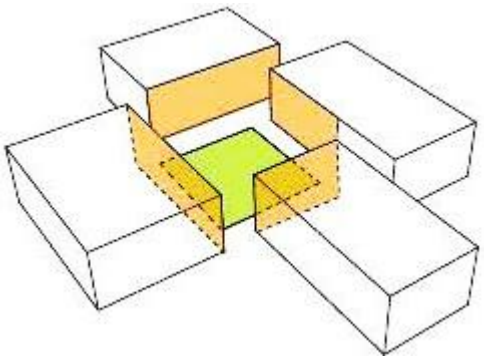


Figure 14: Enclosure and open space

The quality of the space enclosure is determined by seven interconnected factors: size, shape, consistency, height of the body, flooring, architectural characteristics of the surrounding buildings, and the statue (Hedman & Jaszewski, 2002). The quantity of space enclosure is essentially calculated according to the distance of the observer's eye from the height of the enclosing body (Seyedian & Yeganeh, 2012:48).

The residential complex is the outcome of accumulation of a number of apartments in the form of one or more urban blocks. Such complexes can replace the old neighborhoods, but what we face today is a formation called neighborhood unit based on Western definition wherein the sense of place attachment is less than the sense of place attachment in the traditional neighborhoods.



$$Enclosure\ value = \frac{Facing\ Surface\ Area}{Semi-public\ Space\ Area}$$

Figure 15: Enclosure value

Yi and Champaneri, in their book entitled Synchronicity defined Enclosure as the ratio of enclosing surfaces to the space enclosed. In simple terms, it is the ratio of surrounding surfaces to the semi-public or public space within. This parameter defines the

morphology of contextualized boundaries that is built around the open space. A higher enclosure value will mean a highly contained space disconnected front its neighborhood, while a lower value of enclosure will denote a well-connected or exposed space. This would imply that a higher value would indicate an intrinsic space and a lower value would indicate an extrinsic space. Different cultural settings would require different enclosure values for different kind of spaces.

3.7.4 Building height and open space utilization

Gehl (1996), in his book 'Life between buildings' explains how humans are attached to horizontal level living than the vertical ones.

> *Everywhere that people move about and are engaged in activities, they do so on horizontal planes. It is difficult to move upward or downward, difficult to converse upward or downward, and difficult to look up or down. (Gehl, 1996: 63)*

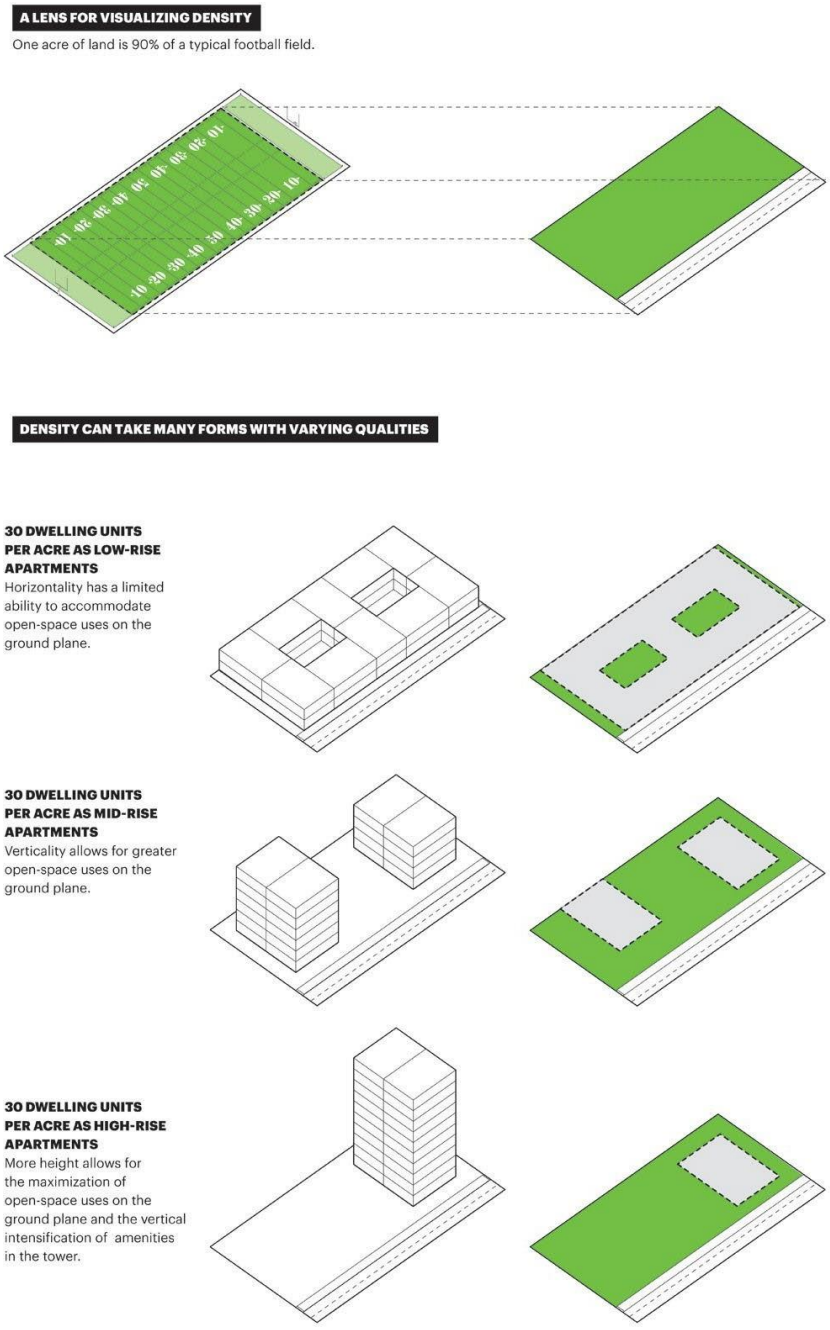


Figure 16: Density via Enclosure & building height in relation with open space source: A Country of Cities_ Building Hyper density and Civic Delight, 2015

CHAPTER - 4
CONTEXTUAL REVIEW

4.1 Introduction

Theories discussed on the section of literature review are contextually discussed and presented on this section. The objective of this chapter is to give picture of housing density and related concepts within the domain of the scope in Ethiopian context, Addis Ababa, particularly. The section then narrates the background of CMC apartment employing some numbers regarding the compound.

4.2 About Addis Ababa

Ethiopia has nine ethnolinguistically based regions, and two ethnically diverse, chartered cities, Addis Ababa the capital, and Dire Dawa. Addis Ababa, the capital of Ethiopia, is home to 25% of the urban population in the country (Urban Age, 2018). Being the diplomatic capital for the continent, it is one of the fastest growing cities in Africa. It is the growth engine for Ethiopia and major pillar in the country's vision to become a middle-income, carbon-neutral, and resilient economy by 2025. Addis Ababa is divided in to ten sub city governments which oversee 28 lower-level woredas, made up of a further 328 neighborhood units (kebeles)(*ibid*).

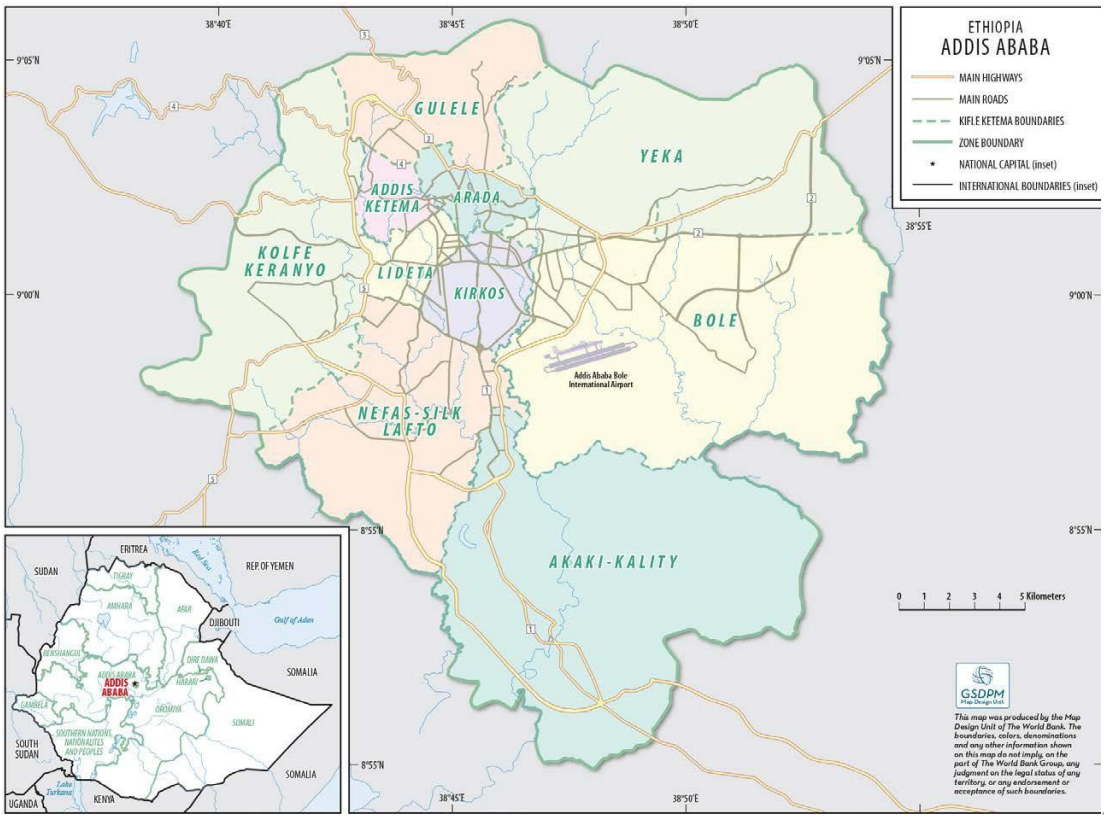


Figure 17: Addis Ababa, Administrative boundary source: (World bank, 2015)

4.3 Housing density in Ethiopia

According to World Bank the Ethiopian level of urbanization is reported to be 20%, which is less than sub-Saharan average which is 40%. This makes the discussion of urban density shallow. The densest city of the country has been growing in a sparse manner.

The Coptic Church of St. George and a marketplace (Arada) being the central core of the city, was dense, while the area between the old imperial palace and the new one, built in 1934 for Haile Selassie, was less densely built up. The architectural fabric of the city was featured very few masonry buildings. The traditional dwellings (tukuls) which are constructed using mixed building techniques and arranged separately in group marked the city's appearance. Most areas were also possessed numerous eucalyptus trees, which were planted at the end of the nineteenth century. The city's loose structure, including fields and zones of vegetation, had a rural quality (Hebel & Angélil, 2009)

This remained character of the city for long period of time. Housing density of the built up area of Addis Ababa in 2013 was estimated to be around 29 housing units per ha. Currently the densest city is estimated to have only 32 Hu/Ha which is below the lowest bench mark set by the structure plan. The table below shows the housing density towns and cities in Ethiopia.

Table 9: Population and Housing Density (Built-up Area) source: (Abaynew & Wubalem, 2017)

S. N	City	Built-up Area in (ha)	Population	Population density (number of inhabitants/ha)	Housing density Hu/ha
1	Dire Dawa	2,656	285,000	107	25
2	Hawassa	4,207	436,581	109	23
3	Mekelle	8,318	340,852	41	10
4	Jima	4,244	186,147	44	10
5	Dessie	3,711	233,971	64	14
6	Addis Ababa	26,600	3,433,999	130	32

Table 10. National standard of density for Mixed Residences Source: AA structure plan, 2017

Mixed Residence	Minimum Gross Density (housing units per hectare)	Location
High density mixed residence	150 Hu/ha	Centers, corridor, high density mixed residence zones and commercial areas.
Medium density mixed residence	100 Hu/ha	Mixed residence inside the inner ring road.
Low density mixed residence	50 Hu/ha	Mixed residence outside the inner ring road.

