



Ethiopian Institute of Architecture, Building Construction,
and City Development /EIABC/

Space- syntax as a tool for place making by restructuring public spaces within
mixed-residential areas of Addis Ababa, the case of Meskel flower district

By
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A Thesis submitted to the school of graduate studies of Addis Ababa University for
the partial fulfilment of the degree of Masters of Science in Urban Design and
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Declaration

I, the undersigned, declare that this thesis is my own and original work for **Meskel flower, Kirkos sub-city of Addis Ababa** and has not been presented for any other degree in any other university, and that all sources of material used for the thesis have been properly acknowledged, by following the scientific guidelines of the Institute.

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April, 2022

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Abstract

Placemaking is a process that inspires people to reinvent or reimagine public spaces as the heart of every community. It also strength the connection between peoples and places they share. The main existing problem in the study area is the existence of fewer open spaces when compared to standards. The existing open spaces are not providing the intended services and most of them are leftover spaces without any function and some are even used for emerging slum housing. The general objective of this study is identifying spatial capital of the neighbourhoods and redesign open. In this paper analytical research is used together with qualitative and quantitative data types. Software like GIS, AUTOCAD, and depthmapX are used for data analysis. The main finding from this paper is, the Study area is poorly connected in relation to the required function, the linkage and integration of public spaces with people's primary uses are poor and roads within residential areas have poor connection and are characterized by dead ends. So, the overlayed street integration and open space map was developed in response to creating functional open spaces to achieve the desired mixing of functions and accessibility based on the standards, which provides responses to the problems that were collected and analysed. This study attempts to provide sample design proposals of selected areas or nodes of the overlayed map, with placemaking as the main focus area.

Keywords: Axial map, Accessibility, DepthmapX, Diversity, Spatial capital

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Table of Content

Acknowledgment.....	iv
Abstract.....	v
Table of Content	vi
List of Table	x
List of Figures.....	xi
Acronyms and Abbreviations	xiv
CHAPTER ONE: INTRODUCTION.....	1
1.1 Background of the study.....	1
1.2 Problem statement	3
1.3 Objective.....	5
1.4 Research Questions	5
1.5 Scope	5
1.6 Significance of the study	6
1.7 Limitation	6
1.8 Organization of the paper	7
CHAPTER TWO: LITERATURE REVIEW	8
2.1 Theoretical review	8
2.1.1 What is place making	8
2.1.2 Place and place making in cities.....	8
2.1.3 Classification of place making	9
2.1.4 How to make a great place	13

2.1.5 Important quality of a place.....	14
2.1.6 Placemaking process	16
2.2.1 Spatial capital as a tool for place making	18
2.2.2 Urbanity and accessible diversity	18
2.2.3 How to measure spatial accessibility.....	19
2.2.4 Spatial Diversity and How to Measure it	20
2.2.5 Spatial capital as a measurement of urbanity	21
2.2.6 Historical background of space syntax.....	21
2.2.7 Concepts and Measures from Space Syntax Analysis.....	23
2.2.8 Application of space syntax as a tool in analytical urban design	30
2.2.9 Advantages and limitation of space syntax	32
2.3 Contextual review.....	34
2.3.1 Mobility characteristics of sub-Saharan Africa.....	34
2.3.2 Mobility characteristics in Addis Ababa	34
2.3.3 Walking, movement and modes of transportation in Addis Ababa.....	34
2.3.4 Addis Ababa Road network and connection	35
2.3.5 Open space in Addis Ababa	37
CHAPTER THREE: MATERIALS AND METHODS.....	38
3.1 Study area description	38
3.2 Data types	40
3.3 Data sources.....	40

3.4 Method of data collection	40
3.5 Method of data analysis	40
3.6 Research design	42
3.7 Analysis	45
3.7.1 To map the study area based on the spatial capital of different localities	45
3.7.1.1 Existing Street network	45
3.7.1.2 Existing Land use	46
3.7.1.3 Connectivity (socials vs public space)	47
3.7.1.4 Commercial Street	48
3.7.1.5 Public space	49
i. The spatial connectivity and integration of street	50
ii. Building density per plot	52
iii. Integration of axial map and building density	54
iv. Spatial diversity	55
a. Shannon Diversity	58
b. Shannon diversity index	58
3.7.2 To compare the spatial capital of each locality.	66
CHAPTER FOUR: RESULT	74
4.1 Map the study area based on the spatial capital of different localities.	74
4.2 Compare the spatial capital of each locality.	75
4.2.1 Result of four zones	75

4.2.2 Comparison of diversities of zones	76
4.2.2 The major finding from the space syntax analysis	78
4.3 Propose appropriate urban design solution of place making for the existing spatial capital of selected areas of the district	78
4.3.1 Design proposal	80
4.3.2 Design proposal 1	81
4.3.3 Design proposal 2	83
CHAPTER FIVE: DISCUSSION	85
5.1 Map the study area based on the spatial capital of different localities.	85
5.2 To compare the spatial capital of each locality.	86
5.3 Propose appropriate urban design solution of place making for the existing spatial capital of selected areas of the district.	88
CHAPTER SIX: CONCLUSION AND RECOMMENDATION	90
6.1 Conclusion.....	90
6.2 Recommendation.....	91
Appendix	96

List of Table

Table 1: Methods and Methodology	44
Table 2: Shannon Diversity Index of zone A.....	60
Table 3: Shannon Diversity Index of zone B	61
Table 4: Shannon Diversity Index of zone C	63
Table 5: Shannon Diversity Index of zone D.....	65
Table 6: Comparison of four zones.....	75
Table 7: Shannon Diversity Index of Different zones	77

List of Figures

Figure 1: Four types of place making (Wyckoff, 2016).	9
Figure 2: placemaking depend on broad engagement of stakeholders and activities (Wyckoff, 2016).	10
Figure 3: Strategic placemaking (Wyckoff, 2016).....	11
Figure 4: Key attributes of a place (Guedoudj et al., 2020).	13
Figure 5:Place Vision for the Perth Cultural Centre creatively synthesized the results of a placemaking (IPA, 2018).	17
Figure 6: The elementary spatial units that are used in space syntax (Yamu et al., 2021).	24
Figure 7: Three different types of maps that are used in space syntax analysis (Yamu et al., 2021).	25
Figure 8: An axial map (b) and a global axial integration analysis (c) of a settlement (a) and the justified graph (d), with the root node a representing the main street (Yamu et al., 2021).	26
Figure 9: A topologically shallow j-graph of the main street and (b) a topologically deep graph of the back street (Yamu et al., 2021).	27
Figure 10: (a) The axial map of Rotterdam and the (b) connectivity, (c) global, and (d) local axial integration anal (Yamu et al., 2021).	29
Figure 11: Location of Lijnbaan shopping street in Rotterdam and (b) Two-step analysis (Yamu et al., 2021).	30
Figure 12: Option testing for a new bridge across the Nieuwe Maas River in the city of Rotterdam (Yamu et al., 2021).	32
Figure 13: Conceptual plan	36
Figure 14: Meskel square, Addis Ababa	37
Figure 15: Location map of the study area	39

Figure 16: The workflow of space syntax analysis using the DepthmapX.....	41
Figure 17: Research design	43
Figure 18: Existing Street network	45
Figure 19: Existing land use map.....	46
Figure 20: Connectivity of public space and social	47
Figure 21: commercial street of the study area	48
Figure 22: Public space of the study area	49
Figure 23: Spatial integration.....	50
Figure 24: Spatial connectivity	51
Figure 25: Integration axial map	52
Figure 26: Parcel density of the study area	53
Figure 27: Building density per parcel with in the study Area	54
Figure 28: Integration of axial map and building density per plot.....	55
Figure 29: Building and parcel map.....	56
Figure 30: Space syntax analysis summary	58
Figure 31: Four public space zones classified by functional areas	67
Figure 32: Axial map (a) and parcel density map (b) of zone A	68
Figure 33: Building density and spatial integration map of zone A	68
Figure 34: Axial map (a) and parcel density (b) map of zone B.....	69
Figure 35: Building density (a) and spatial integration map (b) of zone B	70
Figure 36: Axial map (a) and parcel density map (b) of zone C.....	71
Figure 37: Building density (a) and spatial integration map (b) of zone C	72
Figure 38: Axial map (a) and parcel density map (b) of zone D	72
Figure 39: Spatial integration map of Zone D	73
Figure 40: Four zones of the study area classified based on spatial capital.....	74

Figure 41: Comparison of four zones	76
Figure 42: Diversity index for four zone	77
Figure 43: Conceptual Street integration and open space map	79
Figure 44: Design proposal, site plan and 3D view	81
Figure 45: Site 3D view existing and proposal	82
Figure 46: Design proposal, site plan and 3D view	83
Figure 47: Site 3D view existing and proposal	84

Acronyms and Abbreviations

CSA	Central statistical agency of Ethiopia
EiABC	Ethiopian Institute of Architecture, Building Construction and city Development
GC	Gregorian calendar
GIS	Geographic information system
<i>H</i>	Shannon Diversity Index
Int. R3	Integration analysis, radii of 3 (Int R3)
Int. RN	Integration analysis, radii of n
PPS	Project for public spaces
SLCT	Smaller legacy city toolkit
UHI	Urban heat island

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Globally, cities are expanding as a result of growth in human population specially in urban areas. While making city the planning and protection of trees, waterbodies, public parks at neighbourhood level is important segment to create a sense of liveable and comfortable place. Place making society and ecology are most interrelated concepts if a little concern is given to them. In order to achieve social and ecological sustainability simultaneously place making can play a great role (Murphy *et al.*, 2019).

The need for place making is necessary, because of it is useful to improve the physical environment. There are some perspectives which indicates that placemaking would contribute to social developments. Most sociologists make the point that most social problems are related to physical environmental quality (Karacor, 2015).

The aspects of the built form that concern planners are sense of place, neighbourhood belonging, access to services, mixed communities and time in influencing change in built form. Spatial capital by planning practice is a useful trope that helps planners to bring together a series of urban events that could offer considerable insight into the operation of power in the urban environment invalid source specified.

The term spatial capital focus on how people engage with place and it is common in planning practice. Spatial planning help designers and planners to draw greater attention the combined effects of people seeking positions within place which add relational sense of place in planning and design. Spatial capital cover different aspect of urban life and it emphasize the use of place

or place plus mobility which create powerful social advantage through place plus mobility (Mace, 2017).

The world is now seeking for healthy and sustainable urban development, and give much attention for better quality of urban life in the process of urbanization. Ethiopia is still in stage of rapid urbanization, and a more and more people move to cities, the attention should be given for better urban services and high qualified urban life as a driving source for healthy urban development and economic growth. So, the need of transition from rapid urbanization to healthy and sustainable urban development and the cities in Addis Ababa lacks diversity of useable public space for different activities and poor environmental quality.

The city of Addis Ababa was founded by Emperor Menilik in the year 1886. Since then, Addis Ababa remained the capital city of the nations because of its location, hygienic conditions and material convenience. Addis Ababa is one of the fastest growing metropolitan areas in Ethiopia. The rapid urban growth the city saw in the last century resulted in tremendous land cover change dynamics within the metropolitan region. Particularly within the last 15 years rapid urbanization has consumed vast acreages of land adjacent to the city (Kifle, 2016).

Addis Ababa is a capital city and economic center of Ethiopia, which plays the leading role in practices for vital and diverse urban life. There are a lot of problems and challenges emerge in this process such as commercialization of public space. So, the main district of Addis Ababa needs critical spatial intervention for regenerating public street life and neighbourhood level open space of Addis Ababa especially in the central business district and this study is intended to Kirkos sub city mainly Wereda 02 and 03 around Meskel Flower area.

To find proper solution for these problems, this thesis looks for space syntax and public space projects with the place making strategy. Additionally, this thesis finds the way to achieve the balance by placemaking within open and leftover spaces which focus on Wereda 02 and 03 of Kirkos sub city around Meskel Flower area of Addis Ababa and create good public street space for commercial activities of everyday life. There are many open spaces in Addis Ababa, which were left useless by the existing plan of the city. Particularly this research focus area has many open spaces, which were left useless but can utilized and put to use by the community around them using place making as a tool.

1.2 Problem statement

With cities expanding globally and human populations becoming increasingly urban, sustaining ecosystems that support human well-being in cities is both increasingly challenging and urgent. City residents can take on important roles in the stewardship of public parks, trees, and waterbodies in their neighbourhoods, and sense of place is often brought forward as a motivation for engagement.

Currently there is an increase of population globally, and urban spaces also expanded dramatically much faster with much more significant changes than the previous decades. About 50 % of the world population (3.4 billion) is settled in cities. Also, it is predicted that population in cities will reach 60% (5 billion) by 2030, which means around additional two billion people will reside inside cities. There is expanding of building construction to respond to this extremely large dwelling demand and this excessive and unplanned growth of urban areas has caused undesired side effects around the world from these effects the one and more significant is less sense of liveable and comfortable place (Mirzaei & Haghighat, 2010).

Kirkos sub city is one of the 11 sub cities in Addis Ababa among one of the densely populated sub cities in Addis Ababa with a population density of 150 persons per hectare. In order to maintain balance between the population and the natural environment there need to be an intervention mechanism. Because of less open spaces, the situation in kirkos sub city, particularly in the study area (Meskel Flower), has been very unbalanced over the past ten years in terms of achieving balance between society and nature. Here are some empirical evidences in specific areas of the study area.

- The open space inside the study area is not providing the targeted purposes and most of them are leftover spaces without any function, because of this irregular settlement and slum housing emerging in those open space areas.
- According to norms and standards of Addis Ababa Structure plan, 12% – 25% of the area should be left for greenery and natural open space. So, when compared to this standard, there are fewer open spaces (2%) in the study area. As a result, the quality and function of existing open space is poor, for example the newly planned St. Yared Square in the study Area is underperforming.
- The abandoned corridor (old railway) has a lot of potential for merging society with nature, but nothing has been done to make it happen.

Cities should promote sustainable urban development since they are key drivers of global effects due to human development and the highest population density; as a result, cities encounter more artificial environments, making them the most effective intervention targets. As a result, urban design should have an impact on various self-organizing systems in the city, such as pedestrian circulation, because the most tangible concept of urban design is the structuring and shape of urban space.

1.3 Objective

General Objective;

To identify Spatial capital of the neighbourhoods and redesign open spaces within mixed residential areas of Meskel flower district of Addis Ababa for place making.

Specific Objectives

1. To map the study area based on the spatial capital of different localities.
2. To compare the spatial capital of each locality.
3. To propose appropriate urban design solution of place making for the existing spatial capital of selected areas of the district.

1.4 Research Questions

Main question;

How to identify Spatial capital of the neighbourhoods and redesign open spaces within mixed residential areas of Meskel flower district of Addis Ababa for place making?

Specific question;

1. How to map the study area based on the spatial capital of different localities.
2. How to compare the spatial capital of each locality.
3. How to propose appropriate urban design solution of place making for the existing spatial capital of selected areas of the district.

1.5 Scope

This research was carried out in Ethiopia, in the city of Addis Ababa, in the Kirkos sub-city on Woreda 02 and woreda 03 which is located around Meskel Flower. It focuses on open spaces that have been abandoned. The research is focused on the study Area, which is encompassed by four streets: Wollo sefer road in the west, Gotera square and Beyene Aba Sebsib street in the south, and Washington square in the north.

Thematically, this research is limited to place making, pedestrian movement, and related environmental parameters to make resilient place making at neighborhood level open spaces, in the case of Meskel flower Kirkos sub-city Addis Ababa. This research tries to relate placemaking approach and spatial capital concept, so as to achieve sustainability.

1.6 Significance of the study

This research can be used for other researchers, planners, designers, architects, policy makers to focus on spatial capital design approach while making place at neighborhood level or bigger scale. Academically this paper can be used as reference for other studies since it tries to introduce additional information relating to placemaking through spatial capital approach methods.

For the community of Meskel Flower, If the concept is implemented in the Meskel Flower neighbourhood, it will create ecologically friendly spaces that are liveable, functional, habitable, and psychologically comfortable, as well as having extra positive effects on the existing environment.

1.7 Limitation

Many constraints were encountered in this study, ranging from data acquisition to analysis, and the following are some of them. To create an axial map of the city, a clear line map of the city is required. However, obtaining a clear line map of the study area was challenging, therefore the first obstacle was developing a clear line map of the city's whole road system in GIS, which took more time. The quest for software to create an axial map was the second challenge. However, Depthmapx needs a high-performance supercomputer. As a result, producing an axial map of the entire road system of the study area at one time was difficult. So the analysis was carried out by separating the study area into major divisions.