4.4 Characteristics of density in Addis Ababa

4.4.1 Enclosure and density

Single-story form of construction is common throughout Addis Ababa (Angélil & Hebel, 2009). The traditional neighborhood has been settling on horizontally built villages, and towns too (*ibid*). Studies on horizontal transformation in Addis Ababa show that Due to different reasons, increasing more attached or detached units is common in traditional neighborhoods (Alemayehu, 2017). The researches clearly depicted that this horizontal activity of adding more units to the original house as an act of densifying houses.

4.4.2 Height and Density

Upon studying a case study, Angélil & Hebel(2009) analyzed the notion of flexible parameters in the Piazza area, the central part of the capital city, investigating patterns of density. They observed that when the height and quantity of built substance increases with respect to the existing topography, new vertical spaces, such as elevated gardens, open areas, and social interaction points, are provided for functions unavailable at the ground level. A decrease in the number of inhabitants, however, corresponds to a decrease in the height and quantity of buildings. This, in turn, frees up more space on the ground level to accommodate public zones, green spaces, and lots for urban agriculture.

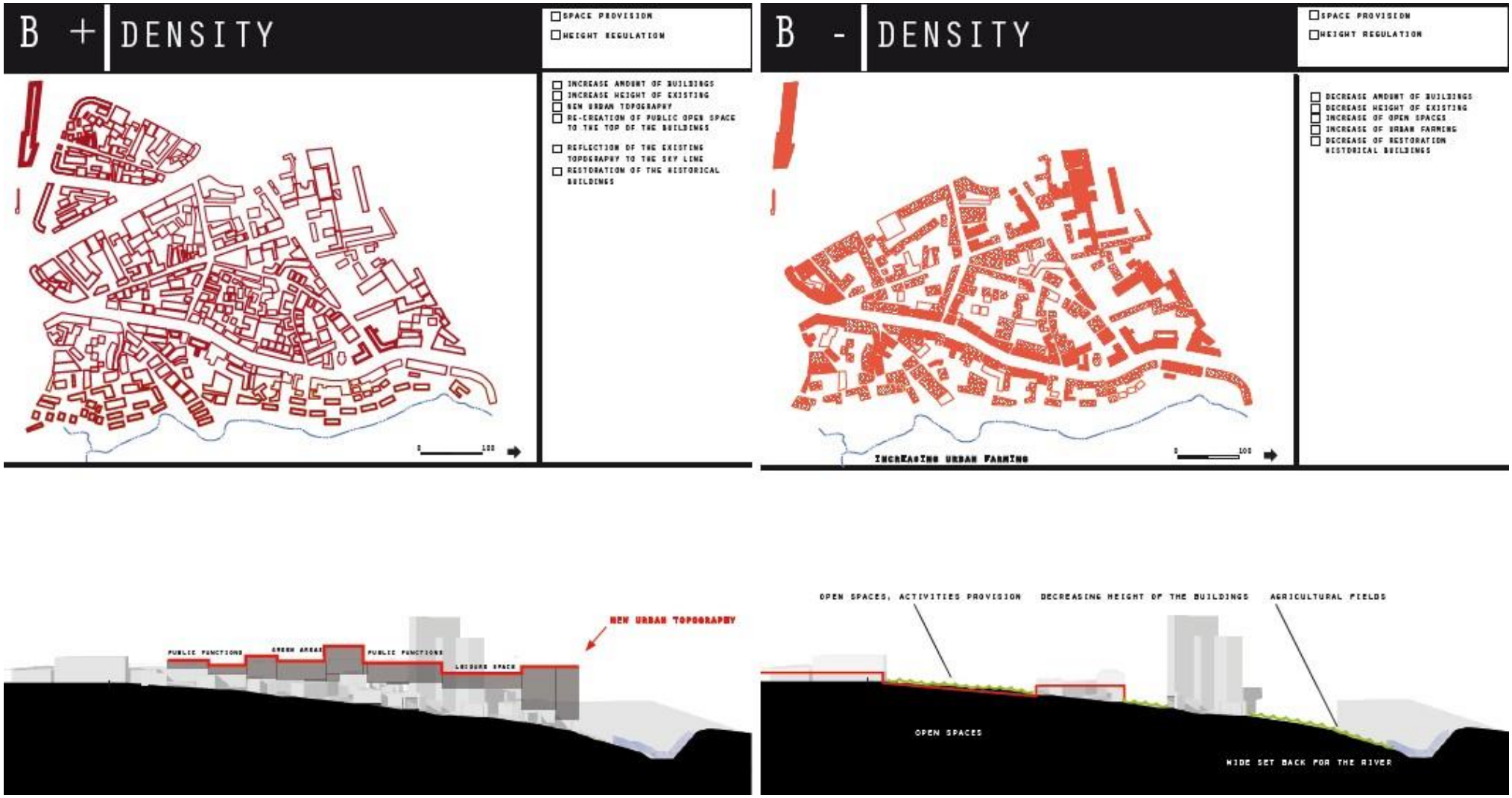
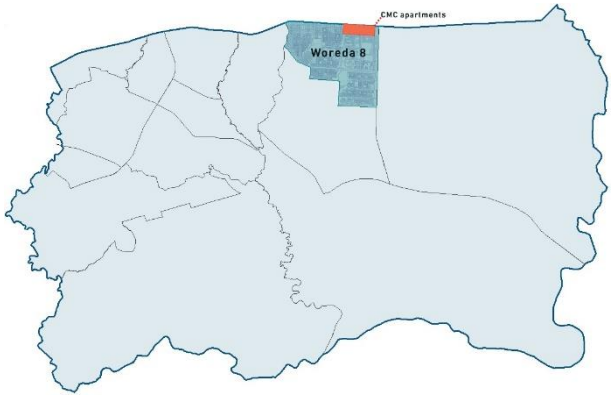


Figure 23: Building Height Vs Housing Density source: (Cities of change , 2009)

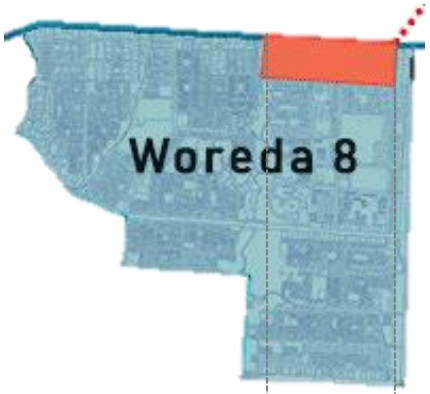
Location of Case, CMC Apartments

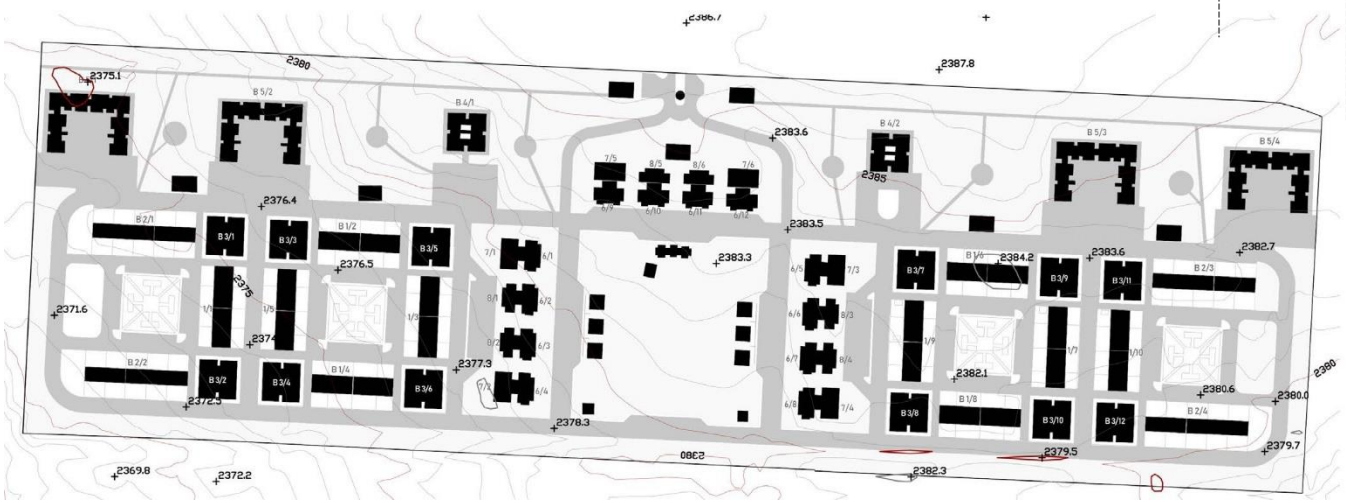
Addis Ababa

Bole Sub-City



Woreda 8





About bole Sub-City

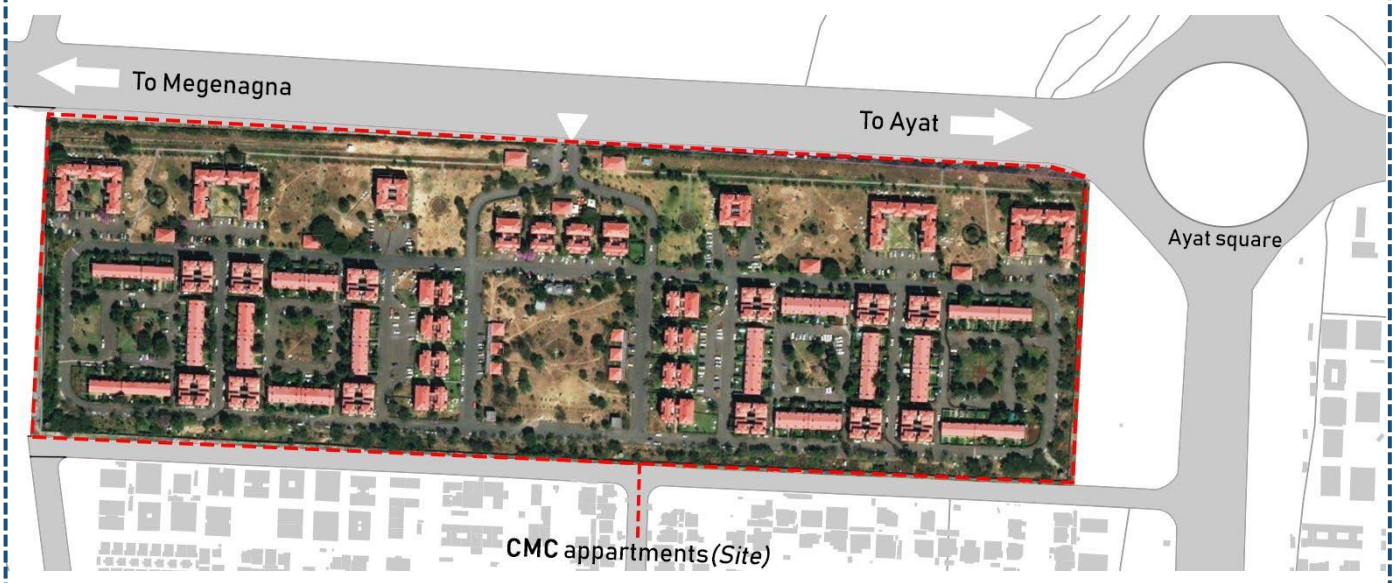
Of the ten Sub cities, Bole is situated in the eastern portion of the city, where the case CMC is found. Covering 308,715 ha, the sub city makes 23.4% of Area of Addis Ababa. Administratively, it is divided in to 14 Woredas containing 503 Neighborhoods.