1.8 Organization of the paper

This paper is organized into six chapters. The first chapter is an introduction part which includes the background of the study, problem statement, objectives, Research questions, significance of the study, scope, limitation of the study. The second chapter state different kinds of literature related to the topic. The third chapter consisted of the methods and materials that used in the research. The fourth chapter states findings and results from the analysis part. Chapter five is devoted for discussion on results and major findings and chapter six deal with the conclusion and recommendation.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical review

2.1.1 What is place making

Placemaking is a process of inspires people to reinvent or reimagine public spaces as the heart of every community. It is to strength the connection between peoples and places they share. So placemaking is a collaborative process by which peoples can shape their public realm in order to maximize shared value. Additionally, it is about promoting better urban design by facilitating social, cultural and physical identities that define a specific place (Wyckoff, 2016).

“Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody” -Jane Jacobs

2.1.2 Place and place making in cities

Place making is the way to improve quality of various places in a neighbourhood, the community and region in which those places are located and helping neighbourhoods and communities imagine and create their better future. So simply place making is the process of creating quality of places that people want to live in, play, work and learn. So, these places where people want to be. They are active, visually attractive, unique locations, often with public art and creative activities. Additionally, they are people friendly, walkable, safe, mixed use, building dimensions relative to street (Wyckoff, 2016). The key elements of quality of places are

- Green spaces
- Quality of public space, recreation
- Mixed uses

- Arts, culture and creativity
- Preservation of historic structures

Quality of place also a result of good form characteristics which includes

- Human scale – designed for people
- Walkable- pedestrian oriented, and bikeable
- Mass, density and scale appropriate to place on transect

When these form characteristics are in place then the result is good quality of place which are

- Connected, safe, welcoming
- Comfortable - addresses perceptions about cleanliness, attraction and character
- Accessible - ability to circulate with in, along and between open and public spaces.
- Sociable – have a physical feature of people can connect with one another (Wyckoff, 2016).

2.1.3 Classification of place making

Place making can be classified as four types which are strategic place making, creative place making, tactical place making and standard place making. *Figure 1* below illustrates that four major types of place making (Wyckoff, 2016).

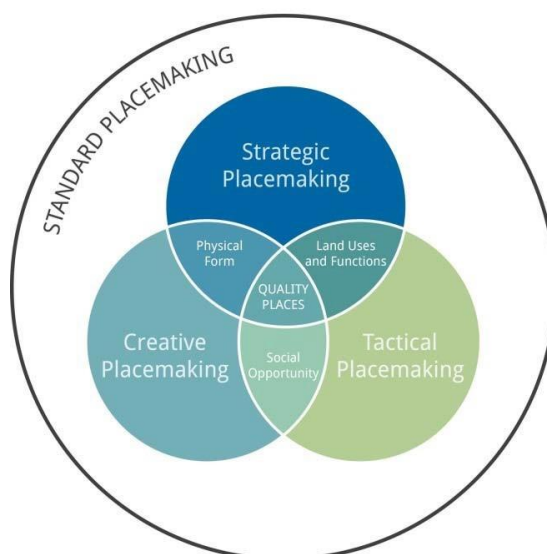


Figure 1: Four types of place making (Wyckoff, 2016).

i. Standard place making

Standard placemaking or simply placemaking is a general term in which it is associated with placemaking as advanced by the project for public spaces. For the most part placemaking is used as incremental way to create a strong sense of place over a long period of time with many separate projects and activities. Placemaking depends on broad engagement of stakeholders to design projects and activities which is shown in *Figure 2* below (SLCT, 2016).



Figure 2: placemaking depend on broad engagement of stakeholders and activities (Wyckoff, 2016).

So, Standard placemaking is a process that create quality of places in which people want to live, play and work in. it requires empowering and engaging people to participate in the process. According to Steuteville, (2014) examples of standard placemaking includes;

- **Project-** downtown and main corridors street and façade improvement in neighbourhood-based projects such as residential rehabs, park improvements, small-scale multiuse projects.
- **Activities-** public place events like sidewalks, town squares, streets, civic buildings etc.

ii. Strategic placemaking

Strategic placemaking is targeted to achieve additional goal beyond creating quality of places. It aims to create quality of places that are uniquely attractive to talented workers, so people want to live there and they create situation for substantial job creation and income growth by attracting business. *Figure 3* below illustrates strategic public actions to support place making (SLCT, 2016).

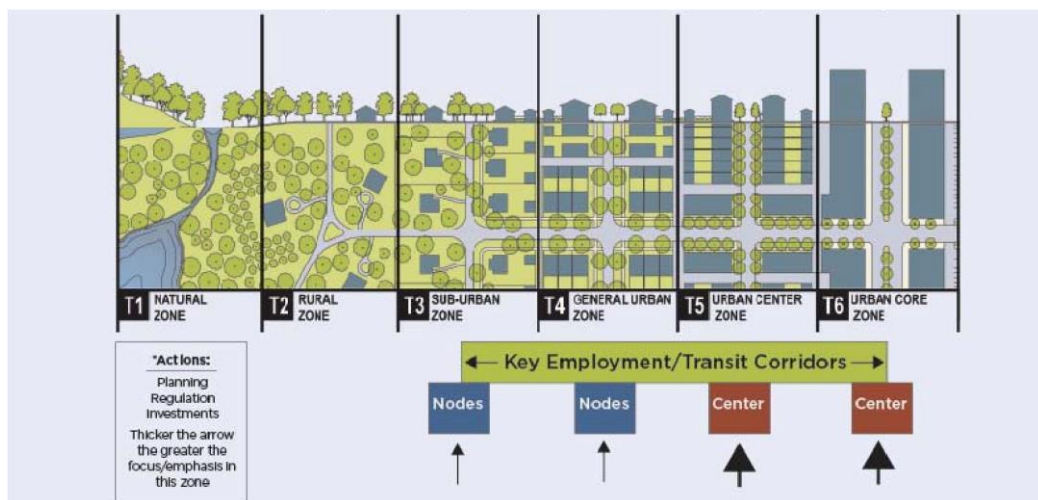


Figure 3: Strategic placemaking (Wyckoff, 2016)

So strategic placemaking is targeted process not accidental involving activities / projects in certain locations defined by corridors and nodes that result in sustainable, human scale, safe, pedestrian oriented, bicycle friendly, mixed use, green places with lots of recreation, multiple accesses. Examples of strategic place making according to Steuteville, (2014) includes.

- **Projects-** mixed use developments in downtowns along key corridors
- **Activities-** targeted talented workers as well as arts, entertainment, recreational activities that add vitality and quality of places that attract wide range of users.

iii. Creative placemaking

In creative place making partners from private, public and community strategically shape the social and physical character of the town, city or neighbourhoods. Creative placemaking animates private and public spaces, revive structures, and streetscapes, improvement of public safety and brings diverse peoples together. Examples of creative place making according to SLCT, (2016) includes;

- **Projects-** creative and cultural thinking such as museum, public art displays, inclusive arts, transit stations with art themes etc.
- **Activities-** entertainment activities that add vitality to quality of places, culture, and new arts.

iv. Tactical placemaking

Tactical placemaking is derived from two separate but related approaches come together. The first is tactical urbanism and the second is lighter, quicker, cheaper in which the name is given by set of activities for public spaces (Steuteville, 2014).

Tactical urbanism is described as improve the livability of our cities and towns commonly starts at the street, block or building scale. The larger scale does their place, incremental and small-scale improvements are increasingly seen (SLCT, 2016).

So tactical placemaking is a process of creating quality of places that uses a deliberate sometimes a phased approach to change that begins with small stage and often at low cost. It targets public spaces with continuously mix of small projects and short-term activities for a long period of time. Examples of tactical placemaking as to Wyckoff, (2016) includes;

- **Projects:** short term projects, small, construction of new form of dwelling in a neighbourhood such as passive solar home.
- **Activities:** temporary activity places, parking space conversions, new bike path, photo renderings to illustrate the potential of adding or removing building in certain places.

2.1.4 How to make a great place

Most of the successful and great places weather a downtown plaza or humble neighbour park, it has four major key attributes that is illustrated in *Figure 4* below.

1. They are well-connected and accessible to other important places.
2. They attract people to participate in activities.
3. They are sociable environments in which people want to be there again and again.



Figure 4: Key attributes of a place (Guedoudj et al., 2020).

2.1.5 Important quality of a place

i. Access and linkages

The accessibility of a place is measured by connections to the surrounding including the visual links. Great public space has ease of access and better connectivity in which it is easy to get to, and easy to navigate (Guedoudj *et al.*, 2020).

ii. Comfort and image

Successful space that is comfortable and looks inviting. A sense of comfort includes cleanness, perception about safety, cleanness and availability of place to sit. A place with better comfort and image should answer the question like does the place make good first impression, are there comfortable place to sit, either in the sun or shade etc. (Guedoudj *et al.*, 2020).

iii. User and activities

For making a greater place a range of activities are the fundamental building blocks. Having something to do in a specific place gives people a reason to come and return. A variety of activities will help a place attract peoples at different time of the day (Guedoudj *et al.*, 2020).

iv. Sociability

Sociability is the most important quality of place to achieve. When place becoming a favourite spot for people to meet friends, feel comfortable interacting with strangers and greet their neighbours then it is a for people on having a great place (Guedoudj *et al.*, 2020).

2.1.7 Principles and guidelines for creating great community places

There are eleven key principles for transforming public space into vibrant community places, weather they are public square, parks, streets, plazas, sidewalks or other outdoor and indoor spaces that have public uses in common (PPS, 2018). These principles are

i. The community is the expert

The important starting of developing a concept for any public space is to identify assets and talents within the community. Trapping the information from the community at the beginning of the process will help to create a sense of community ownership (Aushaf, 2020).

ii. Create a place, not a design

To make a vital place physical element must be introduced that would make people comfortable and welcoming such as new landscaping, seating, pedestrian circulation pattern and developing more effective relationship between the activities going on in the public spaces and surrounding retail. The main goal is to create a comfortable image and strong sense of community (PPS, 2018).

iii. Look for partners

For the improvement of image of public space, partners are critical for enhancing success. Excluding partners at the start of the plan and develop scenarios, these colorations are invaluable in providing support and getting the project off ground (PPS, 2018). Finding the right partner will provide more resources, fresh ideas, and a new source of energy that help the project succeed.

iv. Have a vision

The vision should emerge from each community, but the most important vision for any public space is a concept that arises from the types of activities that might take place there. A vision should be an important location where people desire to be, with good image and comfortable surroundings (Aushaf, 2020).

v. You can see a lot just by observing

Observations of other projects lead to learn a great deal from the successes. By looking how people use public spaces and finding out what people need. Through these observations, it is clear that what kind of activities to be incorporated and what are missing (PPS, 2018).

vi. Form supports function

There is an input from potential partners and communities, to understanding how spaces function, overcoming the obstacles and the experimentation and provides the concept for the space. Although design is important, these other elements tell you what “form” you need to accomplish the future vision for the space (Aushaf, 2020).

vii. Triangulate

Triangulate is a process in which the external stimulus provides a linkage people and promote strangers to talk to other. In a public space, the choice and arrangement of different elements in relation to each other can put the triangulation process in motion or not (PPS, 2018).

viii. Experiment: lighter, cheaper, quicker

The complexity of public spaces limits people to do everything right initially. Elements such as outdoor cafes, seating, public art, community gardens, striping of crosswalks are examples of improvements that can be accomplished to make public spaces lighter (PPS, 2018).

2.1.6 Placemaking process

The placemaking method can be used to improve an existing venue or to design a new one. Because each situation is unique, the steps are not necessarily identical, nor do they always occur in the same order. However, according to PPS, (2017) Public Spaces uses a five-step process to get more people involved in planning, and shaping a place.

i. Define Place, select a site and identify the stakeholders

The first step in turning a place around is to choose the correct site and stakeholders. The placemaking process begins with a gathering of community representatives from the public, private, and civic sectors to identify the primary concerns that different groups confront and to choose a specific location or places on which to focus their placemaking efforts (PPS, 2017).

ii. Evaluate Space, identify issues and collect data

Evaluate how the space is currently being used and how it can be improved (IPA, 2018).

iii. Place Vision

In this step it is to develop a place vision, from the above process. This includes the mission, definition, description, concept plan, action plan and management plan (PPS, 2017). Successful examples of similar spaces or parts of spaces is shown in *Figure 5* below.



Figure 5: Place Vision for the Perth Cultural Centre creatively synthesized the results of a placemaking (IPA, 2018).

iv. Implement vision

Implement your vision incrementally by completing short-term improvements that require a short timeline (PPS, 2017).

v. Re-evaluate place and long-term improvements

Creating great places is a continuous process: It's crucial to revisit previous projects by evaluating the area at various points in time (IPA, 2018).

2.2.1 Spatial capital as a tool for place making

The work defining spatial capital is significant for being based on actual studies of urban social dynamics depicting urban events that are relevant to the daily concerns of planners with a political economy/'just city' approach. Spatial capital studies examine how privileged groups use urban space and place to their advantage, often in combination with mobility, to create inequitable opportunities. He's interested in how they felt entitled (due to habit), allowing them to occupy, dominate, and define specific spaces (Marcus L., 2007).

Space syntax is a configurational theory of architecture, that deals with relation of parts within architecture. So, an analytical theory in urbanism trying to incorporate into space syntax areas in urban morphology. It allows for more simplification and main variable of urban form, that is analyzed with space syntax is accessibility and more deals with how accessibility between spaces in a spatial system in the configuration of urban form (Marcus L.,2007).

2.2.2 Urbanity and accessible diversity

The analytical theory on the social performativity of urban form addresses the relation between urban life and urban form. These two generate a socio-spatial category or can be said as urbanity. More specifically it identifies how urban form influences urban life in which how it organizes, supports and hinders it. By using these ideas as a starting point the urban form will be proposed by doing so creates and it is called spatial capital and that is possible to measure.

The most common concept in the spatial capital is density, whether building mass, density of population or other things (Marcus L. , 2010).

The degree of accessibility is really influenced by density, which is achieved by design of urban fabric of building and street, that is urban form and it really matters the density of specific place. Furthermore, high density by itself does not necessarily create urbanity, even if it is well easily accessed. For example, different institutional areas such as hospitals can be both accessible and dense, but not typically urban. There should be variable necessary distinctive features of urbanity that variable is proposed to be diversity. It is argued that there are two variables of diversity and accessibility often over-ride the impact of the more common variable of density when it comes to discerning urbanity. For example, many low-density small cities present a high diversity and accessibility and also strong sense of urbanity (Marcus L. , 2010). So, urbanity is both socially and spatially, which is constituted by a high level of diversity and accessibility. According to the theory of spatial capital, urban form generates diversity and variations in spatial accessibility, which has direct effect on diversity and social accessibility, which are possible to measure (Marcus L. , 2010).

2.2.3 How to measure spatial accessibility

The measure of urban form is directly relating to its social performativity and have a powerful influence on the degree of diversity and accessibility for urban life. The technique used for such analysis when it comes to accessibility on detailed scale beyond spatial integration analysis developed in space syntax. For such analysis the most developed technique is the intervention of the axial map, which is the representation of urban space, as structured by urban form the experiencing and acting of human point of view, where each axial line represents an urban space that is possible to visually overlook and physically access. Such analysis measures the accessibility of each axial line from other axial line in the map which is called the integration

value of each line. There is a strong correlation between such integration values and pedestrian movement and that is the most generic aspect of urban life (Marcus L. , 2007).

The accessibility measurement of space syntax may also be further developed to place space syntax. Space syntax is a general integration analysis, which deals with analysis of urban space, in which the analysis focused on the accessibility to urban space in itself without any regarded of the content of space, such as retail, residential population or bus stops. In place syntax analysis, the axial map used to measure distance to place data on plots or address points.

place syntax not only analyses accessibility of other places but also the accessibility to specific space as well. Therefore, deal with specific spatial accessibility, such as accessibility to different attractions. Unlike place syntax integration analysis deals with general spatial accessibility, which accessibility to urban space in itself (Marcus L. , 2007).