Figure 19: Location, CMC compound source: Modified from Addis Ababa Masterplan

4.4.3 CMC compound, General info

Table 9: CMC compound basic info

Location	: Addis Ababa, Bole Sub-city, Woreda 8, CMC apartments
Area	: 20.35 Ha
Land Use	: Low density mixed residence
Owner	: Federal Housing Corporation
Construction	1992
Dwellings	: 502 rental-housing units
	: 7 types of building blocks
	: 14 Typologies
Population	: 1857.4 *(estimation: 3.7 person/HH)*



4.5 About CMC apartment (Cooperativa Muratori e Cementisti)

CMC apartment is one of the gated communities in Addis Ababa. Its original objective was never realized and it is now a state-owned gated community of the prestige type run by a state rental agency currently named as Federal Housing Corporation (FHC) (Yeraswork, 2008). Its purpose of construction and history is outlined by various authors in journals and books. According toYeraswork (2008), The apartment enclave was the first large-scale, fortified housing development in Addis Ababa that was pre-fitted with fences and gates and policed by guards. It was created under the Derg as a purpose-designed community. The purpose being to keep members of the diplomatic community and other expatriates out of the inner-and in an enclave of their own. As its completion in the late- 1980s coincided with the twilight of socialism in Ethiopia, the purpose-designed community opened its gates as a rental apartment owned and managed by the state's Rental Housing Agency and home to a disparate group of residents that afforded its relatively.(Yearswork, 2017)

According to (Angélil & Hebel, 2009)This gated community was established in 1992. It is situated east of Addis Ababa's city limits. Commissioned by the communist Derg government, it was built to provide attractive housing to foreign diplomats. This building project was not merely a friendly gesture – the concentration of foreigners also promised the government easy control over its residents.(Hebel, no date)

The narration below about this compound is summarized from the journal 'A city shaped by diplomacy' by Dirk and Anteneh (2017).

Ethiopia underwent a radical change in regime, from 1974 to 1991. The pseudo-communist military government overthrown the monarchy. Driven by the slogan "land for the tiller," It was a time of an ongoing revolution, and conflict persisted through all of those years. Opposite of the country under Haile Selassie in the preceding decades, Ethiopia diplomatically became isolated. Relying on its ties to other socialist countries, the military regime gradually deteriorated its political alliance with the west. Diplomatic hospitality of the city was challenged the most. The construction industry declined to what amounted to zero, Opposite to the preceding decades. This time, the government took the most damaging measure which was 1975 proclamation. According to the

proclamation, urban property and extra houses are nationalized, making it illegal to own more than one house. Discouraged by the ongoing nationalization campaign, the private sector lost any motivation to build. It was only in the late 1980s that individuals and cooperatives began to be interested in building residential communities, motivated by an alarming housing shortage.

Embassies functioned at a bare minimum, and the city's diplomatic capacity ceased to evolve. The CMC residential neighborhood located in the eastern part of the city However, was an exception to the lack of building progress in the diplomatic world of Addis Ababa. Its purpose of construction was to accommodate all foreign diplomats and expatriates in a single neighborhood In line with the policies of strict government control. It also was intended to serve as an enclave where the diplomatic community could be kept under surveillance. The project was undertaken by the Mengistu government, prompted by the global reactions to Ethiopia's disastrous 1985 famine. The extensive Western media coverage of the famine and the worldwide outpouring of sympathy made the government look for stricter ways of controlling foreign presence in the country. A closely watched diplomatic quarter would be an important step towards achieving this. The government understood that this forced accommodation had to offer certain luxuries, and commissioned a Western firm to do the project, instead of builders from the "brotherly" Soviet bloc states that were already active in the city. The Italian builder CMC, affiliated with the Italian communist party, built a low-density residential neighborhood that comprises about 500 apartments and two-story townhouses of varying sizes, in a gated compound. With its distinct prefabricated construction, controlled details, calm pigmented concrete color, and well-groomed landscaping, it presented notable architectural qualities as far as housing design was concerned, qualities which were in fact exceptional in that period. It was only at the end of the 1980s, in the twilight of the socialist regime, that construction of this neighborhood could be completed. Thus, contrary to its original purpose of accommodating the diplomatic community, it was handed over to a state- run housing rental agency (FHC) and was made available to any tenant who could afford to pay the steep rent.

4.6 Typologies in CMC compound

Table 11. List of Buildings in CMC compound

Typologies in CMC apartment								
Block type	Typology	Height	Quantity	No of houses	Plot area	Built up Area	Units/Block	Remark
B1	1	G+1	10	8	0.02 ha*80	145.01 m^2	80	
B2	1	G+1	4	5	0.042 ha*20	105.11 m^2	20	
B3	2	G+3	12	12	0.093 ha*12	561.77 m^2	144	
B4	4	G+3	2	18	0.091 ha*2	579.04 m^2	36	
B5	2	G+2	4*4=16	6	0.25 ha*4	1193.64 m^2	96	
B6	2	G+3	12	6	-	-	72	Area is included buildings 7&8
B7	1	G+2	6	6	0.189 ha*3	457.85 m^2	36	
B8	1	G+2	6	3	0.116 ha*3	383.56 m^2	18	
Total	14						502	

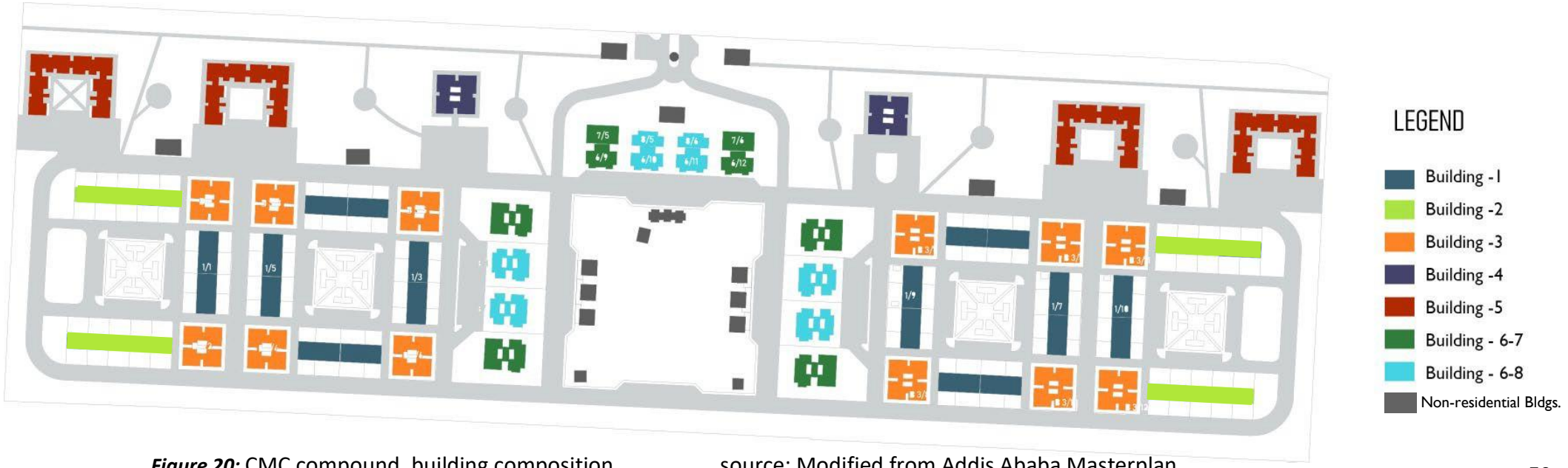


Figure 20: CMC compound, building composition source: Modified from Addis Ababa Masterplan

CHAPTER – 5
DATA ANALYSIS AND PRESENTATION

5.1 Introduction

The data collected during the study are presented, analyzed and interpreted in this section. Making the primary objective to present, both the 'What' and 'How' questions, which are raised as research questions, the section highlights the housing density and how it influenced residents' trend of open space utilization. The data after its presentation, is analyzed in a way that enables to draw clear conclusions about the subject. Moreover, both the qualitative and quantitative data on the two dominant sections of this thesis are presented by using illustrations, graphs, tables, figures and maps. These data are presented, analyzed and interpreted based on the responses of 90 respondents and written sources.

Regarding density calculations, the most popular tools in housing density are employed. This contains Net and Gross housing density, FAR and BAR calculations.

5.2 Housing density of CMC apartments

CMC compound is one of the gated communities in Addis Ababa. Currently the compound is spotted under 'low density mixed residence on the cities' Master plan though it is purely a residential development. The housing density calculations for this compound are carried out in two ways. Gross and net housing density.

5.2.1 Gross housing density of CMC compound

Gross housing density is the number of housing units per total area of the site. Since the site is of pure residential complex having small commercial units, we take the total number of houses and divide it by the total site area. The table summarizes the housing in the compound. *(See the tabular and chart summary below)*

The number of housing unit equals the number of households in these rental units.

$$\textit{Gross residential density} = \frac{total\ number\ of\ houses}{\text{total area of the site}}$$

$$= \frac{502}{20.35\text{ha}}$$

=24.67 Hu/Ha

5.2.2 Net Housing density

The more detailed density calculation is under this category. Net housing density Refers to the number of dwellings per hectare on land devoted solely to residential development. As shown in the figure below, the building blocks in the compound have clear boundary of plots they are built on.

$$\text{Net housing density} = \frac{total\ number\ of\ house}{\text{area devoted for sole housing development}}$$

$$= \frac{502}{5.65\text{ha}}$$

=88.85 Hu/Ha

Figure 21: buildings and plots

source: Modified from Addis Ababa Masterplan

5.3 Floor Area Ratio

Floor Area Ratio (FAR) is the ratio of total gross floor area of a development to its site area. The gross floor area usually takes into account the entire area within the perimeter of the exterior walls of the building, which includes the thickness of internal and external walls, stairs, service ducts, lift shafts, all circulation spaces, and so on. The geometry of the volume differs from building to building that studying this aspect of each building is necessary. Before calculating FAR, the next sub section illustrates the geometric character of each building in CMC apartment.

5.3.1 Architecture of CMC buildings

Buildings in CMC compound have variations in their height, length, geometry and quantity. There are 14 typologies, 7 type of buildings, 56 blocks and 502 housing units. Table 12 gives detail on the numbers concerning the buildings. In this section, the seven types of buildings with their architectural characters are illustrated.

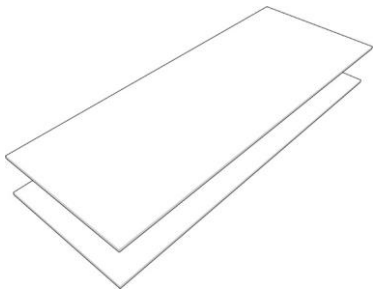
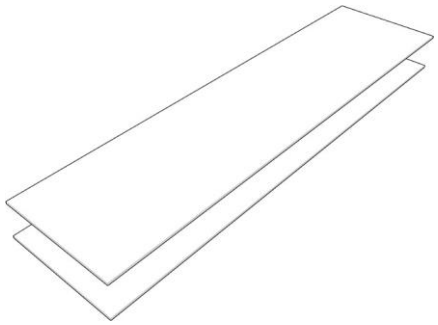
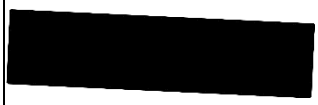
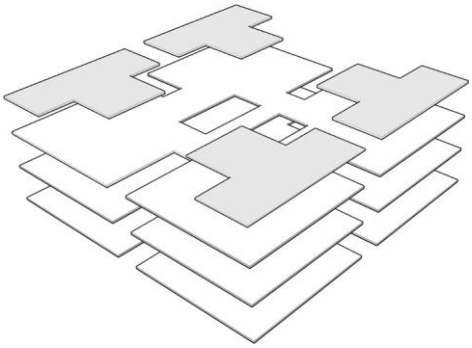
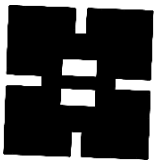
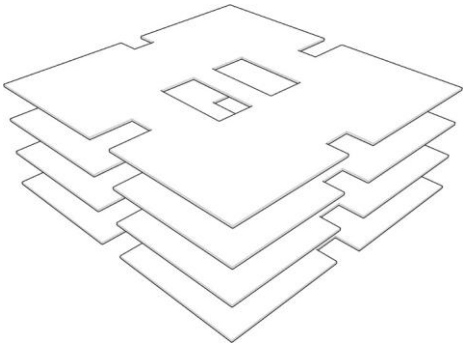
I. The Geometry

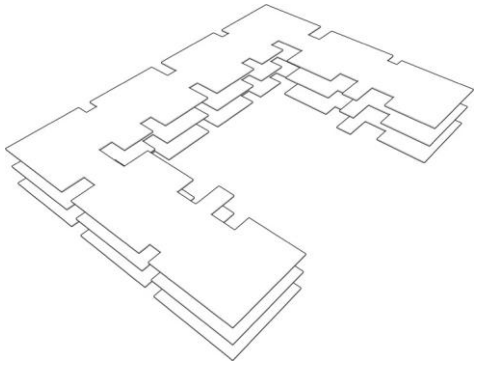
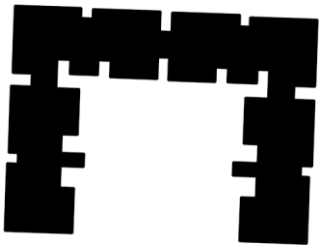
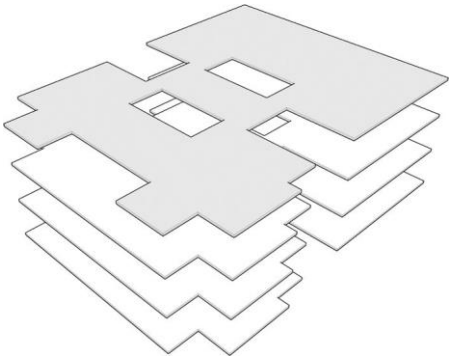
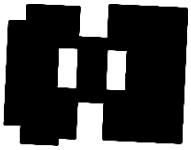
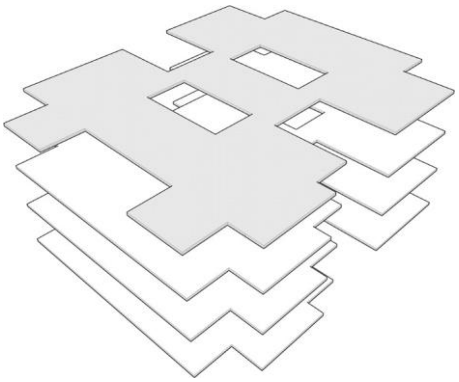
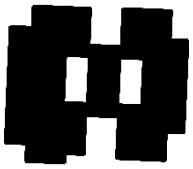
The CMC compound is symmetrical in layout and has buildings with seven types of geometries. The geometries are classified in to four based on their shapes.

a) **Linear**- straight in layout and are only two story buildings. These are Building types 1&2.
b) **Enclosed square-** These are buildings closed in all four sides and have open down in the middle. Building types 3 & 4 under this category.
c) **U-shaped building –** only building 5 is under this category and characterized by four individual blocks connected to each other in a U-shaped configuration.
d) **Interlocked buildings-** These are two buildings numbered as different blocks but connected by open down in the middle. Building types 7 & 8 are connected To building 6. For ease in FAR calculation, I have considered them as a single building.

The aforementioned building blocks have different FARs since they have different floor shapes that even alters within a single building. The FAR is calculated by taking the parcels they are built in. The following table along with the site plan of the compound elaborates this with numbers and illustrations.

Table 12. FAR of CMC Buildings

BUILDING	**GEOMETRY** *(isometric)*	**Basic shape** *(areal)*	**FAR**	**BAR**
Building_1			0.71	0.35
Building_2			0.5	0.25
Building_3			2.1	0.6
Building_4			2.5	0.63

BUILDING	GEOMETRY	Basic shape *(areal)*	FAR	BAR
Building_5			1.4	0.47
Building_6_7			0.96	0.24
Building_6_8			1.44	0.33

	Typologies in CMC apartment						
Block type	Typology	Height	Quantity	No of houses	Area	Units/Block	Remark
B1	1	G+1	10	8	145.01 m^2	80	
B2	1	G+1	4	5	105.11 m^2	20	
B3	2	G+3	12	12	561.77 m^2	144	
B4	4	G+3	2	18	579.04 m^2	36	
B5	2	G+2	4*4=16	6	1193.64 m^2	96	
B6	2	G+3	12	6	-	72	Area is included buildings 7&8
B7	1	G+2	6	6	457.85 m^2	36	
B8	1	G+2	6	3	383.56 m^2	18	
Total	14					502	

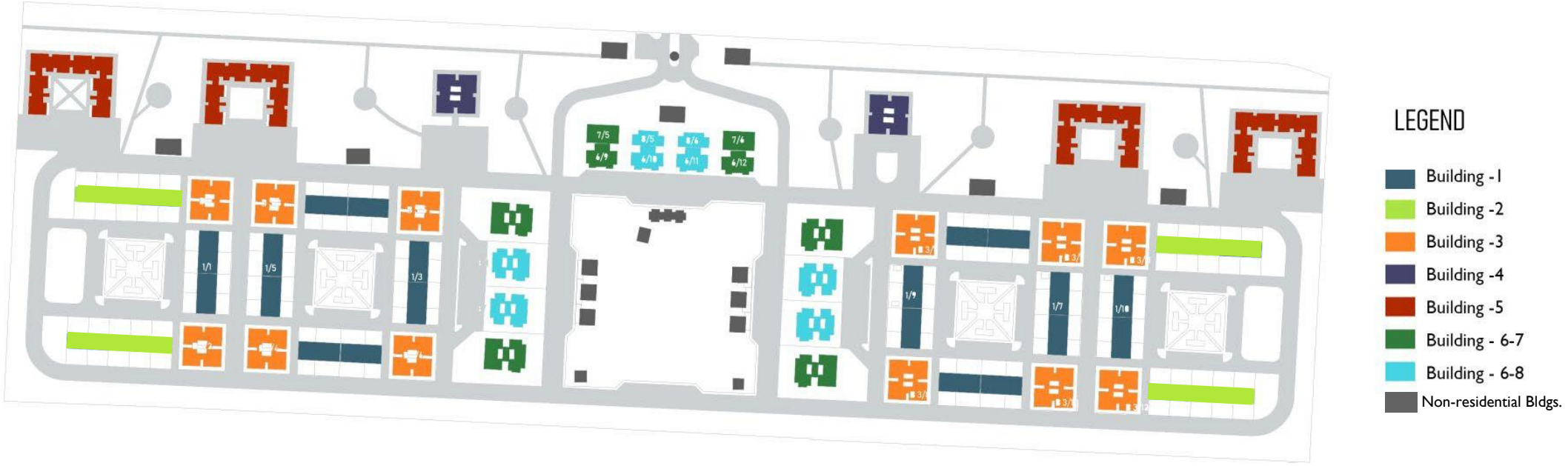


Figure 22: CMC compound, building composition source: Modified from Addis Ababa Masterplan

5.4 Composition of the compound

5.4.1 Neighborhood level composition

Beside the calculation of net and gross housing density, it is essential to identify the shares of residence, open space and circulation with in the given area of the compound. This in addition to the numerical findings, elaborates a clearer picture of the compound whether compact or sparse in terms of density.

Based on the types of spaces for built up, circulation and public, Semi- public and private open spaces, CMC compound has the following percentage of composition.

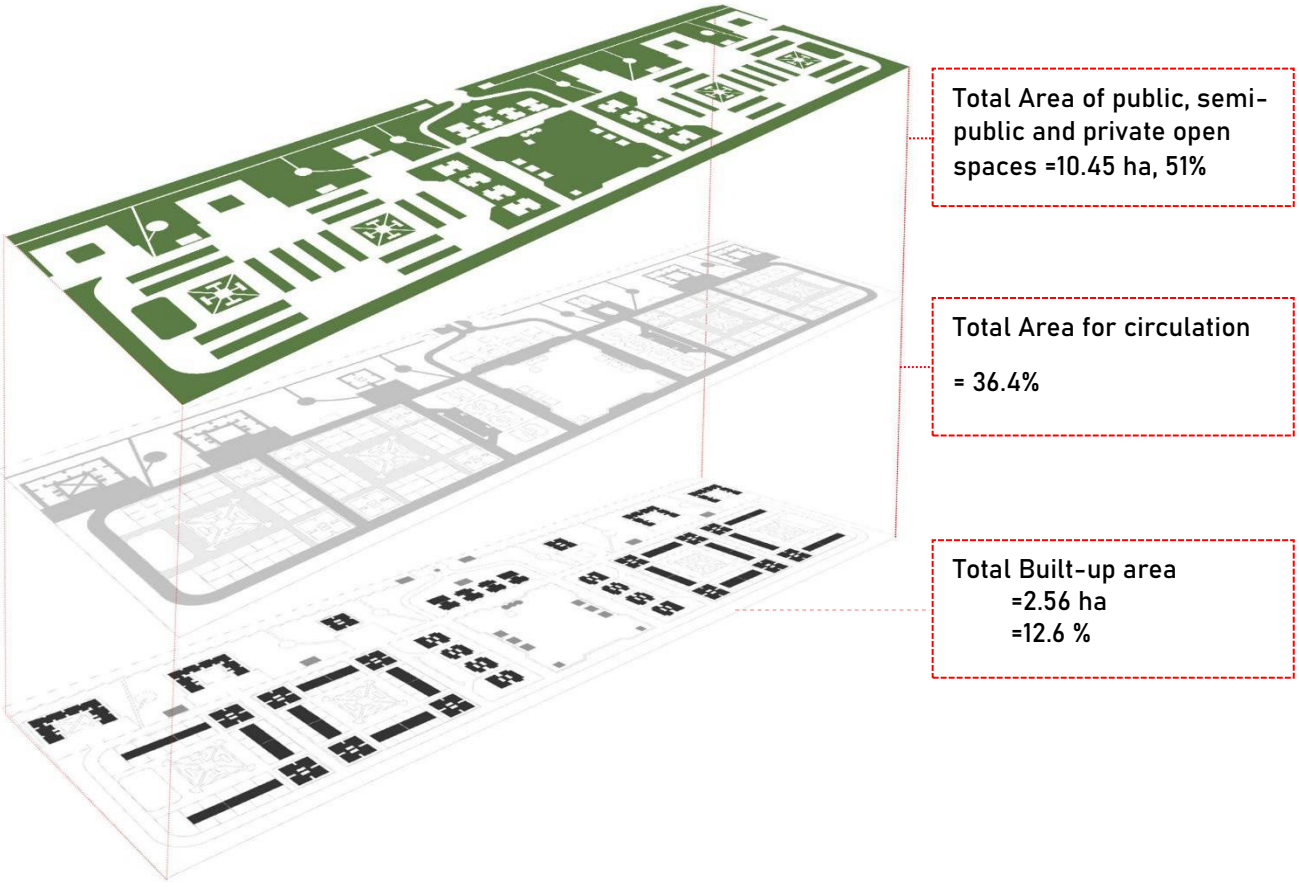
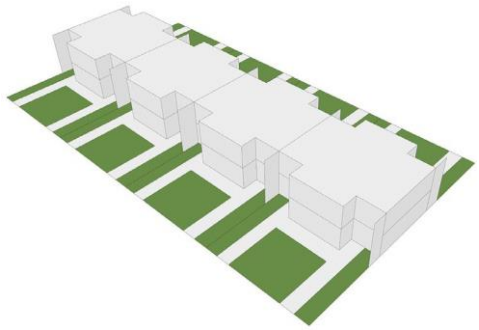
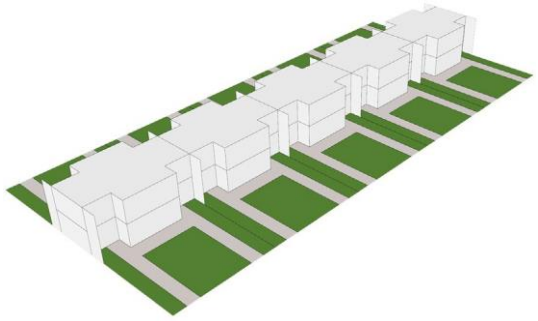
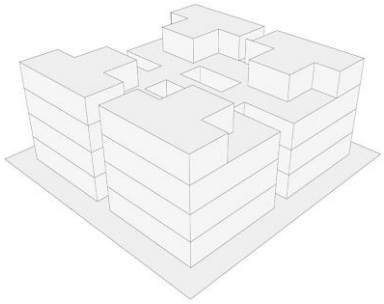
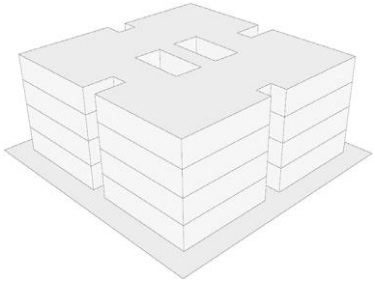
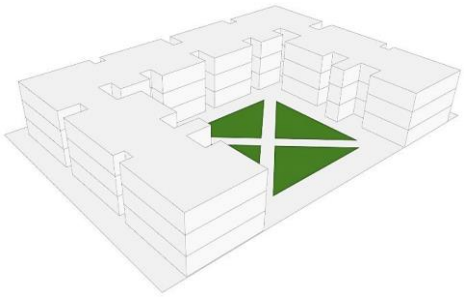
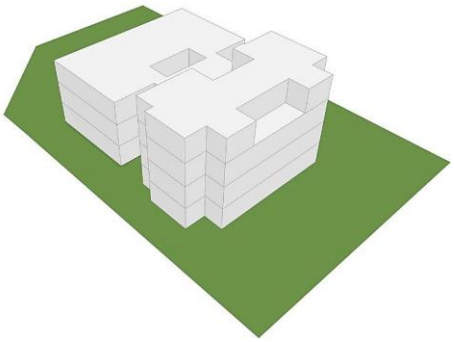
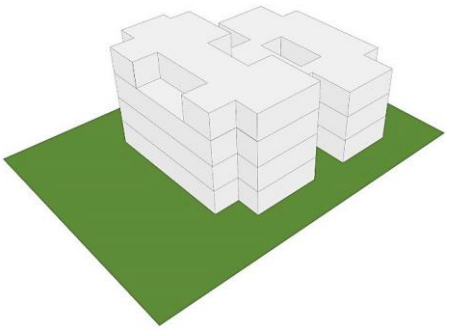