Place syntax analysis is also representing in many respects more life-like mode of geographical data. In most of the time it represents density with in geographical units, such as blocks, city districts, plots. So, it also deals with representation of the accessibility within a certain radius such as walking data and then accessibility to density map shows the density in the context of accessibility (Marcus L. , 2010).

2.2.4 Spatial Diversity and How to Measure it

The development of the axial map shows the successful in capturing movement. So here the focus shift from experimentally defined space (axial line) to legally defied space such as publicly and privately owned domains. The plot with some activity in urban space represents the presence of an actor. So, an area with many plots have potential to carry higher amount of actor in which higher number of strategies for action. Place space syntax measures the accessibility to specific types of space such as plots or address plots. For example, many axial

lines from each plot in an area can show the distribution of potential diversity (Marcus L. , 2007).

2.2.5 Spatial capital as a measurement of urbanity

The place syntax and integration analysis are the powerful techniques for the analysis of spatial diversity and accessibility, as well as influential mode of measuring density. So, from these identified that urban form is the most influential on generic aspect of urban life (Mace, 2017).

Space syntax is the area of research that deals with spatial configurations to identify their structure and logic. Space syntax is useful in analyzing and describing patterns of urban space at both building and urban level. Space syntax seeks to answers questions like (Mace, 2017):

- What is the relationship between spatial cognition and configuration?
- How the configuration properties of spatial system be measured?

The spatial configuration of urban and architectural spaces can be studied in spatial cognitive experience. There is a development of reliable method currently in studying spatial patterns and led researchers attempting to use space syntax as a tool to examine the strength of design proposals in terms of functionality and can be reflected in the accessibility, flexibility, suitability and safety of a place to hold various range of activities (Mace, 2017).

2.2.6 Historical background of space syntax

The spatial features of a sustainable city can be characterized using the space syntax approach and theory. Penn & Hillier, (1937–2019) was a space syntax pioneer. His contribution to the understanding of the built environment through an operational approach for analyzing spatial relationships between built things resulted in a new refined understanding of the relationship between space and society. It integrates tangible aspects (movement and land use) with intangible factors (cognition and behaviour) in a way that other methodologies for space

analysis do not. The original version of the space syntax method was developed in the 1970s. Bill Hillier and his colleagues at the University College London's Bartlett School of Architecture have worked to develop the space syntax theory and practice over the years. So, at present, Space syntax is being used in study and practice all over the world (Yamu, *et al.*, 2021).

Space syntax facilitates the description of the spatial features of a sustainable city by providing precision with reference to spatial ideas and numerous analytical methodologies. Concepts and analytical techniques are already in place. The present challenge is to use these technologies in planning to improve the sustainability of built environments. For the calculation of configurative spatial links between streets in the built environment, the space syntax technique uses graph theory from discrete mathematics. In a broader sense, space syntax is a collection of approaches that can be used individually or in various combinations (Yamu, *et al.*, 2021).

Bill Hillier & Hanson, (1984) recognized early on that space syntax allows for a spatial arrangement to be used to explain the social organization of a settlement. Whereas Hanson's subsequent writings were mostly concerned with the socio-spatial systems within buildings.

“How the urban system is put together geographically is the wellspring of everything else,” Hillier described the significance of the spatial arrangement. As a result, the layout of buildings and how the street network is laid out have an impact on social relationships and people's subsequent socio-economic activity. consequently, the term "space" appears in the space syntax approach as an active matrix of settlement processes in which the city's physical structure is intimately linked to its social and cultural interactions (Yamu *et al.*, 2021).

The term syntax as it is understood as a set of “rules for the construction of a discourse” means ascribing a specific structural essence to the space, whose constitutive rules can be investigated through the study of relationships between the individual elements that comprise the space.

The international success of space syntax can be attributed to four factors: first, a simple definition of space and the spatial elements that are employed in the analysis are provided (Yamu *et al.*, 2021).

Second, space syntax is a set of analytical tools for calculating spatial interrelationships in the built environment. Thirdly, space syntax provides a set of strategies for correlating spatial analysis results with other socioeconomic variables. Fourth, space syntax is a set of hypotheses concerning the relationships between space, spatial relationships, and society that has been developed via scientific research (Yamu *et al.*, 2021).

2.2.7 Concepts and Measures from Space Syntax Analysis

- i. **Convex space:** A convex space is one in which "all points (locations) within that space can be connected to all others without going outside the space's boundary." In other words, when two persons are placed in any spot within a convex space, they can see each other. Intervisibility is essential for identifying a convex space (Yamu *et al.*, 2021).
- ii. **Convex map:** Convex maps are used to evaluate spaces inside buildings as well as public areas between groups of buildings in a neighbourhood or small village for spatial analysis. The analytical scale varies from architectural space to the public domain of a community. In urban studies, the convex map has been replaced by the axial map since an axial map can be prepared and drawn considerably faster than a convex map (Yamu *et al.*, 2021).
- iii. **Axial line:** An axial line is the longest sightline in a space within the built environment that indicates a moving path. Each axial line indicates a public urban space that connects to other public urban spaces in urban studies (Yamu *et al.*, 2021).

- iv. **Axial map:** The set of the longest and fewest axial lines in a built environment is called an axial map. The resolution of an axial map might be low, medium, or high. Only the major relationships between parts of the built environment are included in a low-resolution model, also known as a strategic model. A medium-resolution model is an extension that includes more pragmatic built-up and non-built-up feature relationships (Turner *et al.*, 2005).

The study of the precise routes of pedestrian movement is the focus of a high-resolution model, often known as a pedestrian model. The main distinction between the high-resolution model and the other two models is that for producing an axial map, the pavement will be the focal point. Hybrid models, which mix multiple resolutions for different regions of a city, are also available (Turner *et al.*, 2005).

The two basic essential spatial units used in space syntax are shown in *Figure 6*. In computational space syntactic analyses, three alternative forms of fundamental maps are shown in *Figure 7* below.

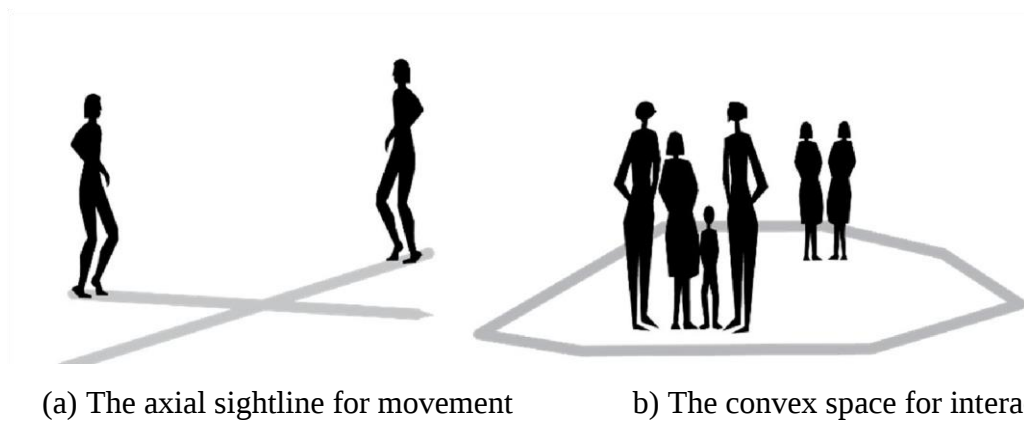


Figure 6: The elementary spatial units that are used in space syntax (Yamu et al., 2021).

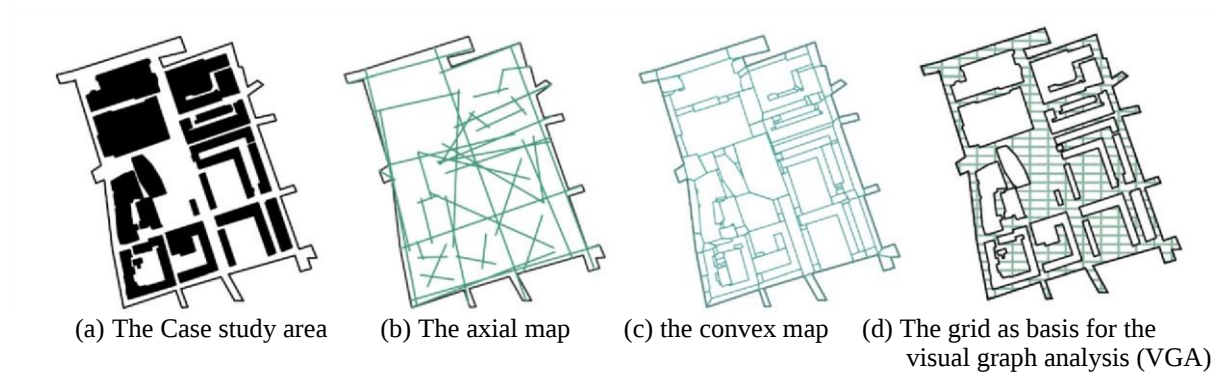


Figure 7: Three different types of maps that are used in space syntax analysis (Yamu et al., 2021).

- v. **Urban grid:** This is the network of public areas that connects a settlement's structures, regardless of its geometric regularity (Turner *et al.*, 2005).
- vi. **Justified graph (j-graph);** As a directional graph, a justified graph shows the spatial relationships or connections between distinct places. A node, vertex, or point represents each space, whereas an edge, which is a line, represents a link between two nodes. Only the spatial configurational relationship is taken into account while creating a justified graph. Geometric qualities are not displayed by j-graph. The geometric model of an urban street network that may be translated into a j-graph is known as an axial map.
- vii. **Depth:** The number of edges along the path from the root node to the chosen node determines the depth of a node in a j-graph. The root, for example, has a depth of 0 while any of its surrounding nodes has a depth of 1. A path from the root node to the end node that contains a large number of nodes is called topologically deep, while a path with a small number of nodes is called topologically shallow (Hillier B. , 1999).
- viii. **Total Depth:** The number of spaces to pass through from a chosen or given beginning place in the system determines total depth. The sum of all feasible steps from a given starting point is a system's total depth. When paired with the shape of the system, the depth value gives crucial information for the interpretation and study of an urban landscape. When describing the depth of a system, the terms 'shallow' and 'deep' are

frequently used. The total depth value of a shallow system is low, whereas the total depth value of a deep system is large. A shallow system's j-graph looks like a bush, while a deep system's looks like a tree. *Figure 8* below illustrates that how public spaces are abstracted as axial lines and make up an axial map (Yamu *et al.*, 2021).

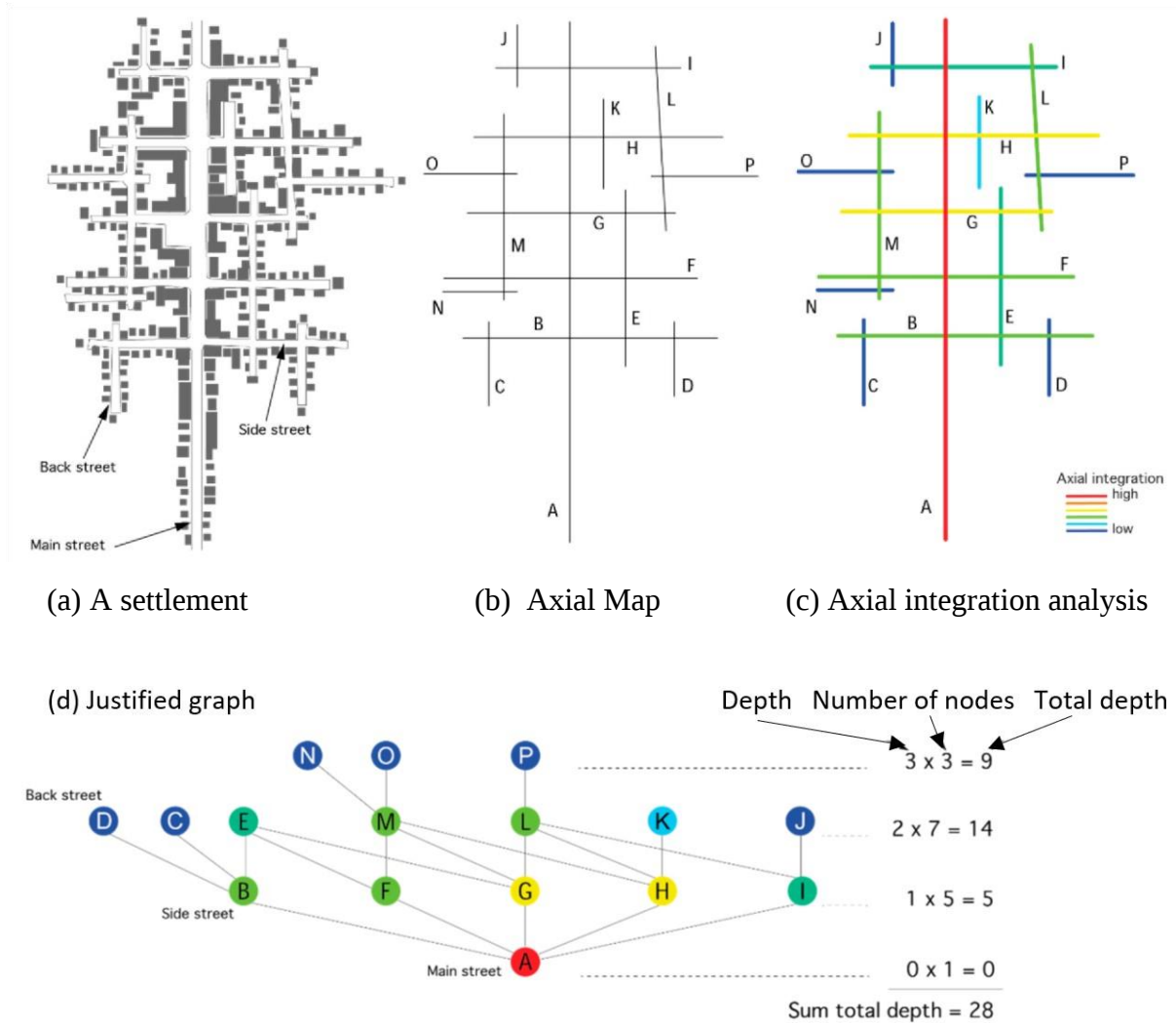


Figure 8: An axial map (b) and a global axial integration analysis (c) of a settlement (a) and the justified graph (d), with the root node a representing the main street (Yamu *et al.*, 2021).

- ix. **Connectivity:** Connectivity is a static local measure that describes how many connections each street has to its immediate neighbours. One of the fundamental ideas in graph theory is connectedness. A street with a high connectivity value has numerous

connections to its side streets, whereas a street with few connections has a low connectivity value (Klarqvist, 1993).

- x. **Axial integration:** This measure considers to-movement and estimates a street's degree of accessibility to all other streets in the urban system, taking into account an urban entity's total number of direction changes (syntactic steps). Connectivity is closely linked to axial integration. The higher a street's integration, and hence its accessibility, the fewer direction changes it makes to all other streets in the system. In short, the higher the connectivity to other lines and the higher the integration value of an axial line in an urban area, and vice versa. *Figure 9* explains how to calculate axial integration for topologically shallow and deep systems (Yamu *et al.*, 2021).

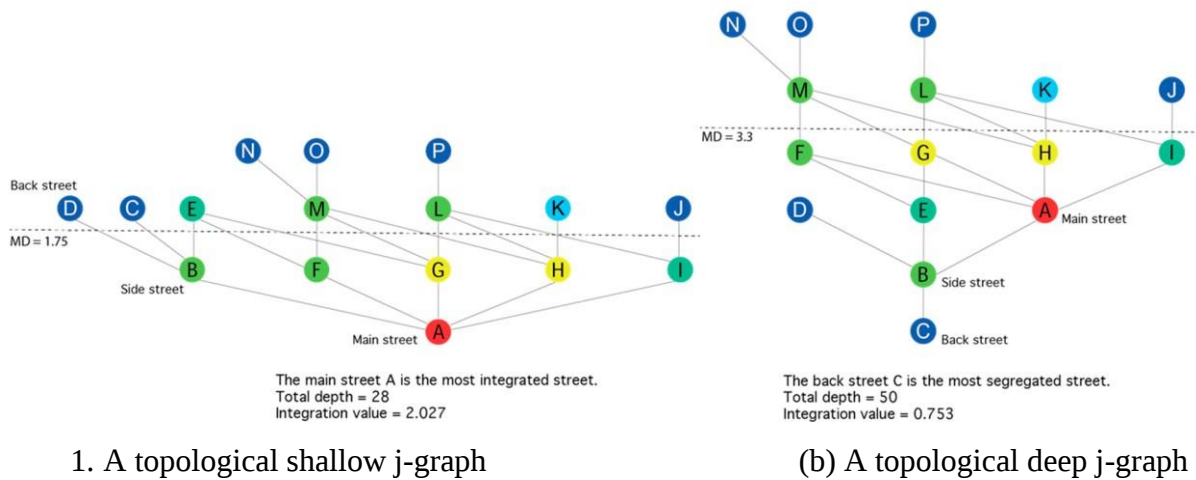


Figure 9: A topologically shallow j-graph of the main street and (b) a topologically deep graph of the back street (Yamu *et al.*, 2021).