Figure 23: CMC compound, Composition of open space, Circulation and buildings. source: Modified from Addis Ababa Masterplan

5.4.2 Plot level composition

Plot	Plot area	Area of single block
		145.01 m^2
	Similar to building 1	105.11 m^2
		561.77 m^2
		579 m^2

Plot	Plot area	**Area of single block**
		1193.64 m²
		457.85 m²
		383.56 m²

5.5 Housing density and Residents' Open Space Utilization

This section explores the current trend of open space utilization in CMC compound and then links this entity to the characteristics of housing density. The characteristics selected to define density in this thesis are building height (vertical attribute) and enclosure (horizontal attribute). Linking these issues needs taking other determinants in to account because of the assumption that there might be complex backgrounds other than density. These factors in one way or another might affect open space utilization. This might include the personal interest to use open space, the absence of experience to use open space, indoor activity dominance and so on. These broadly are categories under human behavior and the response to the natural environment. Since this issue is totally out of the scope of this study it is not addressed accordingly. However, it is important to understand that these factors have their own role behind the ultimate agenda. The other determinant is typology. Different utilization patterns are noticed as typology alters. The level of quality and comfortability of the open spaces is also the other determinant. In order for the conclusion to be clear and reliable taking these in to account is crucial. The details are discussed in the following subtopics.

5.5.1 Enclosure and open space utilization

Of the two most common schemes of densification, horizontal increment of units is the one. Without change of given area, increment of units whether horizontal or vertical has its influence in defining the type of open space around them. Enclosure in this case, with efficient use of open space incrementally encloses the area to its entirety. As studies show, the more the enclosure value the more the residents likely utilize the area enclosed. In CMC compound it is found that there are two types of enclosures. Cluster level enclosure and building level enclosure which are discussed as follows.

5.5.2 Cluster level enclosure

This type of enclosure is formed by two types of buildings that differ by height, by privacy and geometry. The two types of cluster enclosures identified are:

a) **Open U-shaped –** as illustrated in the picture, this type of enclosure is open only in one of the four sides. The rest three sides are composed of building 2 (two sides) and building 1(one side) which are linear buildings, making two of building 3 blocks at their joint. The faces that are highlighted on blue shows that they are exposed to the semi-public spaces in the middle. The count of area highlighted divided by the area of the semi-public space yields the enclosure value of this cluster. This enclosure has defined the open space in the middle as semi-public space. Since the compound is symmetrical, there are two clusters of this type.

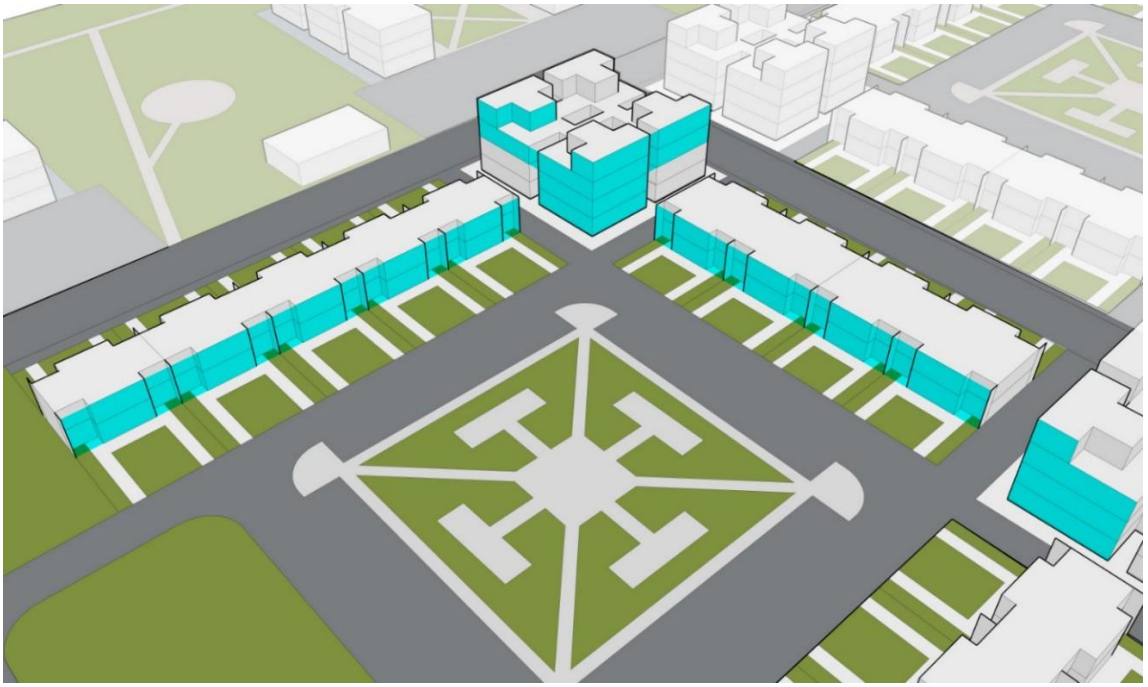
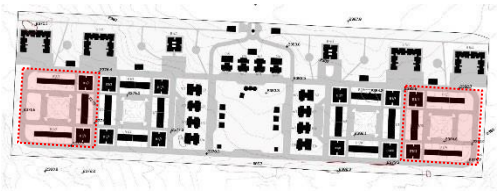


Figure 24: U-Shaped Enclosure, Cluster level Modeled by the Author.

$$= \text{Enclosure value} = \frac{\text{Facing surface area}}{\text{Area of semi-public space}}$$

$$= \frac{1799.46}{1703.35}$$

$$= 1.05$$



b) Closed square shaped

This cluster is similar in layout to the former one except it is closed in all four sides. As a result the exposure value increases. Building 1 and 2 have private compounds of their own, they however are incorporated in the enclosure value calculation because the type of open space taken in to account is semi-public not private.

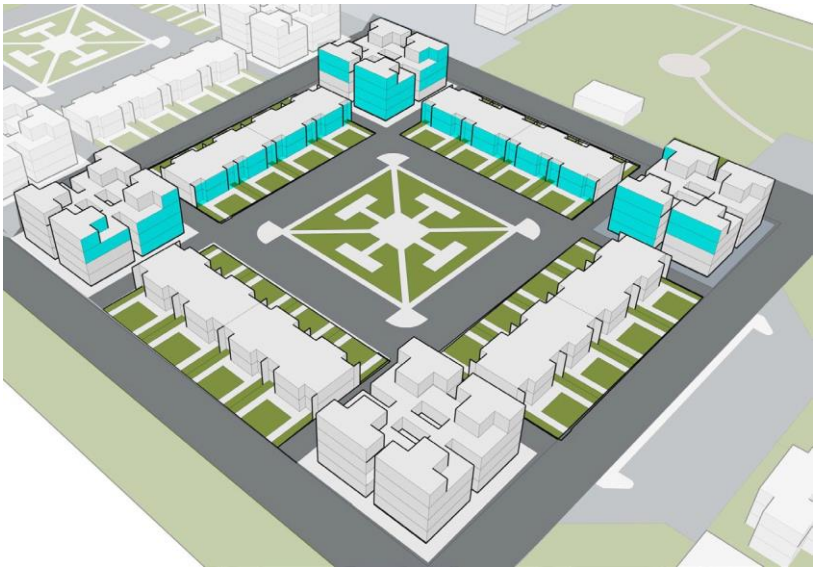
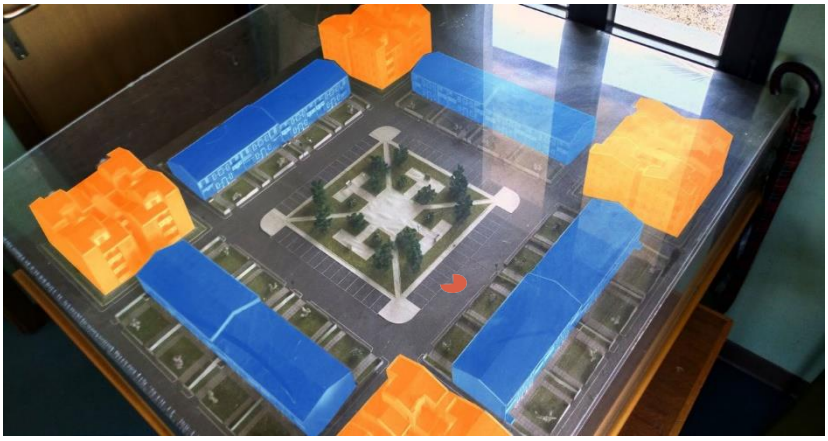


Figure 25: Rectangular Enclosure, Cluster level

Modeled by the Author.



$$\text{Enclosure value} = \frac{\text{Facing Surface}}{\text{Area of semi} - \text{public space}}$$

$$= \frac{2952.44}{1703.35}$$

$$= 1.73$$

5.5.3 Building level enclosure

Smaller in scale of enclosure is building level enclosure. Building 5, being a U-shaped connection of four buildings defined a semi- public space in the middle. It is an example of enclosure formed by length of residence. The basic difference it has with the former ones is that the building has physical connection to form this U-shaped configuration while the clusters are fragmented due to the presence of circulation areas defined on the joints. As far as Enclosure is concerned buildings 1 and 2 has less length than building 5. There are 4 buildings in the compound with this character.

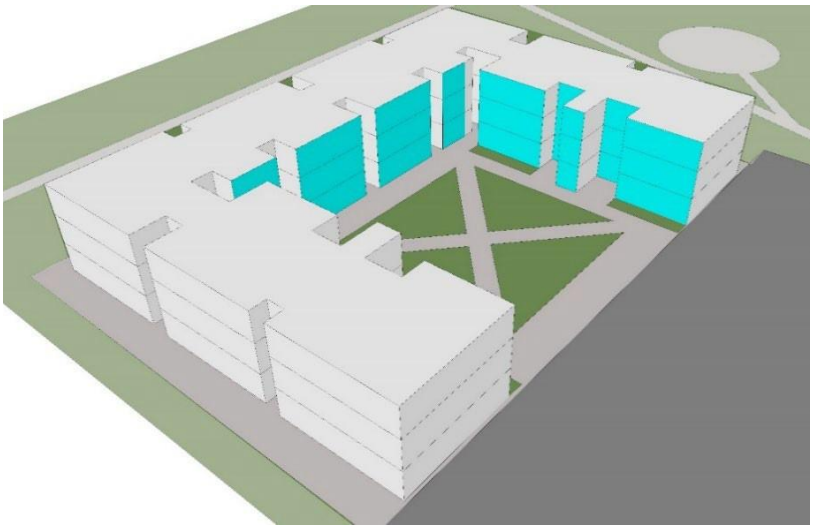
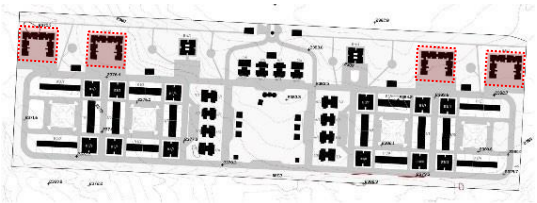


Figure 26: U-Shaped Enclosure, building level Modeled by the Author.

$$\text{Enclosure value} = \frac{\text{Total area of bu}}{\text{Area of semi} - \text{pu}}$$

$$= \frac{626.93}{430}$$

$$= 1.46$$



5.6 The role of Enclosure in defining the types of open spaces

The building layout by which the blocks arranged defines the open space around them. Based on the nature of function and design of the compound types of open spaces in CMC compound are categorized in to three.