- xi. **A syntactic step:** A single direction shift in an urban system is referred to as a syntactic step. Two syntactic steps, for example, imply two direction shifts. Three syntactic steps imply three changes in direction (Hillier B. , 1999).

- xii. **Two step analysis:** This form of analysis shows how many streets may be accessed in two directions from a specific street or road, or from a group of streets and roads. This sort of study is commonly used to determine the local catchment of a shopping street (Hillier B. , 1999).
- xiii. **N-step analysis of point depth analysis:** In terms of the frequency of direction changes, this form of analysis indicates how topographically deep all streets and roads are in comparison to one or several particular streets. The greater the number of direction changes from a single street or set of streets, the deeper an area is topologically (Van Nes & López, 2010).
- xiv. **Global and local radii:** Topological radii, which corresponds to the number of direction changes, are commonly used in classical space syntax analyses. A radius of n is used in the 'global' integration analysis, while radii of 3 or 5 are used in the 'local' integration study. In a built environment, global axial integration analysis determines how each axial line is connected to all others in terms of the total number of direction changes to all other axial lines. Local axial integration analysis, on the other hand, calculates how each axial line in a constructed environment is connected to its neighbouring streets in terms of the number of direction changes (Yamu *et al.*, 2021).

Figure 10 shows three different types of axial analyses of Rotterdam. The global integration analysis (*Figure 10 c*) shows where the most spatially integrated streets are located. The 5 percent score of the most heavily integrated streets is represented by the red and orange axial lines. The most integrated streets locally are depicted by the local integration with a radius of 3 (*Figure 10 d*) (Yamu *et al.*, 2021).

The connectivity map (*Figure 10 b*) depicts the number of direct connections between each axis and its immediate neighbours. The dark blue lines have just one to two connections, whereas the yellow and red lines might have up to 32. *Figure 11* shows two step analysis of the Lijnbaan, one of the main shopping streets in the centre of Rotterdam. The red axial line (*Figure 11 b*) indicates the starting point for the analysis. The two-step analysis visualizes how many streets can be reached within two direction changes from the origin (Yamu *et al.*, 2021).

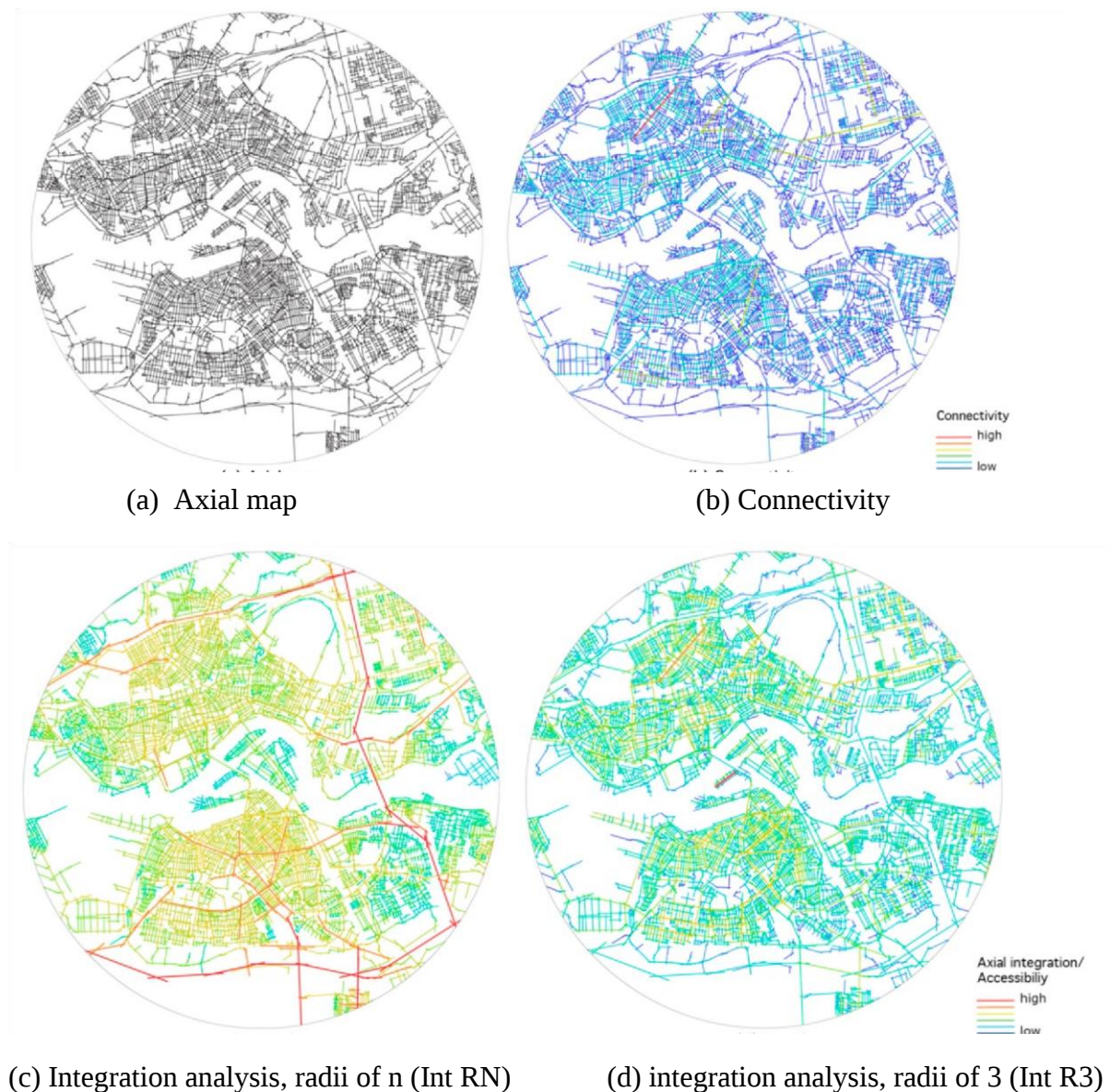


Figure 10: (a) The axial map of Rotterdam and the (b) connectivity, (c) global, and (d) local axial integration anal (Yamu *et al.*, 2021).



Figure 11: Location of Lijnbaan shopping street in Rotterdam and (b) Two-step analysis (Yamu et al., 2021).

2.2.8 Application of space syntax as a tool in analytical urban design

Space syntax has acquired popularity in the domains of architecture, urban planning, urban design, urban sociology, transportation engineering, criminology, and archaeology over the previous two decades. The space syntax toolbox includes approaches for analyzing, forecasting, and postdating the built environment's expected socioeconomic implications (Yamu *et al.*, 2021).

First deal with space, then with form, in order to build a well-functioning built environment. This means that the pathway network as the city's anchor must come first in urban planning and architecture. In other words, acknowledging that the spatial structure is the determinant of functionality and hence superior to form is critical for the planning and design of a well-functioning place (Yamu *et al.*, 2021).

If the volume and density of people in the streets affect the land use intensity, then space syntax evaluates the consequences on the future potentials of street life that are linked to land use.

This means that space syntax may be used in urban planning and design to examine the spatial consequences and potentials of various urban design approaches (Marcus L. , 2007).

As a result, urban design plans can be evaluated to determine the possible degree of vitality in urban street life. Space syntax can aid in the establishment of sustainable cities and communities by assisting decision-making for well-functioning urban architecture. For the purpose of experimenting with and developing urban planning and design scenarios (Aushaf, 2020).

Figure 12 depicts a space syntax analysis of two possible bridge positions. Option test A helps to improve the spatial integration of Rotterdam's southern center. As a result, the center will have the spatial capacity to become Rotterdam's major center. Option test B relocates Rotterdam's main center to the city's western outskirts. The idea of the natural movement economic process and the theory of the natural urban transformation process are used to draw findings from option testing in space syntax (Yamu *et al.*, 2021).

A space syntax analysis of two possible bridge positions is shown in *Figure 12*. Option test A contributes to the southern center of Rotterdam becoming more spatially integrated. As a result, the center has the potential to become Rotterdam's major center. Option test B relocates Rotterdam's central business district to the city's western outskirts. The theory of natural movement economic process and the notion of natural urban transformation process are both used to draw results from option testing in space syntax (Yamu *et al.*, 2021).

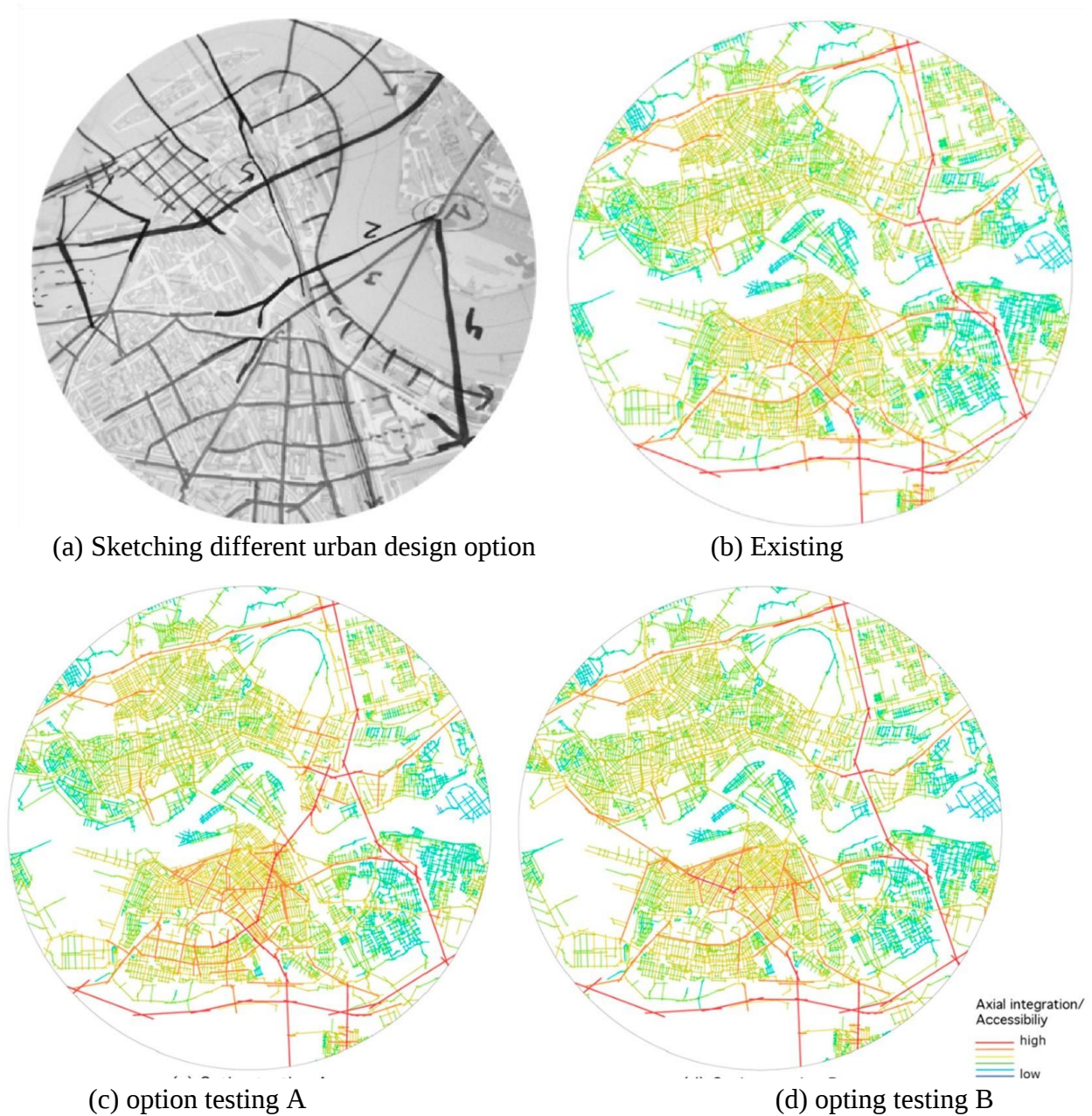


Figure 12: Option testing for a new bridge across the Nieuwe Maas River in the city of Rotterdam (Yamu et al., 2021).

2.2.9 Advantages and limitation of space syntax

Advantages of space syntax is summarized by the following five points (Yamu *et al.*, 2021).

- The use of space syntax establishes a conclusive link between the conceptual argument and real-world confirmation.

- Space syntax creates a strong link between theory and practice, allowing ideas to be easily transformed into practical applications such as evaluating specific building and urban designs in terms of pathway movements and potential interpersonal encounters.
- Unlike many other quantitative approaches and models, space syntax provides quantitative procedures that almost definitely evolved from the realm of environmental and architectural experience and, unlike many others, actually describe the real-life world structure.
- Non-specialists can readily and rapidly see spatial and environmental patterns and linkages using space syntax, which is a creative translation of these quantitative data into colourful graphic and cartographic presentations.
- Perhaps most importantly, space syntax articulately demonstrates that spatial patterns are the primary way in which the physical environment contributes to human life.

Despite its benefits, space syntax has disadvantages, including the lack of 3D information and the failure to consider attractors such as public transit hubs as crucial elements in shaping urban configuration and navigation. The argument was that 3D information is required for the intelligibility of the built environment in Lynch's concept (Yamu *et al.*, 2021).

Another issue levelled against space syntax is that it ignores metric features while analyzing mobility networks. Indeed, space syntax was designed to work just with topological distances at first (number of direction changes). After 2004, angular segment analysis included metric and geometric distances (degree or angular deviation) (Yamu *et al.*, 2021).

2.3 Contextual review

2.3.1 Mobility characteristics of sub-Saharan Africa

“Within the group of emerging countries, the subgroup of Sub-Saharan African countries stands out for a variety of reasons. Despite the fact that other parts of emerging countries are quickly industrializing as a result of the new global economy, African cities remain economically excluded. Furthermore, Sub-Saharan Africa has the highest percentage rate of urban population increase in the world. African society is anticipated to become primarily urban by 2025 (Emagnu, 2018).

2.3.2 Mobility characteristics in Addis Ababa

Addis Ababa, Abidjan, Lagos, Luanda, and Kinshasa are predicted to be the five largest cities in the Sub-Saharan African region by 2015. The transportation issues in Addis Ababa are new, as the current quality of road traffic management is appalling. Addis Ababa has a relatively high population density and rapid urban population expansion, which, when combined with a low GDP per capita, puts a premium on mobility service quality. The very limited supply of infrastructure reflects this stress. In Ethiopia, public transportation is extremely important for urban mobility (Emagnu, 2018).

2.3.3 Walking, movement and modes of transportation in Addis Ababa

Walking and public transportation are the most popular modes of transportation in Addis Ababa, accounting for around 85% of all journeys. For example, walking accounts for 78 percent of trips in the Addis Ketema sub-city, but just 40 percent of journeys in the Bole sub city. The average walking distance is 1.5 kilometres. Cycling is a popular form of short distance travel among low-income and risk-taking males, although it is not included in official statistics (Wondimu, 2020).

2.3.4 Addis Ababa Road network and connection

Addis Ababa has changed dramatically in terms of size and demography, finance and economic structure, and physical and spatial organization since its founding in 1886. Empress Taitu's spatial development program had resulted in the creation of various "Sefers" surrounding the novelty residences.

Non-motorized modes of travel were used to connect Sefers (villages within larger settlements) on the earliest highways. During Emperor Haile Selassie's first reign, the development of modern highways was accelerated (Elias & Laura, 2018). During that time, the municipality of Addis Ababa's public works department was in charge of road development. During and after the brief Italian occupation, the road work was reinforced significantly.