- ☐ **Private open spaces-** these are open spaces enclosed in private compounds and are meant to function solely for the residents in the compound. Residents in Building 1 & 2 have these type of open spaces.
- ☐ **Semi- private open spaces-** open spaces those are public for anyone but due to the closeness they have for the buildings around them, they are meant to function for the residents in those buildings. Due to lack of familiarity for these open spaces residents other than these buildings tend not to use them. Building 5 has this type of open space.
- ☐ **Semi- public open spaces-** these are spaces similar to the former one but has low degree of privacy. They generally are spatially enclosed between building 1, 2 and building 3.
- ☐ **Public open spaces-** these types of+ open spaces incorporate those, which are in the middle of the compound and spaces coinciding the compound's fence. These are totally public.

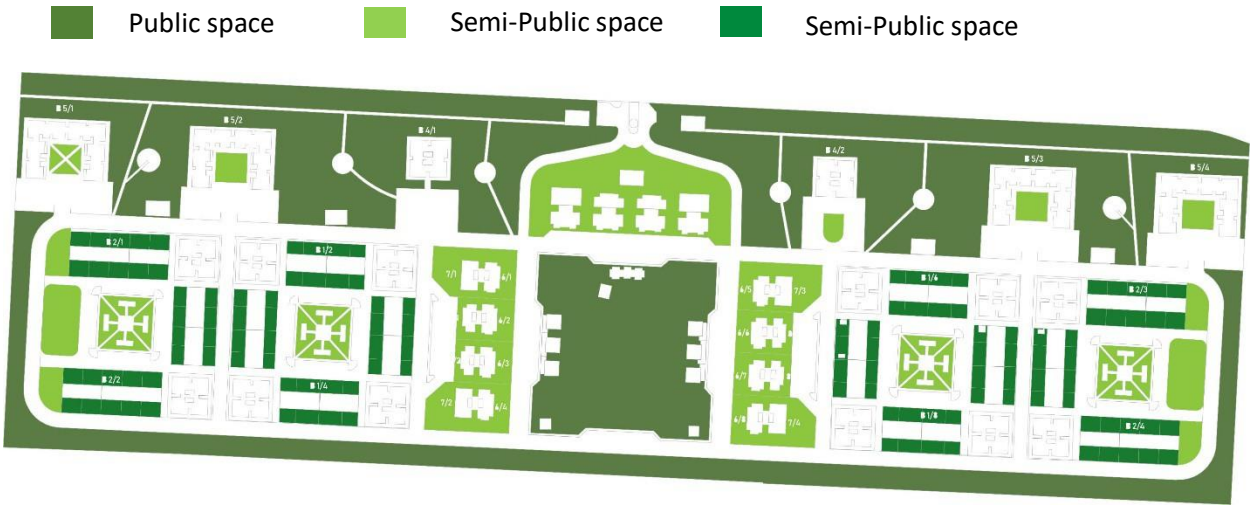


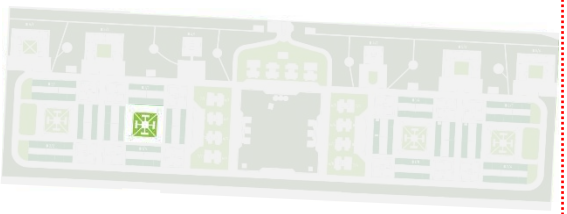
Figure 32: Types of open space
Modified by the Author.

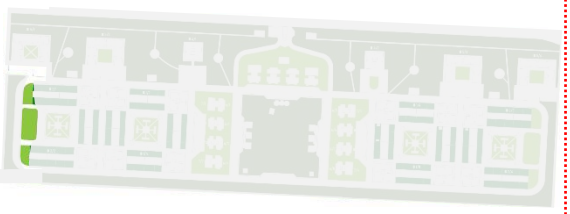
Public open space = 70715.16 m²
Private open space = 13988
Semi-Public = 19840.15 m²
TOTAL = 104543.31

Private space

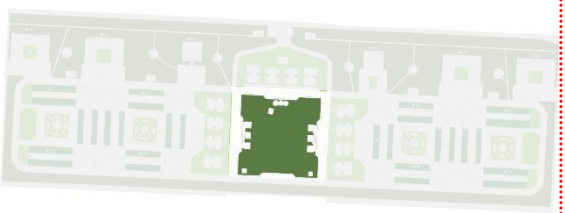
Building types 1 & 2 have their private compounds, hence the type of open space is private.

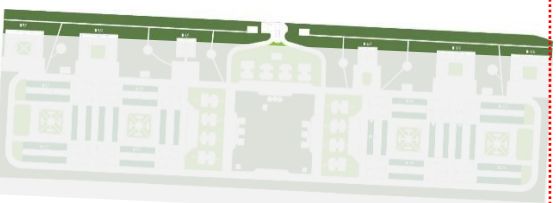
Semi- public space





Public space





5.7 Enclosure and open space utilization

In addition to the role of defining the type of open spaces, enclosure also influences the open space utilization pattern of the residents. Based on the layout of the compound, the proximity between open spaces and residential units vary. This brings variation on the preference
and frequency of visit of open spaces. The following section numerically explains this phenomenon.

5.7.1 How does Enclosure influence open space utilization?

As mentioned earlier in the introductory part of this chapter, the variables selected to measure open space utilization in relation to enclosure are not the only ones. The notion of this fact helps better understand how the selected variables work. It is found difficult to compare the buildings in the compound due to three main reasons.

- **The type of sampling selected-** in purposive sampling as stated in chapter 2 of this thesis, it is the duty of the researcher to decide the number of samples based on the point of data saturation. The point at which data saturates varies from building to building resulting the numbers of samples to vary. This makes difficult to compare entities with different numbers of samples. However, Percentage comparisons are carried out.
- **The parameter selected –** enclosure is the parameter selected to measure the utilization of open space. In building level, only building 5 has this character that comparing others with this building makes them losers. This implies that the advantages that building 5 has due to enclosure is absent in other buildings. Similarly, buildings that form enclosure in a cluster include buildings 1,2 and 3. buildings other than these are not spatially enclosed either in building or in cluster.
- **Presence of private compounds-** though buildings 1 and 2 form enclosure with building 3 in a cluster, they have private compounds. The availability of small private open spaces unlike other building types, influenced their utilization of semi-public spaces.

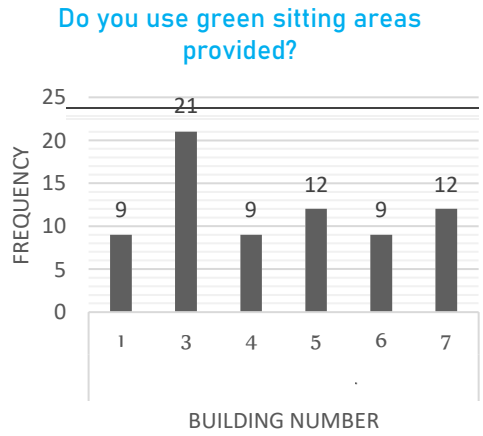
To measure the intensity of open space utilization the researcher selected three variables concerning enclosure.

5.8 Open space utilization of residents

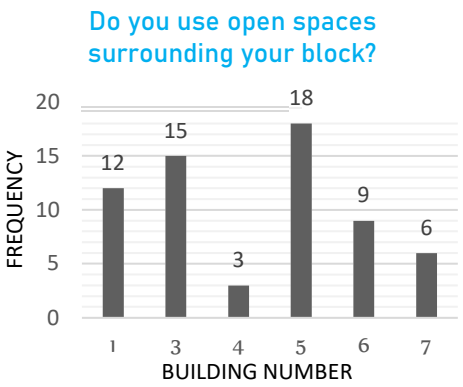
Open space utilization of residents in CMC compound differs due to several reasons. Those which are selected as variables here are the bold ones. For ease of analysis, the preferences of the residents are selected based on the type of open space, the activities they frequently do and their preference of building type if they were given the chance. The first two are actual and empirical while the third is a 'what if' type question to identify their interests relating it to open space utilization.

5.8.1 Preference by type of open space

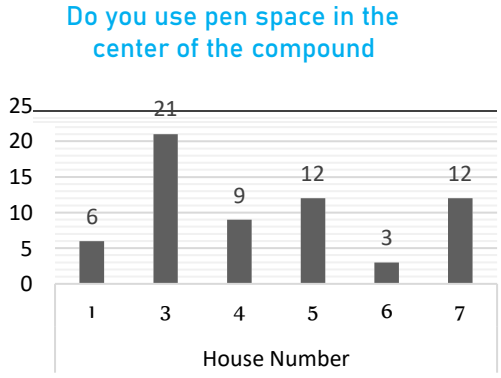
The types of open spaces as spatially illustrated in the previous section, are well defined and easily recognizable. Spatially, open spaces that are enclosed either in building or in cluster have proximity to the buildings engulfing them, while buildings without enclosure are spatially fragmented with lower proximity to the open space nearby. This phenomenon brings variation in preference of types of open spaces. Green sitting areas are found in the clusters that form enclosure, building 5 and in the middle of the compound. Due to proximity all respondents in building 5 prefer to utilize (sit) the open space immediately after them which is semi-public space. All Respondents from buildings 6 and 7 also prefer to use the open space nearby which is public in type. Three forth of the Respondents from building 3 use semi-public space in the cluster and also public space in the middle of the compound. Building 4 being physically detached from rest of the pack, is closer to a public space. And finally, building 1 having private compound, makes its residents interested in staying in the compound. Other indicator is the utilization of the residents show in the open space surrounding their block. The graphs supported by the tables depicting numbers in percentage are presented as follows.



Do you use green sitting areas provided?		
Building number	Number of respondents	% of respondents with their respective number of sample
1	9/12	75
3	21/27	77.77
4	9/12	75
5	12/18	100
6	9/9	100
7	12/12	100
Total	**63**	**Av=87.96**

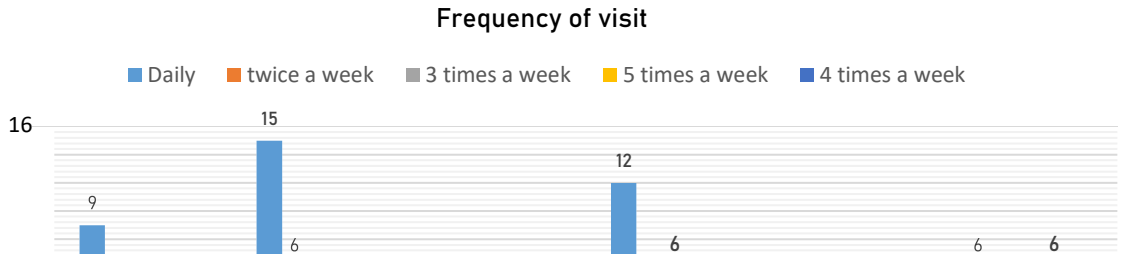


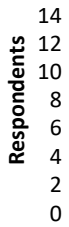
Do you use open spaces surrounding your block?		
Building number	Number of respondents	% of respondents with their respective number of sample
1	12/12	100
3	15/27	55.5
4	3/12	25
5	18/18	100
6	9/9	100
7	6/12	50
Total	**63**	**Av=71.75**



Do you use green sitting areas provided? Yes		
Building number	Number of respondents	% of respondents with their respective number of sample
1	6/12	50
3	21/27	77.77
4	9/12	75
5	12/18	66.66
6	3/9	33.33
7	12/12	100
Total	**63**	**Av=67.12**