The city's existing road patterns are primarily radial and orbital, with primary routes radiating from the center to the five outlets and a ring road around the city's core and intermediate areas. In 2011, walking was the most popular mode, accounting for 55 percent of total modal share. According to travel demand predictions, walk trips will account for roughly 45 percent of all journeys in 2020 (Mohapatra, 2017). The use of bicycles is minimal; the terrain and lack of bike lanes have contributed to this. Since there are now three bike routes in the city, legislators and planners' lack of attention to this mode of transportation appears to have shifted.

Placemaking, in general, is a process of developing high-quality environments in which people desire to live, play, work, and learn. Standard, strategic, tactical, and creative place making are the four primary types of places making. Furthermore, there are four key forms of place quality to consider: access and connectivity, comfort and image, user activities, and sociability which are directly related to density, diversity and accessibility. It is known that these modes of measurement of the variable's movement, density and diversity could be combined into a more general analytical theory of urban form using space syntax as a tool. Spatial capital study looks

at how privileged groups utilize urban space and place, frequently in combination with mobility, to create inequitable opportunities.

The diagram below (Figure 13) tries to relate the two concepts (place making and space syntax) and the relative concepts with each other. When we come to accessibility it is the most important quality of a place. A place should be accessible which is directly analyzed by the space syntax theory, the second quality of a place is sociability which deals with the interaction of people with strangers or different people. The difference in people can be (residents, workers, guests/ tourists etc.).

The other qualities of a place are comfort/image and activities. Activities of a place is concerned with types and range of activities with in a place. These two concepts (comfort and activity) are directly and indirectly affected by density which is one concept that is analyzed by space syntax theory. If there is high density with in an area it will result in the lack of open spaces (places) or congested activities within a place that will affect the comfort/image of a place. The concepts in both space syntax and place making in one or in another way are related two each other.

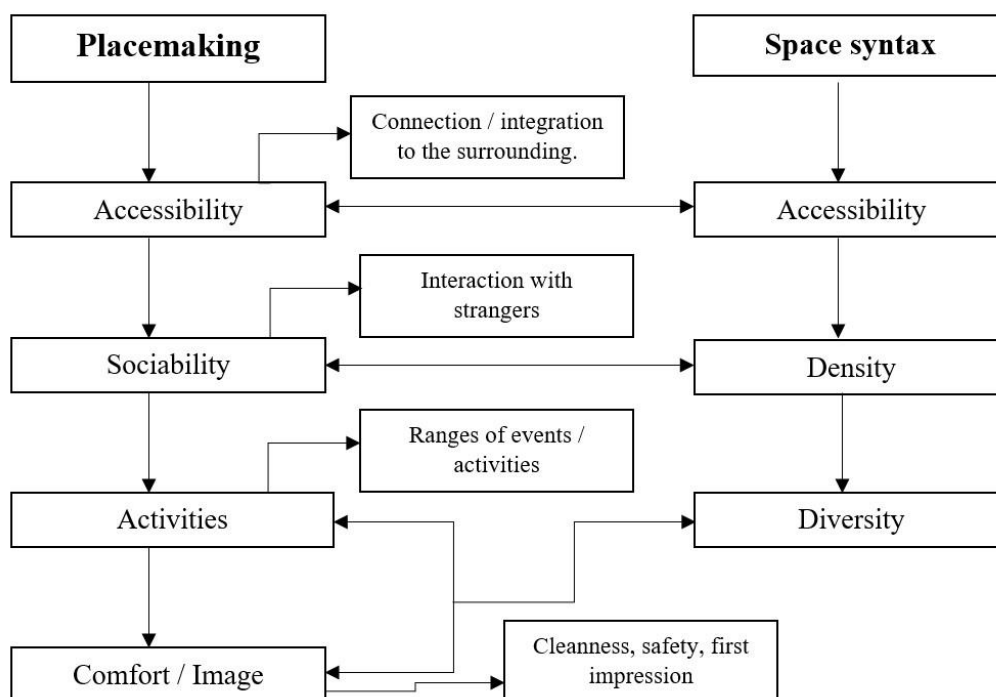


Figure 13: Conceptual plan

2.3.5 Open space in Addis Ababa

Meskel Square is a square in Addis Ababa, Ethiopia. It is frequently used for public gatherings, demonstrations, and festivals, including the Meskel Festival, from which it takes its name. There are also concerts, parades, and different government and public activities also held there. Meskel Square is the most central and main square of Addis Ababa. It has a huge importance for the as it is the site where the Ethiopian Christianity followers celebrate Meskel year on September 27th or 28th.

Meskel square has different unique activities held in the place for example every morning, Meskel Square is full of athletes training which is something unique. On special occasions like Meskel Celebration (one of Ethiopia's non-tangible UNESCO World Heritage sites), it is a ground where visitors experience real Ethiopia. Areal photograph of Meskel Flower is shown in *Figure 14* below.

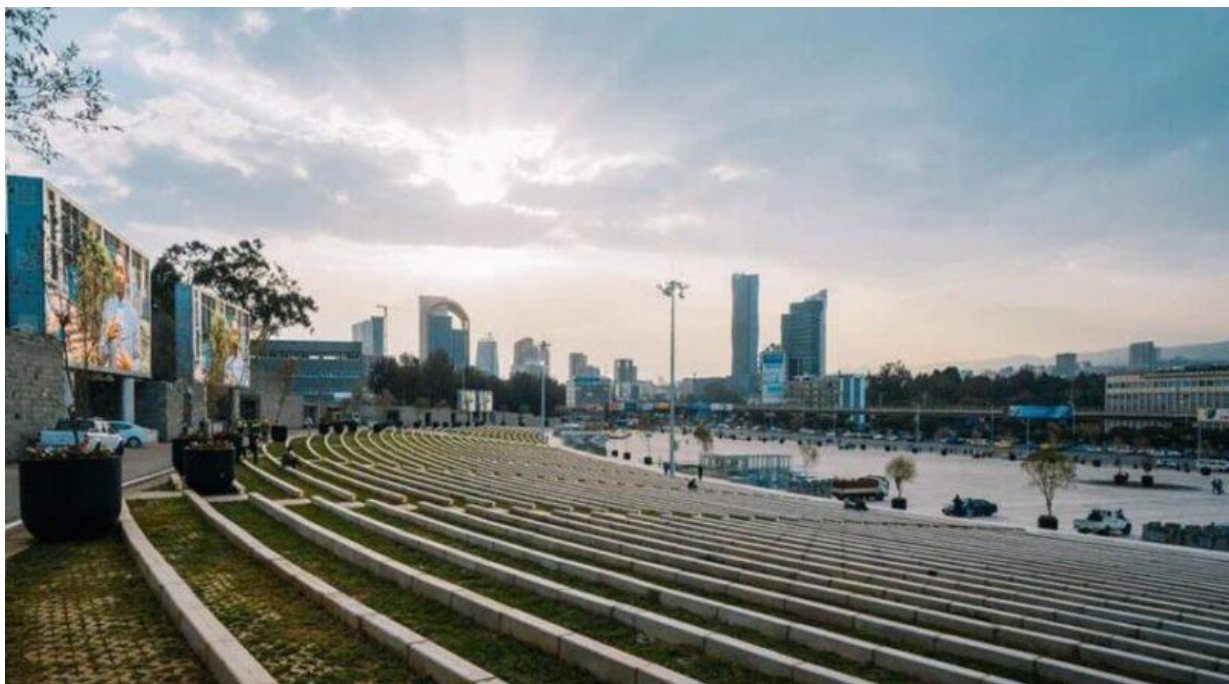


Figure 14: Meskel square, Addis Ababa

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study area description

The study area is located in the capital city of Ethiopia, Addis Ababa city, Kirkos sub city, mainly woreda 02 and 03 which is located around Meskel flower. Kirkos sub city is situated at elevation of 2,352m and it is located at longitude 38°76'29.88"E and latitude 9°0'24.49" N.

Based on national census conducted by the Central Statistical Agency of Ethiopia (CSA) in 2012, Addis Ababa town has a total population of 4.8 million people. Woreda 02/03 is a relatively more urbanized area when compared to other part of the city. It has a very diverse demographic group.

According to Meteoblue climate diagrams based on 30 years of hourly model simulations, the town temperatures vary from 5 °C (the mean daily minimum for every month) the coldest month November and December to 26 °C (the mean daily maximum for every month) the hottest month May. The precipitation of the town is maximum at July and monthly average reaches up to 147 mm and the minimum precipitation is recorded in November and December. The location map of study area is shown in *Figure 15* below.

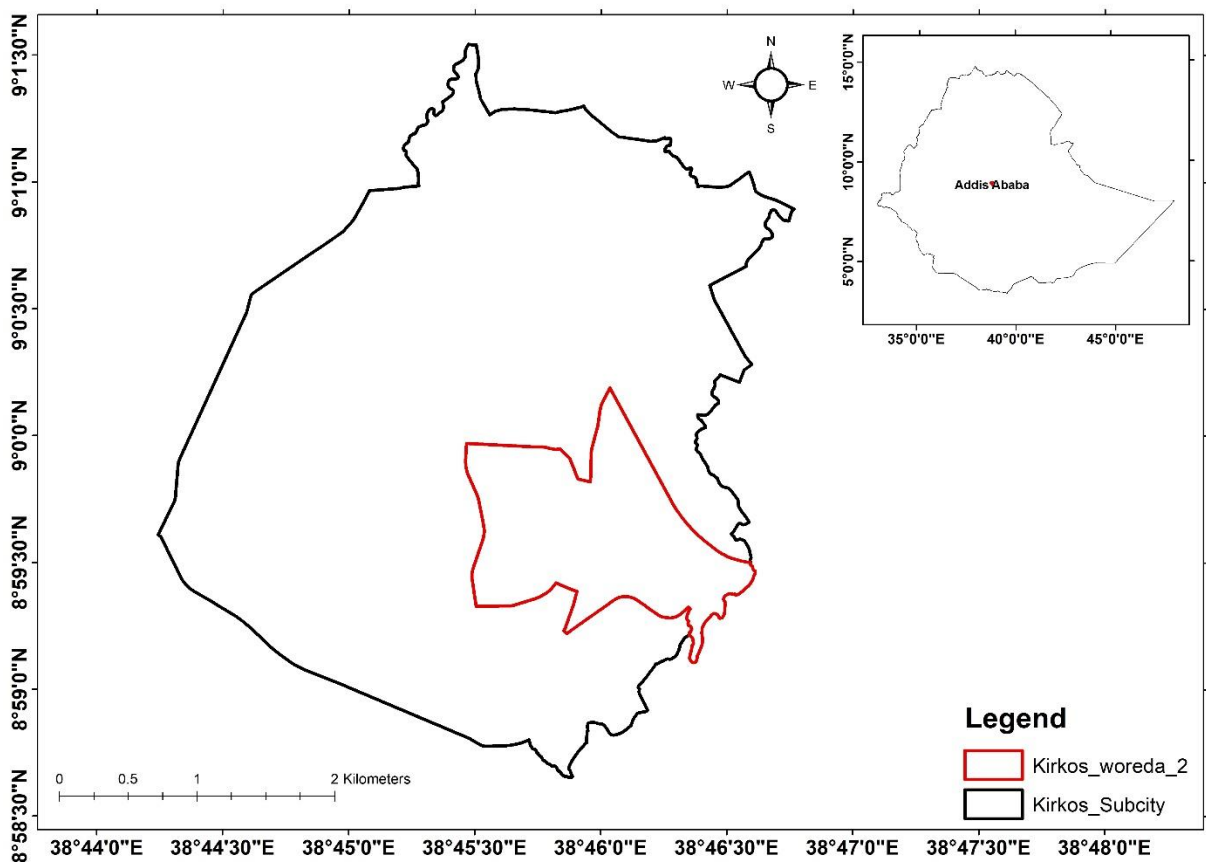
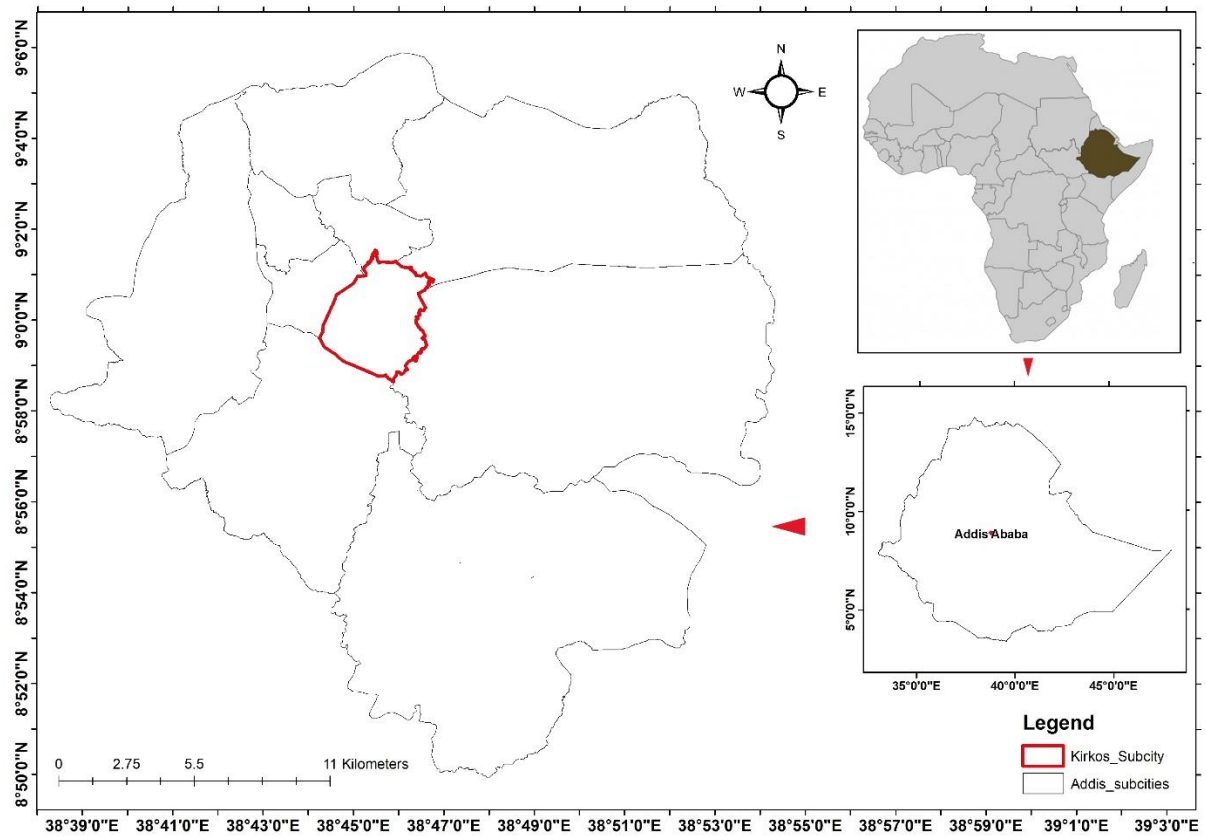


Figure 15: Location map of the study area

3.2 Data types

There are several types of data used in this study, including qualitative and quantitative data types, in which the majority of the data is both numerical and non-numerical or in which the data is collected in the form of words, sentences and numbers. The data types employed in this study include street networks and land use maps, which aid in the production of much of the spatial connectivity studies, such as connection (socials vs public space), commercial streets, and so on.

3.3 Data sources

The information was gathered from primary and secondary sources. This study's primary data was gathered through site observation and in-depth interviews. Books, and journal articles, the Addis Ababa Planning Commission are secondary data sources.

3.4 Method of data collection

Collecting and studying previous data from Addis Ababa urban plan commission concerning place making, commercial street and determine the drawbacks of the studied design system and the existing design of the neighbourhood plan in the case areas. Software like GIS, AUTOCAD and depthmapX are used. In addition to these another published written documents and additional data sources will be used for the study as an input.

3.5 Method of data analysis

i. To map the study area based on the spatial capital of different localities.

To map and characterize the current spatial capital of the action area within each locality, the existing street network and land use maps are used. To determine the existing spatial capital of

the study area, the street network is added to the software used, which includes DepthmapX, AutoCAD, and ArcGIS. As a result, by integrating input data from the street network and the study area's land use map, this stage helps to identify the study area's spatial capital.

ii. To compare the spatial capital of each locality

After identifying of each spatial capital of different localities the second step is to measure and compare of each spatial capital of the study area by using of DepthmapX and ArcGIS software. As a result, this stage helps in determining which areas require more intervention and which areas have a high level of spatial capital, as well as by screening high problem area, which leads to the most appropriate urban design solution.

The street network of the study area was analyzed using depthmapX software and the overall process of the data analysis is shown in the *Figure 16* below. Space syntax is a configurational theory of architecture, that deals with relation of parts within architecture.

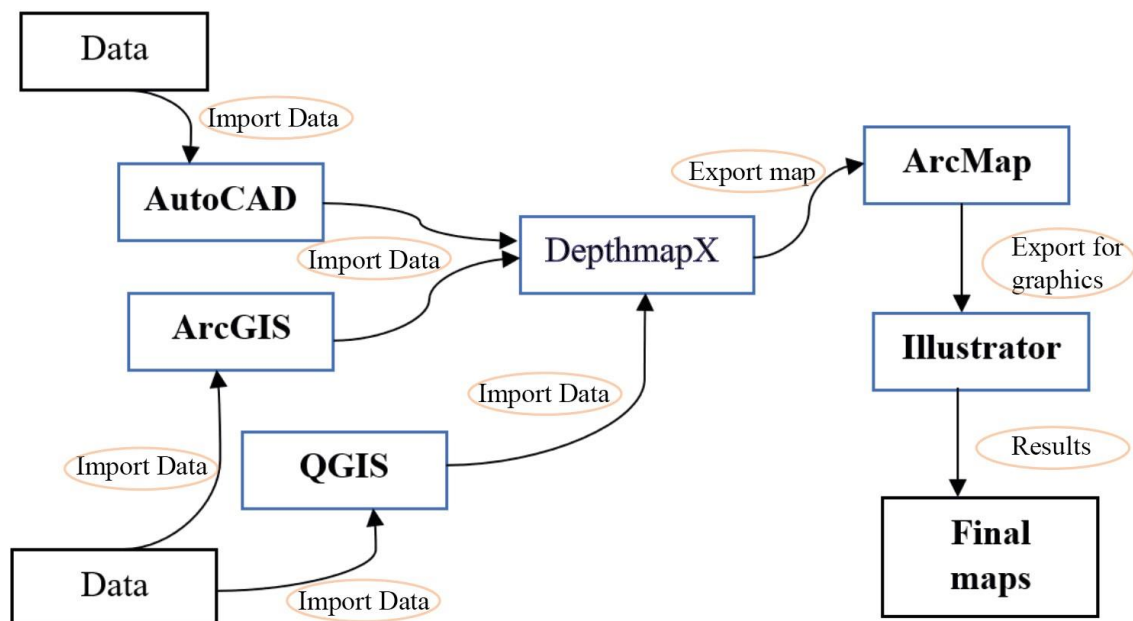


Figure 16: The workflow of space syntax analysis using the DepthmapX

iii. To propose appropriate urban design solution of place making for the existing spatial capital of selected areas of the district.

The data collected and analysed above help in identifying the key problem area, which in facilitate and encourage in identifying the existing problem area. So, using ArchiCAD, Autodesk Revit, AutoCAD and Sketchup software, an appropriate urban design solution is developed based on the data. Finally, Lumion software is used to create a final render of the study area's urban design.

3.6 Research design

The research design is over all process of research flows that integrates relevant component and data interpretation. This research design represents the process of this study paper. *Figure 17* shows the combination of instrument and material used in the overall research process.

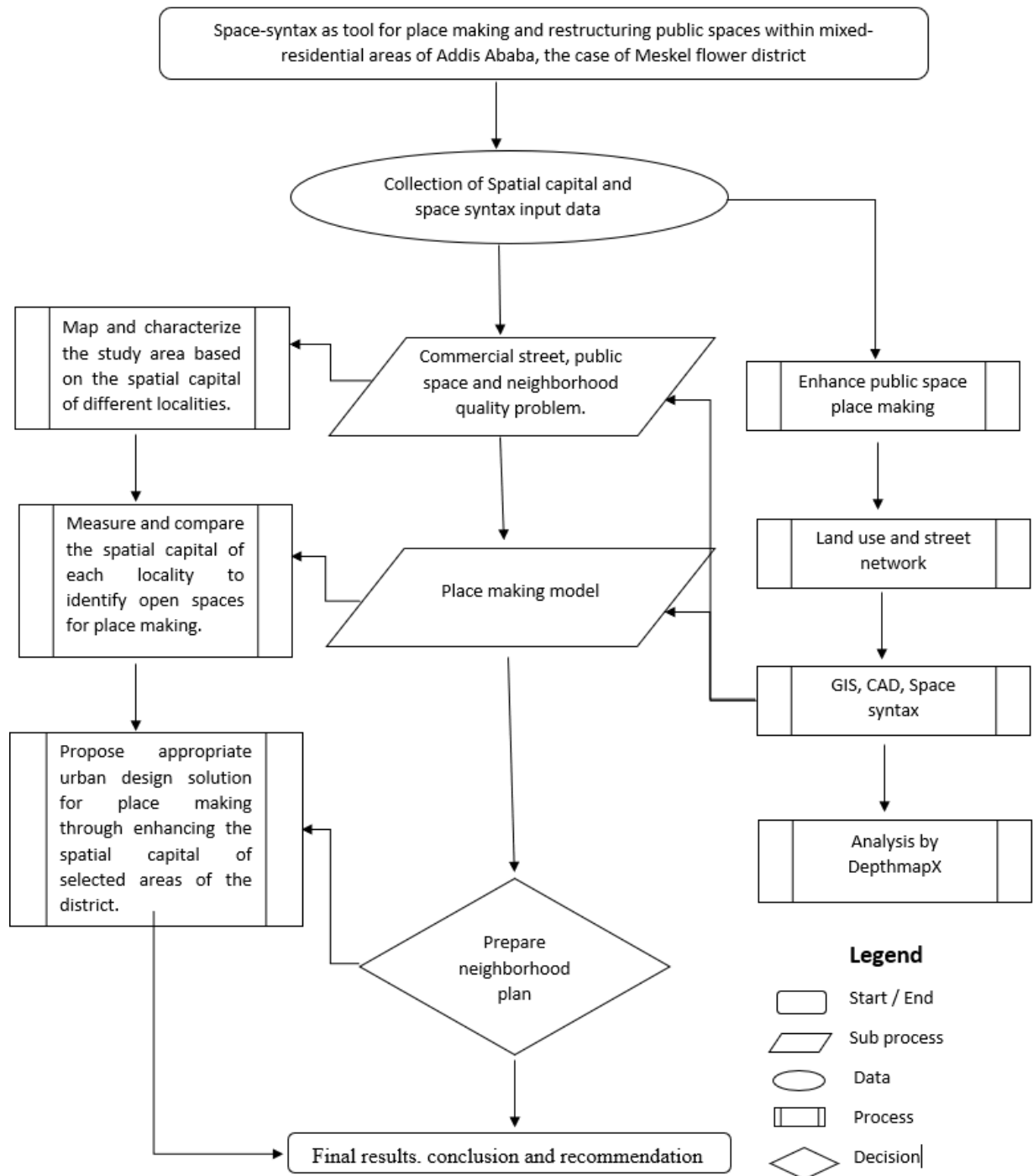


Figure 17: Research design

A summary of the methods

The methodology includes study area description, method of data collection, and method of data analysis and finally summarized in *Table 1* below.

Table 1: Methods and Methodology

Objective	Data type	Data source	Analytical tool	Analysis
To map and characterizing the study area based on the spatial capital of different localities	Street Network, Land use	From Addis Ababa Planning commission	ArcGIS, AutoCAD, DepthmapX	DepthmapX showing spatial capital of different localities
To compare the spatial capital of each locality to identify open spaces for place making	Street network, Land use	From Addis Ababa Planning commission	ArcGIS, DepthmapX	DepthmapX based ArcGIS to measure and compare spatial capital of each location.
To Propose appropriate urban design solution of place making for the existing spatial capital of selected areas of the district.	Land use, Street network	Self-analysis	Sketchup, Revit, Lumion	Sketch up and recit modelling of the study area urban design and Lumion render

3.7 Analysis

3.7.1 To map the study area based on the spatial capital of different localities

3.7.1.1 Existing Street network

The study area's street network provides a variety of routes and distribution, resulting in adequate accessibility in the study area. The study area is bisected by four main roads. However, some access roads in the study area have dead ends and are not connected to other roadways. The existing street network of the study area is seen in *Figure 18* below.

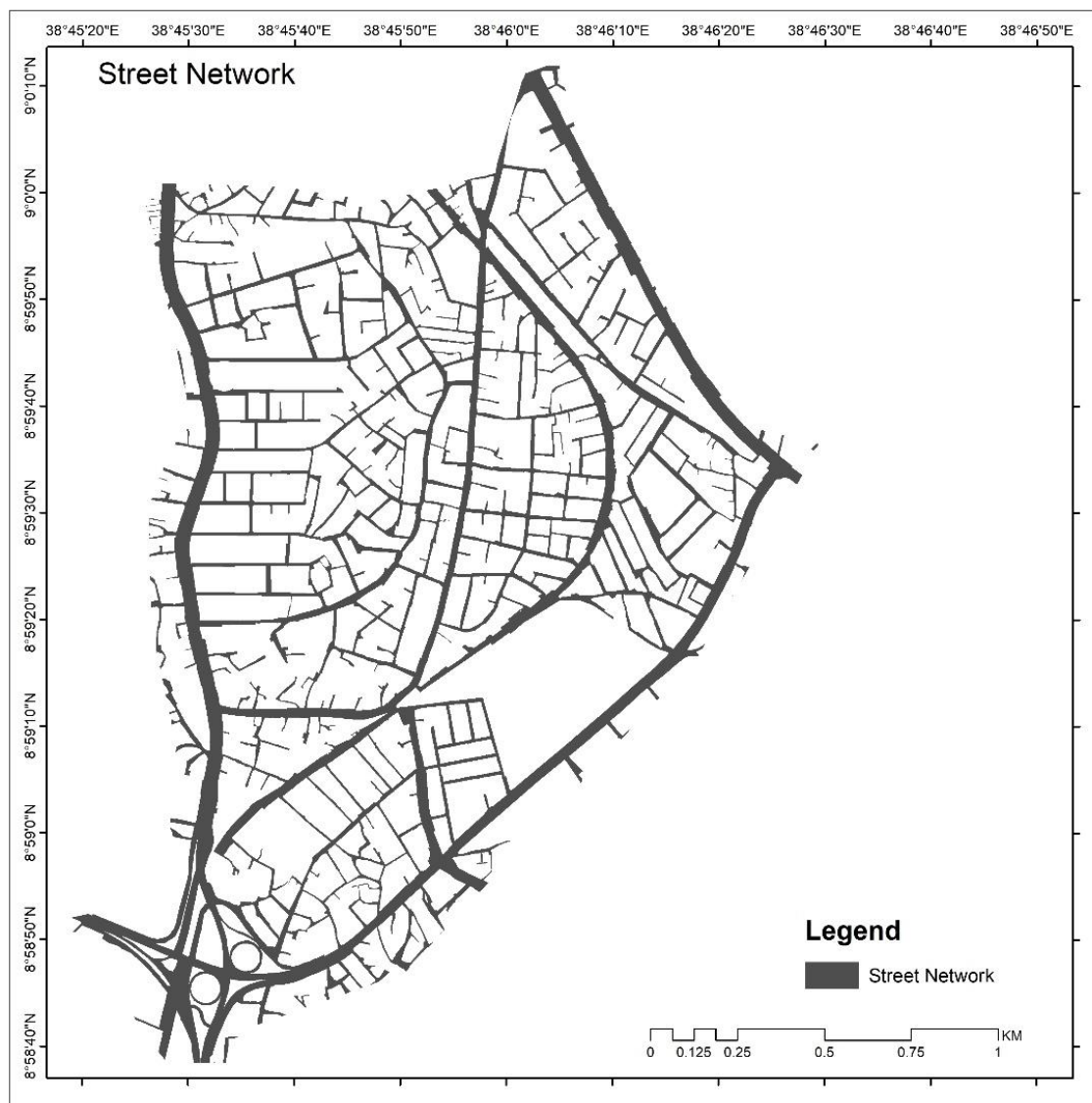


Figure 18: Existing Street network

3.7.1.2 Existing Land use

The existing land use in the study area is mostly dominated by residential; beside the main street there are commercial land uses and this increases the activity of the main streets in which they have actively used as a commercial. *Figure 19* shows the existing land use of the study area. The existing land use have less distribution of variety of public space and recreational area.

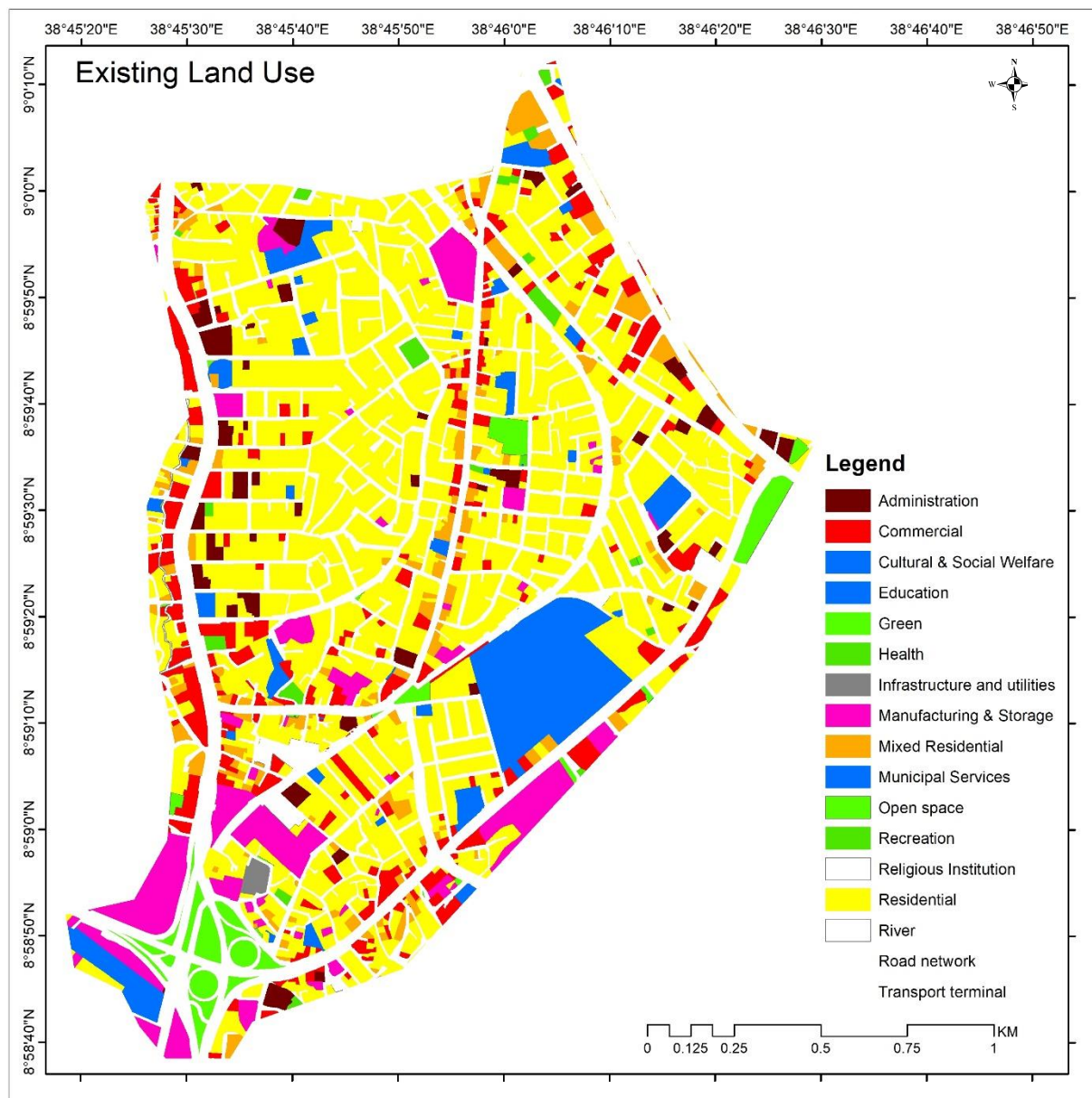


Figure 19: Existing land use map

3.7.1.3 Connectivity (socials vs public space)

There is a very low connectivity of public space in the study area with the main streets that has good social access. Additionally, there is lack of public space when compared with the existing society and population density with in the study area. *Figure 20* shows the distribution of public space and social affairs. The distribution of public space is low as compared on the area of the site.