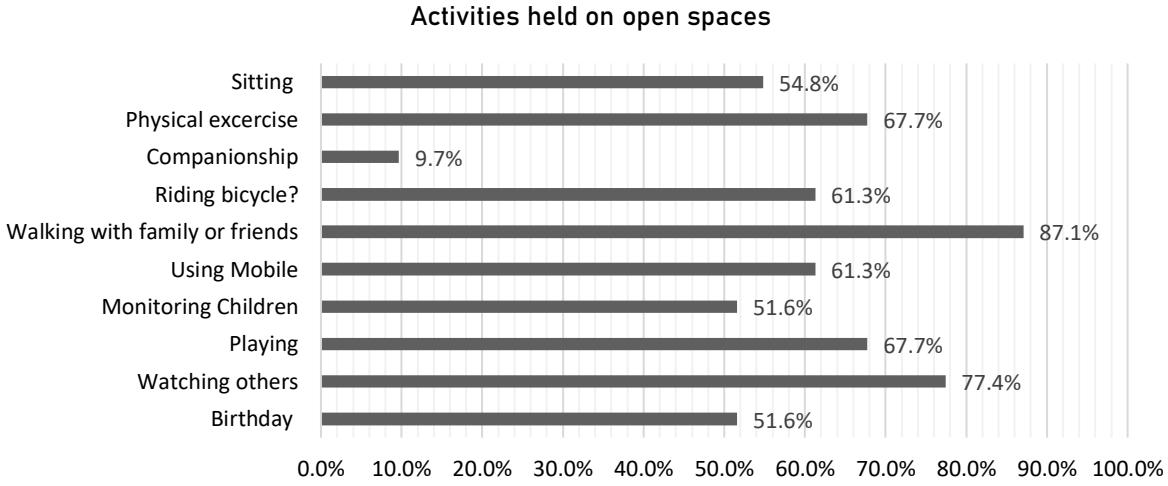
The other indicator of utilization is the frequency of visit of open spaces. According to the respondents, the most frequently used types of open space are sitting green areas and open space in the center of the compound. Residents seldom tend to use walkways. Though it is difficult to compute and compare the intensity of utilization of residents of various building types by the given number of sample size, it was easy to identify their preference of open spaces. The bar graph below clearly shows that respondents from buildings 3, 5 and 1 daily visit open spaces.





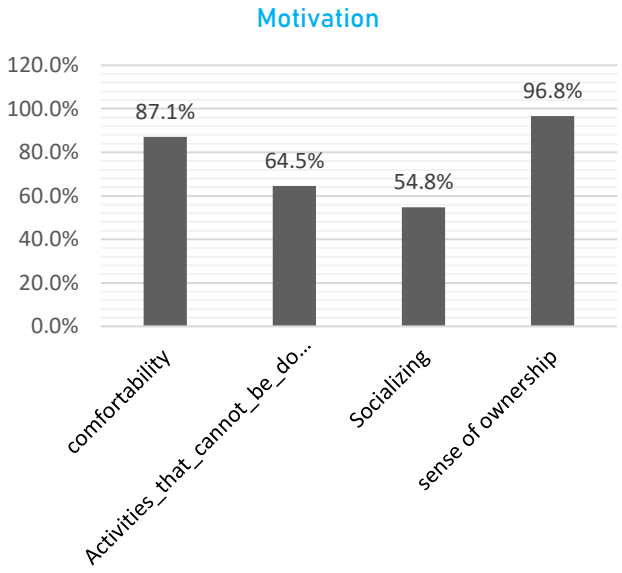
5.8.2 Preference by activities held on open space

Preferences of open spaces also depend on the choice of activities residents carry out. The most rated activities held by the respondents include walking (which is held on walkways), watching others, playing, physical exercise, riding bicycle and using mobile. Playing and watching others mostly occurs on the field located in the middle of the compound and next in rank is enclosed semi-public spaces. While physical exercise, walking and riding bicycle are held on walkways that surrounds the compound and near the buildings. None of the respondents said they prefer the public space coinciding the fence of the compound.



5.8.3 Preference by motivation

The combination of the former two brings motivation for utilization of open spaces around them. According to the data collected the dominant motivations of the residents are sense of ownership and comfortability of the open spaces. Moreover, all the respondents said the open space is also adequate. Next in rank are activities that cannot be carried out indoors and socializing.



5.9 Building height and open space utilization

The second characteristics selected is vertical entity defining density. This section interprets the influence of height on open space utilization. One of the reasons for the selection of this entity is that the maximum height of building is 4 story hence, the only vertical circulation is staircase. For ease of understanding the compound regarding building height, the composition of the compound is described as follows.

5.9.1 Composition of CMC apartment, building height

The heights of buildings in CMC compound are classified in to three.

- **G+1 town houses-** these are buildings within private compound. Building 1 and 2 are under this category
- **G+2 buildings-** these are of two kind. Building 5 and Buildings that are attached to building 6. Buildings 7 and 8 are this kind.
- **G+3 Buildings-** these are also of two types. Detached buildings (Buildings 3 & Building 4) and attached building 6 which is attached to building 7 and 8

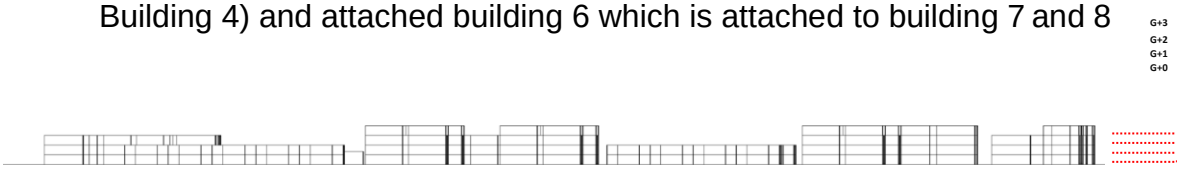


Figure 33: CMC, Building height

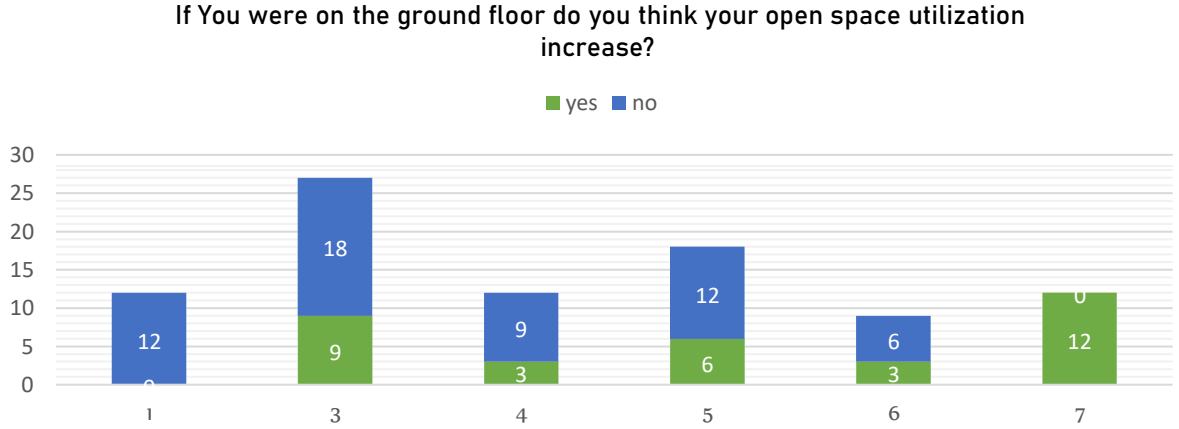
5.9.2 Increment of building height: how far from the ground?

As illustrated on the section of the compound the buildings in CMC compound are low rise (maximum G+3) having only staircase as vertical circulation. This in contrary to the accustomed neighborhood that has high ground level attachment might bring variation on the sense of place of the residents due to several reasons resulted from increment of height. Regarding increment of building height more than half of the respondents said their open space utilization wasn't influenced. The table below shows that buildings with 2 story said they were never influenced by increment of height while those with more than 2 story building said they were influenced to some extent. The table below summarizes the details.

Influence of building height on open space utilization		
Building number	Number of respondents	% of respondents with their respective number of sample
1	12/12	100
3	21/27	77.77
4	9/12	75
5	12/18	66.66
6	3/9	33.33
7	6/12	50
Total	**63**	**Av=67.12**

5.9.3 Increment of height: detachment from outdoor activities?

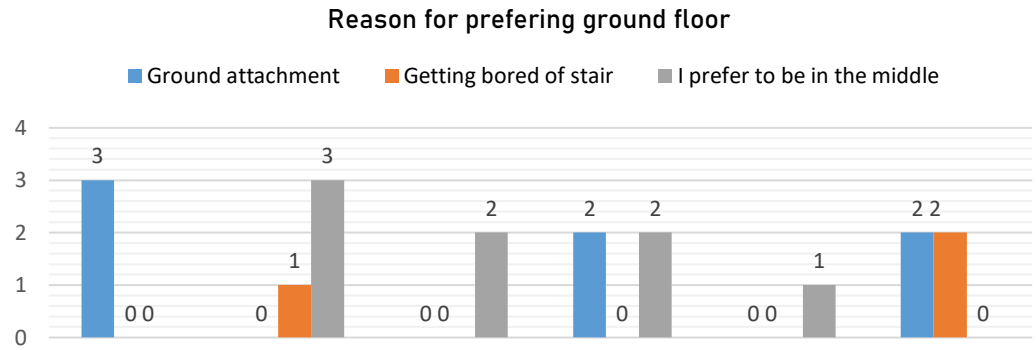
The other reason that ground floors are preferred over the others is that its closeness to ground level living, which highly promotes outdoor activities.



As clearly indicated on the graph 63.3% of the respondents said they would have the same open space utilization if they were on the ground floor. Similarly, half of the respondents said they prefer to live on the ground floor.

Building number	% of respondents with their respective number of sample
Ground	50
First	7
Second	23
Third	20
Total	**100%**

While asked their reason for preference of ground floor only 16% of the respondents are related to ground attachment and 63.3% of the respondents said it will give them access to open space.



CHAPTER – 6
SYNTHESIS OF FINDINGS & RECOMMENDATION

3.3 Introduction

The thesis focusing on the spatial entities of housing, set two research questions. These questions being addressed on analysis with numerically supported and narrated data, have their own implications both qualitatively and quantitatively. This section makes its primary focus on summarizing the key findings of the research, in a way that unfolds new knowledge on CMC compound regarding density and its influence on open space utilization. Moreover, the section describes the implications of the numbers concerning housing density and then explains its influences based on the data analyzed and presented using the purposively selected samples that represent targeted population.

6.2 Housing density

The housing density, based on the results from both net and gross housing density calculations confirms that the housing density of CMC apartment being 24.67 Hu/Ha is below the lowest bench mark set for housing density nationally. The smallest bench mark set nationally (regarding low density mixed residence) is 50-99 HU/Ha. Hence the housing density is low. But as far as the international standard is concerned the net housing density being 88.85 falls under medium density housing. The medium range in international standard set by UN-HABITAT is 40-120 Hu/Ha.

The results of both calculations (Net housing Density =88.85 Hu/Ha, Gross housing density= 24.67 Hu/Ha) and the built up area ratio shows that the residential development is sparse, showing high proportion of the land in the compound as unbuilt.

FAR of the buildings couldn't convey the fact of compound's sparse nature. As depicted on the previous section, buildings are built on their own plots, having low building height (max: G+3) which also results in low FAR less than 2.

The low building height also tells that the density in the compound is achieved both horizontally and vertically. As far as proportion is concerned however, the density is due to building height than horizontal development/ Enclosure.

All the population within the compound lives as a tenant, hence no additional households per housing unit.

The composition of the compound also shows that more than half of the compound is occupied by open spaces ranging from private to public. The built up space makes up only quarter of the compound making the rest circulation space. This is the other reason for the residential sparse development within the compound.

6.3 Influence of housing density

The two selected characteristics of housing density namely building height and enclosure are found to have influence on the utilization of open spaces. The open space utilizations show variations in building and cluster level enclosures.

6.3.1 Influence of enclosure

Respondents from both cluster level and building level enclosed housing units show a better open space utilization. only building 5 forms building level enclosure while building 1 and 3 form cluster level enclosures (see chapter 5).