Figure 20: Connectivity of public space and social

3.7.1.4 Commercial Street

Commercial street is street activity where retail stores found together and the surrounding building use as a commercial in which both suppliers and consumers can trade their goods and services. *Figure 21* shows the commercial street with surrounding commercial and mixed-use building of the study area, the main street in the center and right side has high value of as commercial street.

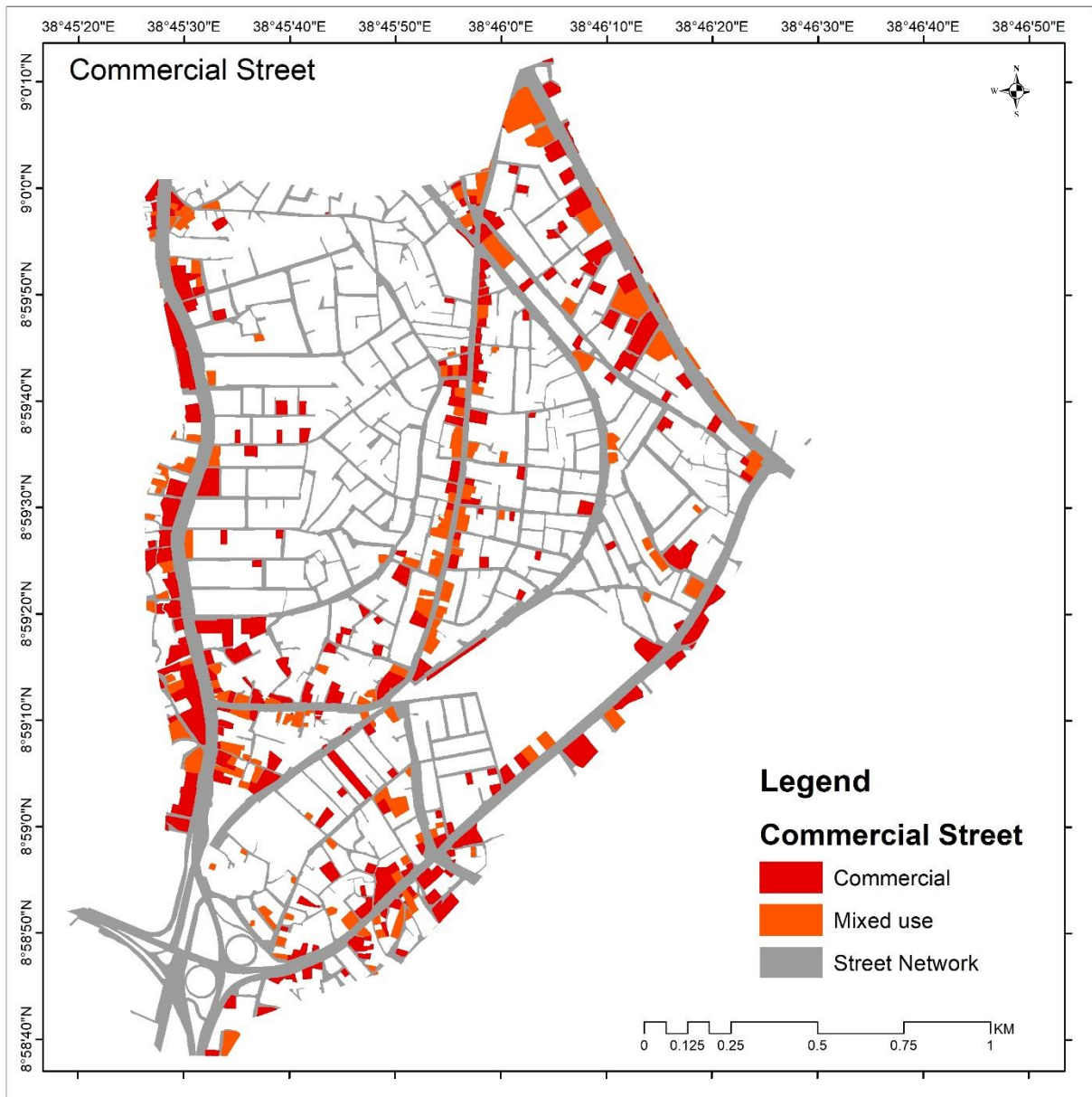


Figure 21: commercial street of the study area

3.7.1.5 Public space

Public space is a place or an area that is open and accessible to all peoples with no limitation of socioeconomic level or any other parameter. The distribution of public space found in the study area is low. There is not enough public space found on the area. *Figure 22* below shows the public space and its distribution throughout the site.

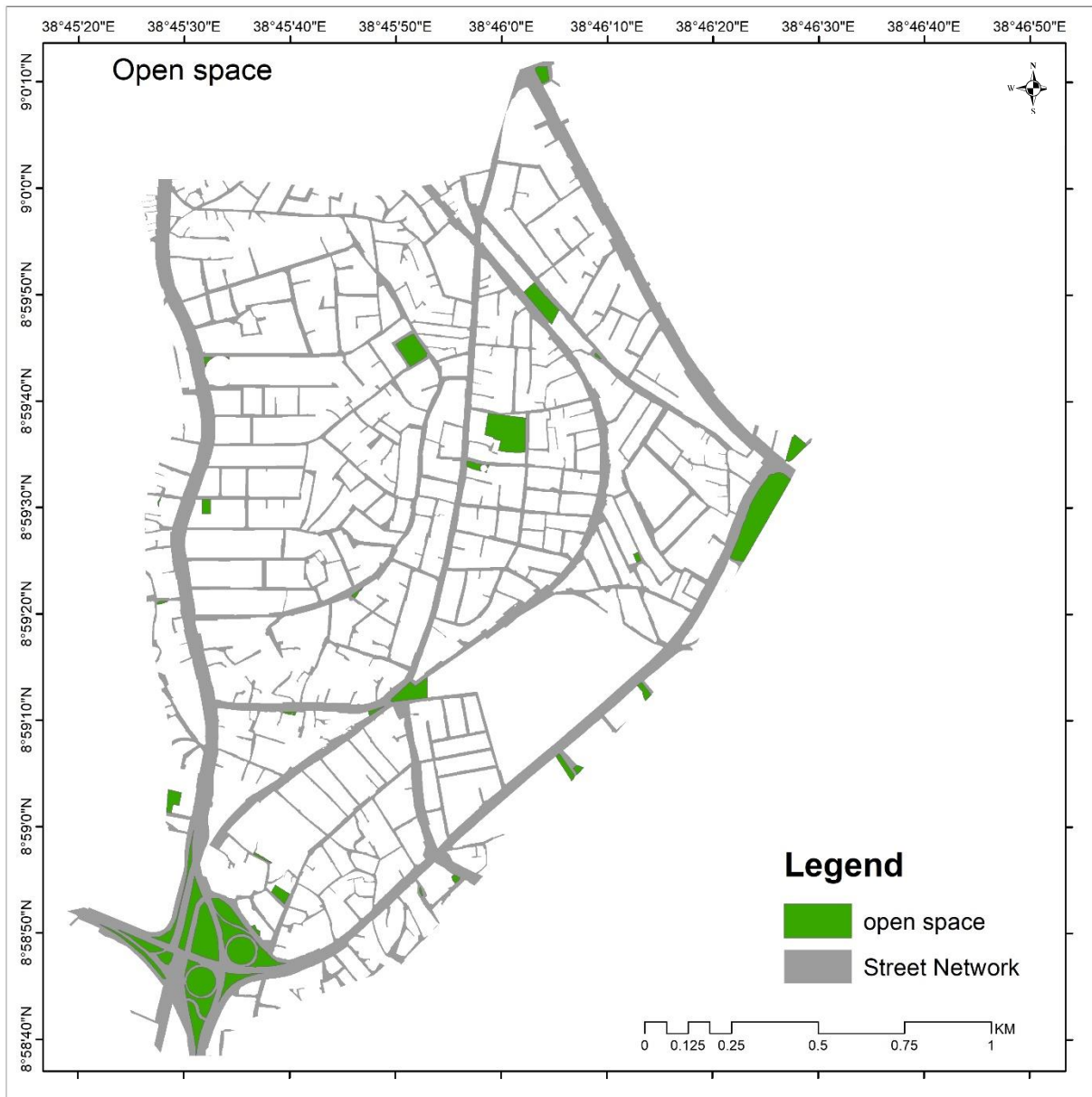


Figure 22: Public space of the study area

i. The spatial connectivity and integration of street

The map below on *Figure 23* shows the spatial integration of the street. The integration is done by space syntax depth map. The main street in the center has high integration with the surrounding street and neighbourhood. The roadway in the centre of the site offers good value for designing an active street based on spatial integration.



Figure 23: Spatial integration

The spatial connectivity of streets in the study area is depicted in *Figure 24*. The red color in the middle of *Figure 24* indicates great connectedness, whereas the blue color denotes low connectivity, which is mainly characterized by dead ends. The main roadway in the site's center has a high level of connectivity, with several links, connections, and intersections. The finding

demonstrates that a street with excellent connectivity has a wide range of activities and functions. When compared to another street, this one is more active. *Figure 24* below depicts a street with poor connectivity. The dead-end street, short links, and poor street networks in the residential neighbourhood.



Figure 24: Spatial connectivity

Space Syntax is a tool for measuring and comprehending social behaviour. Two of the most crucial characteristics are connectedness and integration. Space syntax analysis is used to determine the degree of integration (or centrality) of a street in a network. In the Space Syntax concept, streets can be represented as axial lines that correspond to straight lines of sight, and their topological relationships serve as the foundation for a wide range of indicators. The

accessibility of each axial line in the map from every other axial line, which is known as the integration value of each line. The distribution of spatial integration, as seen in *Figure 25* below. Place syntax-analysis has evolved from the accessibility measure used in space syntax research. (Stähle et. al. 2006).

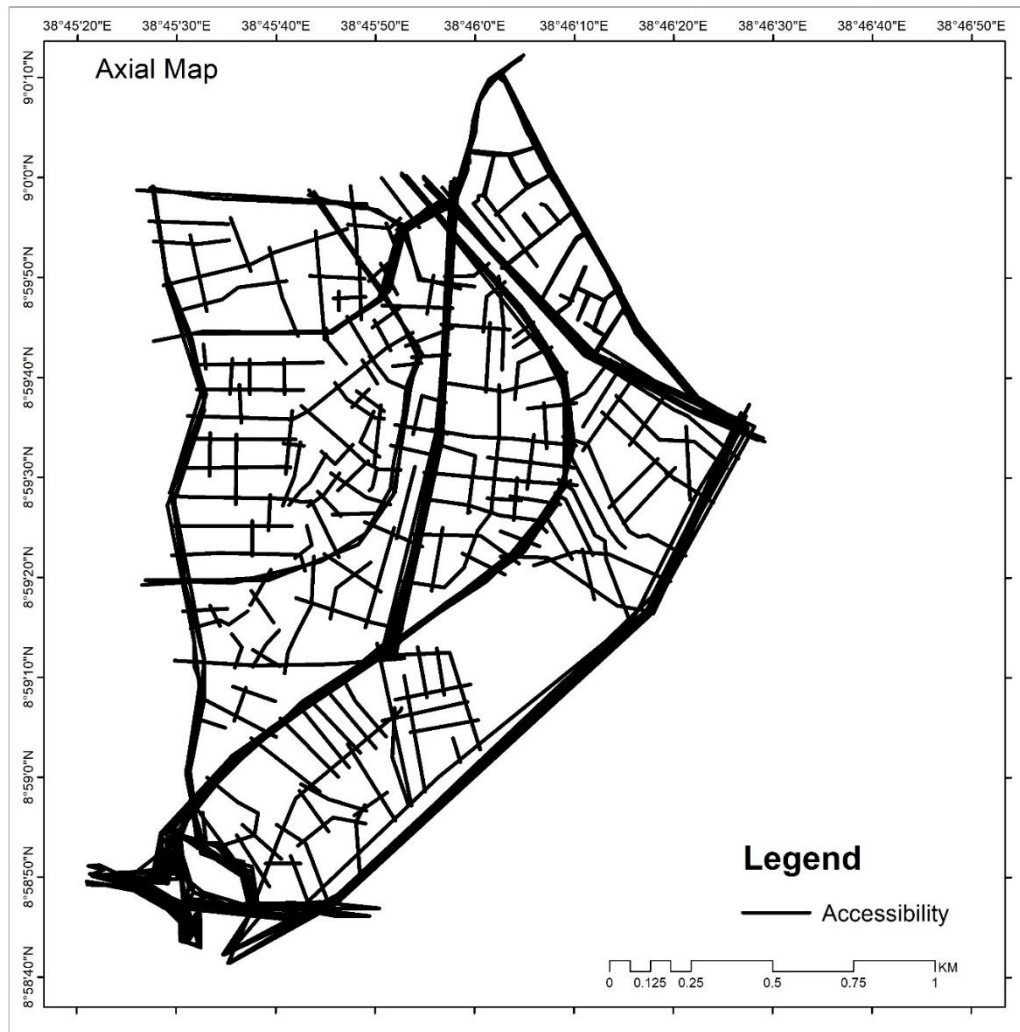


Figure 25: Integration axial map

ii. Building density per plot

The number of developed units in a given area of land is referred to as density. Dwelling units per acre, for example, are commonly used to measure residential density. The density of a residential or commercial development is measured in dwelling units per acre, while population density is measured in residents per acre.

Density was determined per plot and parcel for this study, with high density exceeding 80 percent, medium density between 50 and 80 percent, and low density less than 50 percent, according to norms and standards of Addis Ababa Structure plan. *Figures 26 and 27* show the plot density and building density within the research area.