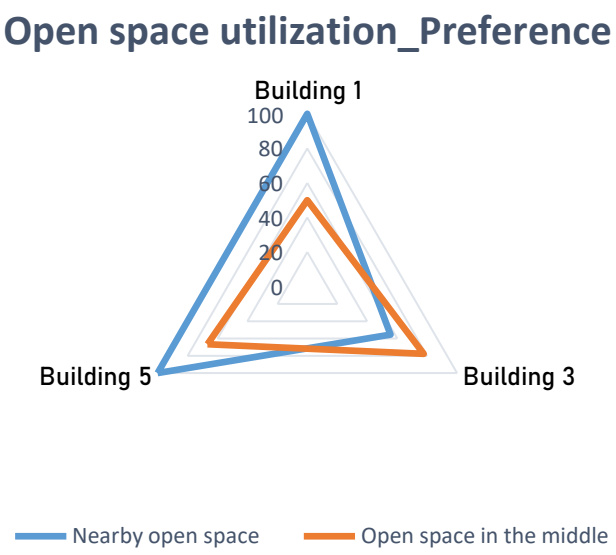
a. Cluster level enclosure

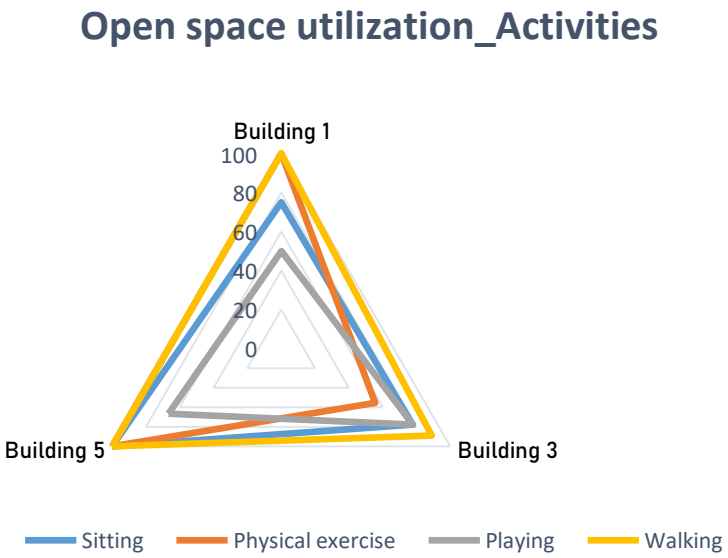
In both the U-shaped and rectangular cluster level enclosures the residents have shown differences on open space utilization as compared to building level enclosures due to the following reasons

- ✓ Proximity of the semi-public spaces to the units. As far the closeness of the open spaces is concerned, spaces enclosed in building are closer than spaces enclosed in cluster.
- ✓ Housing units with private compounds utilize private open space, resulting in decreased trend of semi-public spaces

Respondents form Building 5 showed better utilization of open spaces as far as semi-public and public open space utilization is concerned while Buildings 1 and 5 prefer to use open spaces surrounding their block.

Frequencies of respondents to visit open spaces is high on buildings 3 and 5, while respondents fro, building 1 have a less tendencies to frequently use open spaces. Both the cluster level and building level enclosures can be summarized in the following graph.





6.4 Status of open spaces

Beyond checking the open space utilization, it is necessary to identify the open spaces in the compound are up to the standard.

- ✓ **Size-** the size of open spaces is more than adequate covering more than half (51%) of the area in the compound. Based on the national standard 30% of a neighborhood should be green and open spaces.
- ✓ **Variety and proportion –** as identified as per the definitions of open spaces the open spaces in the compound has all the varieties ranging from private open spaces to public space. Of which 67% is public,18.9% semi-public and 13.3 private open spaces.

- ✓ **Location and orientation-** as clearly indicated on the map showing the types of open space the compound has one in the middle of the compound which is fair in distance for the buildings in the compound and along the fence of the compound engulfing different semi-public spaces. The private spaces are within the private compounds.
- ✓ **Rating for user-friendliness and comfort-** up on observation the open spaces are found to be user-friendly and comfortable with adequate green coverage. All the respondents confirmed this while data collection

6.5 Influence of building height and open space utilization

The building height in the compound is low and the only available vertical circulation is staircase as indicated on chapter 5. While conducting data analysis all of the respondents from building 1 said building height never affected their open space utilization.

- ✓ More than half of buildings with stories 3 and above replied height has influenced their open space utilization.
- ✓ In average 67.12% of residents from these buildings replied height matters.

Increment in building height likely influences the open space utilization incrementally.

6.6 RECOMMENDATIONS

CMC compound, being exceptional in Ethiopian housing history, happened only once. The need for recommendations in this case seems ambiguous because the construction has been completed with excellent level of quality both regarding architecture and provision of open space. However, lessons can be derived from the findings which are crucial for housing developments ahead both for public and private sectors. The following points are important according to the author.

- ✓ For architects, urban planners and designers, due to the inevitability of housing density, incorporating the recreational and social aspirations of residents is essential. This can be achieved via provision of adequate sized, user-friendly, comfortable and various types of open spaces with in the compounds of residential developments.
- ✓ While designing the building blocks employing different architectural styles that have pleasant exteriors, forms and layouts in building and cluster level increases the level of preferences for the residents concerning the utilization of the compound as a whole.
- ✓ Well planned circulations in the compound also enhance the residents level of interests to physical exercises, walking and socializing activities.
- ✓ Increment of height should be planned along with vertical circulation alternatives.
- ✓ Improving the quality of open spaces between the blocks in a residential complex or outdoor environment is crucial since the desirability of improving these areas is directly related to the residential quality of living standards.

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APPENDIX

Questionnaire: Impact of residential density on open space utilization

The objective of this interview is to assess and evaluate the impact of housing density on open space utilization. The focal areas of this interview are Comparison of former trends of open space utilization with the current one, Assessing the impacts of enclosure value, Shared external spaces, configuration of building, Shared external spaces, Access from dwellings and Networks.

Part 1. Household data

[1] Age_____ [2] sex ☐ Male ☐ Female

[3] Block number_____[4] Floor level_____

[5] Household size_____ M_____ F_____

[6] Number of children_____[<18]

[7] When did you came here? Month_____ year_____

[8] When did you start to live here in CMC apartments? Month_____ year_____

[9] In what type of dwelling do you used to live before you moved to here?

1. Private compound ☐ G+0 ☐ G+1 ☐ G+2 ☐ G+3
2. Condominium on Floor Level ☐ one ☐ Two ☐ Three ☐ Four ☐ _____
3. Apartment Floor Level ☐ one ☐ Two ☐ Three ☐ Four ☐____
4. Cooperative houses ☐ Entire house ☐ G+_____
   ☐ Portion of the house Floors_____
5. Kebele house
6. Other

Part 2. Open space Utilization *[Former trends]*

[10] What type of open space did you use most?

☐ ☐Private, enclosed in my compound
☐ ☐Semi-private, shared with neighbor
☐ ☐Semi-public, shared with neighborhood
☐ ☐Public, outside my compound, nearby public spaces, open spaces in the city

[11] What was the size of open space around your former dwelling?

☐ ☐Large ☐☐ Medium ☐ ☐ Adequate ☐ ☐ Small ☐ ☐ None

[12] What activities do you do in open spaces? [Rating 1-4]

☐ ☐ Socializing 1-4[ ]
☐ ☐ Observing others 1-4[ ]
☐ ☐ Playing *[Children activity]* 1-4[ ]
☐ ☐ Supervision of children playing 1-4[ ]
☐ ☐ Solo mobile phone use *[Wi-Fi internet]* 1-4[ ]

☐ ☐ walking with children, family or friends 1-4[ ]
☐ ☐ Cycling 1-4[ ]
☐ ☐ Hanging out
☐ ☐ Doing physical exercises [jogging, running, aerobics…] 1-4[ ]
☐ ☐ Sitting 1-4[ ]
☐ ☐ Domestic chores *[washing the car, mending a bike, washing and gardening.]* 1-4[ ]

[13] What ways of moving do you use in open spaces?

☐ ☐ On foot
☐ ☐ Bicycle
☐ ☐ Pushchair *[babies]*
☐ ☐ Motorcycle
☐ ☐ Skate
☐ ☐ Wheelchair
☐ ☐ others

[14] How often do you visit open spaces?

☐ ☐Every day
☐ ☐☐times a week
☐ ☐☐times a month
☐ ☐_____times a year

[15] What is your favorite time to visit open spaces?

☐ ☐Working day, after work/ school [after 11;30LT evening]
☐ ☐Working day, before work/ school [after 12:00LT morning]
☐ ☐Saturday, morning
☐ ☐Saturday evening
☐ ☐Sunday morning
☐ ☐Sunday evening
☐ ☐Holidays
☐ ☐other

[16] How long do you stay visiting open spaces?

☐ ☐10-30min [☐☐working days, ☐☐weekends]
☐ ☐30-60min [☐☐working days, ☐☐weekends]
☐ ☐1-2hrs [☐☐working days, ☐☐weekends]
☐ ☐> 2hrs [☐☐working days, ☐☐weekends]
☐ ☐other

[17] How do you rate your open spaces utilization?

☐ ☐Very good
☐ ☐Good
☐ ☐Medium
☐ ☐Seldom [occasional]
☐ ☐Never

Part 3. Psychological, sociological and aesthetic stimulants to use open space *[Former trends]*

[18] How attractive were open spaces in your former place?

☐ ☐Attractive
☐ ☐Medium
☐ ☐Less attractive
☐ ☐Not attractive

[19] How relaxed were you by the open spaces in your former place?

- ☐ ☐Released
- ☐ ☐Relaxed
- ☐ ☐Less relaxed
- ☐ ☐Tense

[20] Safety of the open spaces in your former place?

- ☐ ☐Safe
- ☐ ☐Medium
- ☐ ☐Tolerable
- ☐ ☐Dangerous

[21] How organized were open spaces in your former place?

- ☐ ☐Ordered
- ☐ ☐Medium level
- ☐ ☐Tolerable
- ☐ ☐Disordered

[22] What type were open spaces in your former place?

- ☐ ☐Sport fields
- ☐ ☐Grass field
- ☐ ☐Playgrounds
- ☐ ☐Paved surfaces
- ☐ ☐Private backyard
- ☐ ☐park

Part 4. Density related *[Current trends]*

[23] As compared to your former open space utilization, rate your status in CMC compound.

1. Better than before
2. Similar
3. Less than before
4. I never use open

[24] If your answer for Q.23 is 3 or 4, why do you think there is a decrement?

1. It is boring to go up and down via the stair every time I want to go out.
2. I replaced the activities that can be done at home
3. The open spaces are not adequate
4. The open spaces are not user friendly
5. Other_____

[25] Do you think building height has influenced your open space usage?

1. Yes,
2. Sometimes
3. I don't feel it
4. No.

[26] If you were in the ground or first floor, do you think it is more comfortable for open space usage?

1. Yes,
2. No difference
3. No.

[27] Which floor do you prefer for living?

1. Ground
2. First
3. Second
4. Third

[28] Why do you prefer ground or first floor? (If their answer for Q.25 is 1 or 2)

1. It will promote attachment for the ground
2. I am highly attached to ground activities
3. Ease of access for open spaces
4. _____

[29] Compared to the building u reside, which building in CMC compound do you think is open space friendly? [Color site plan attached]

1. Building 1
2. Building 2
3. Building 3
4. Building 4
5. Building 5
6. Building 6
7. Building 7
8. Building 8

[30] Why do you think building_____is open space friendly?

1. It has better access for open spaces
2. It has lower heights
3. It is not enclosed
4. It has larger width that exposes it for open space
5. Its location in the compound
6.
7. Other_____

[31] What changes do you observe on children trend of open space utilization?

1. They tend to use regardless of floor heights.
2. They tend to play at home rather than outside
3. They tend to play at school than in the compound
4. They do not prefer to play in the playfields provided since they are from their houses.
5. Other_____

[32] How satisfactory is the available open spaces?

1. Very satisfactory
2. Satisfactory
3. Medium
4. Tolerable
5. Unsatisfactory

[33] Which age groups are affected by building height?

1. Children
2. Older people
3. Disabled
4. Obese people
5. Other…