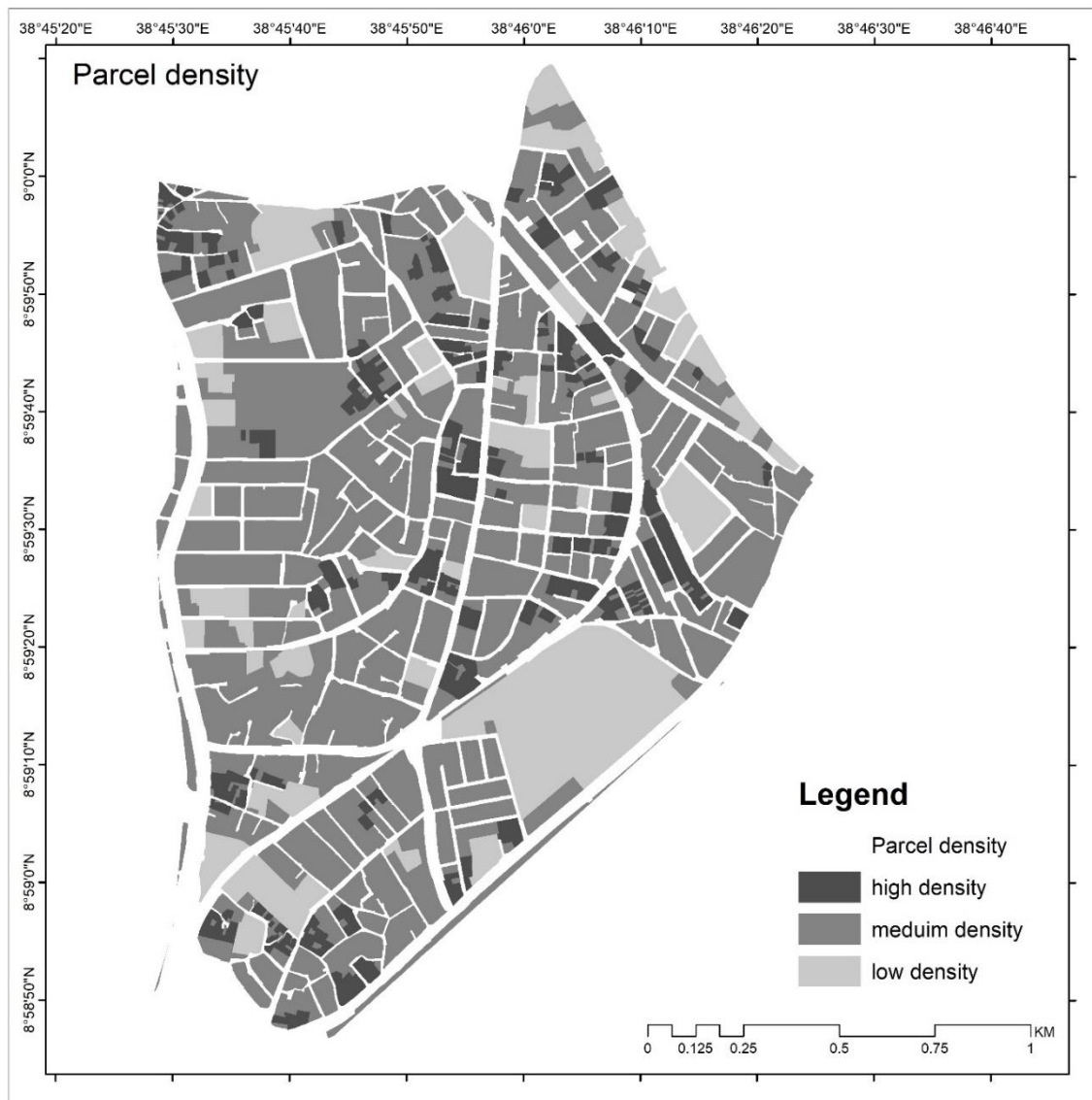


Figure 26: Parcel density of the study area

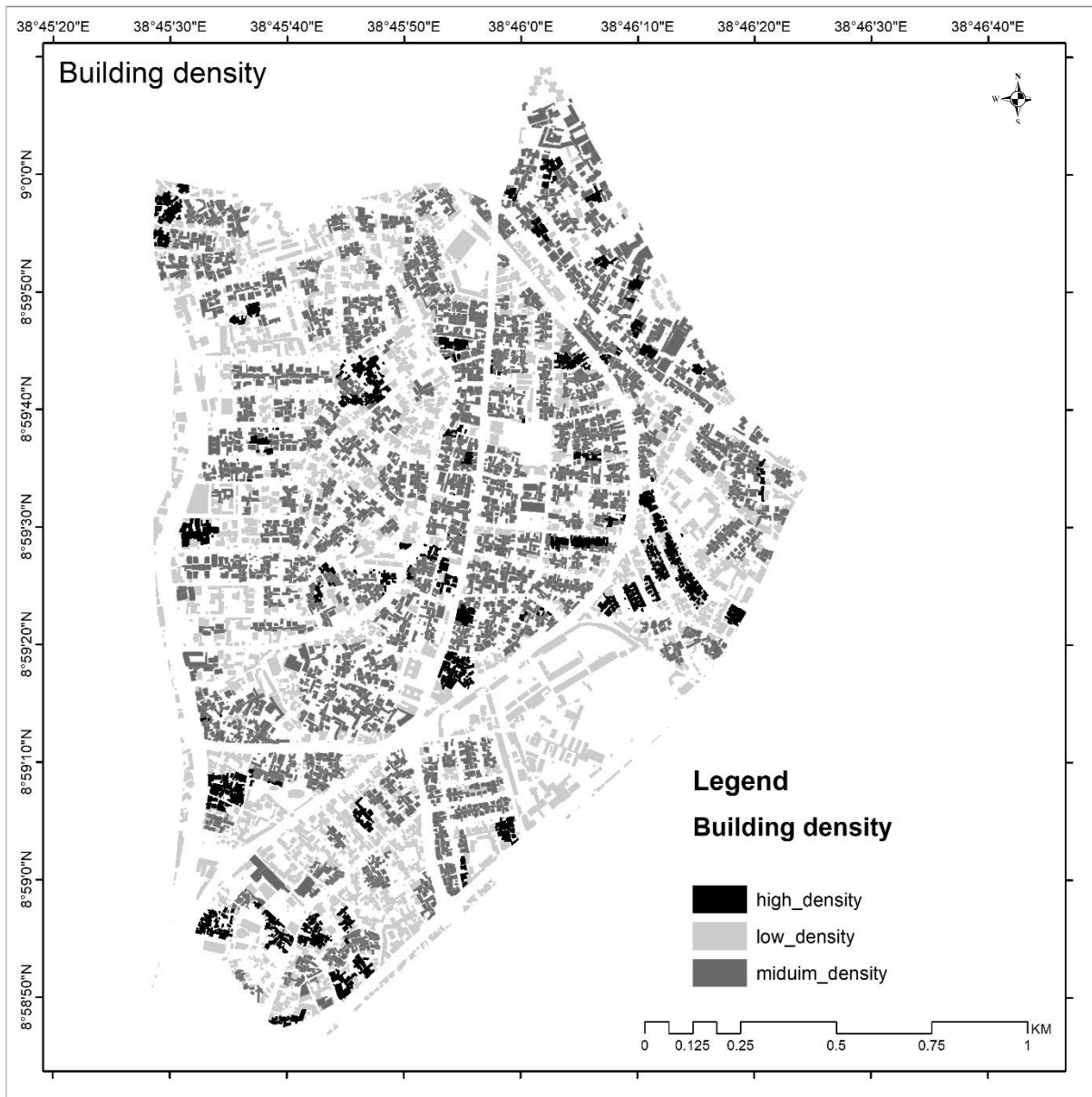


Figure 27: Building density per parcel with in the study Area

iii. Integration of axial map and building density

A geographic area with interesting streets and attractive places to view and easy to walk are more likely encourage people to travel by foot. The map shown in the *Figure 28* investigated the relationship between building density and street network. As shown on the map on the *Figure 28* below the axial map overlayed with the building density per plot, in which it tries to

identify the major active street covers and the attached development without setback and high density.

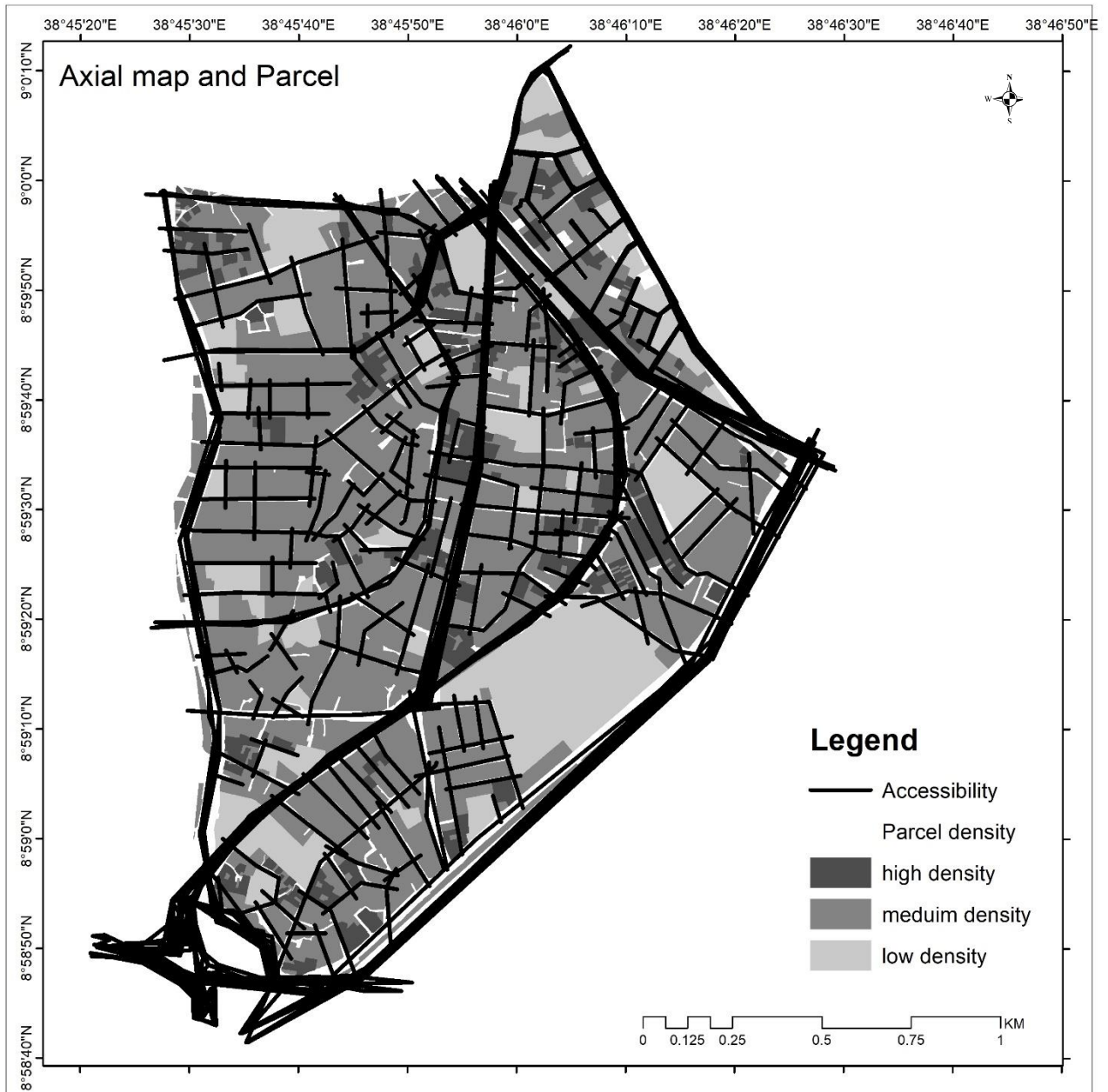


Figure 28: Integration of axial map and building density per plot

iv. Spatial diversity

It is vital to encourage cities to become more diverse. The degree of mixed usage of space, functions, and types of inhabitants is referred to as diversity. For the variable of variety, complex analytical approaches such as integration analysis were created. Legally defined

space, such as privately and publicly owned domains (plots or parcels), must be precisely designated in order to realize diversity. This is because the plot, through its disposer, indicates the presence of an actor in urban space, as well as the precise location of that actor's effect. Such actors usually devise specific strategies for their respective domains.

An area with a high proportion of plots has the potential to carry a greater number of action plans, which is likely to result in greater diversity among these strategies. Finally, such an area appears to have the ability to create more diversified material than an area with fewer plots and thus fewer characters and strategies. Other factors, such as land-use rules, can obviously mitigate the effect, but the goal here is to reflect the unique influence of urban form. The research area's building and parcel map is shown in *Figure 29* below and divided into four zones based on their localities.

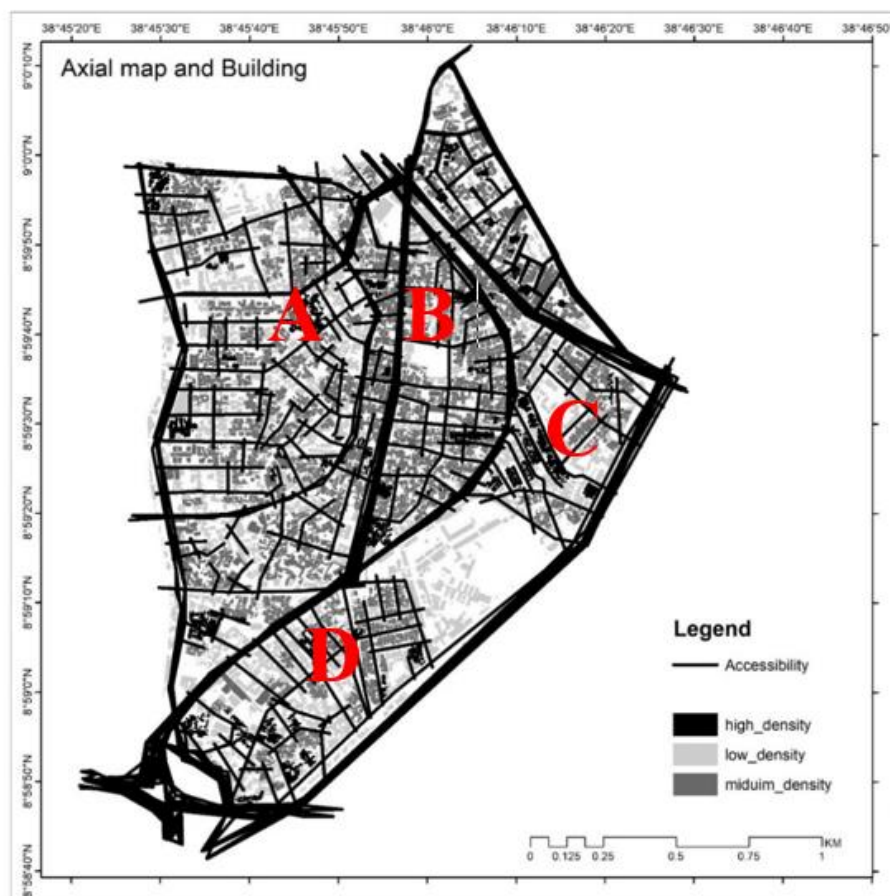


Figure 29: Building and parcel map

According to norms and standards of Addis Ababa Structure plan, the land use mixity (diversity) in core areas per house hold is 40 – 80 m² per household, for housing unit and supporting physical and social infrastructure services is 80 – 100 m² per house hold and for housing unit and supporting physical and social infrastructure and higher level uses 100 – 120 m². So according to norms and standards of Addis Ababa structure plan, the study area has high diversity and land use mixity which fulfill about 65% of the standards according to norms and standards of Addis Ababa.

According to norms and standards of Addis Ababa Structure plan the house hold density per hectare in core areas is 125 – 380 house hold. The study area has more than 460 house hold per hectare on and it is characterized by high density.

The accessibility of the study area is calculated in DephmapX software illustrated in *Figure 25*, the study area has very low connectivity and characterized by dead end roads. So, by calculating the length of each connectivity representing line, more than 68 % of the study area is characterized by very low and low connectivity. About 20% of the study area has high and very high connectivity. So, by summarizing the results the study area has a value of about 45% of desired accessibility.

Each parameter of the space syntax theory is described in the *Figure 30* below. The study area has a high density and diversity, but low accessibility, according to the summary.

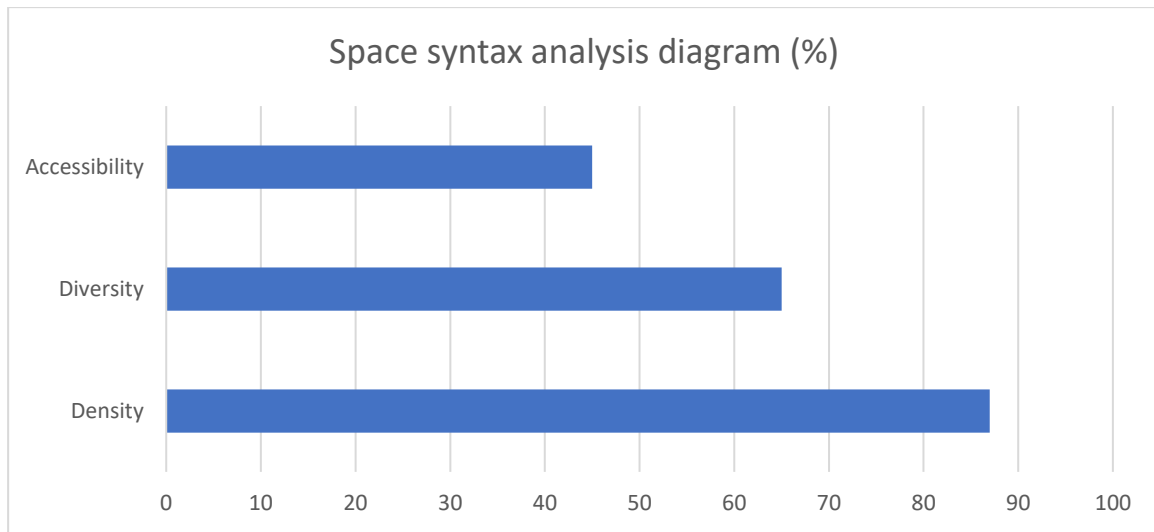


Figure 30: Space syntax analysis summary

a. Shannon Diversity

The Shannon Diversity Index (sometimes called the Shannon-Wiener Index) is a way to measure the diversity of species in a community and it is denoted as H (Sarma & Das, 2015).

b. Shannon diversity index

The Shannon diversity index (H) also called information statistics indices is another index that is commonly used to characterize species diversity in a community. It is not itself diversity, but just indices of diversity. Just like the diameter of a sphere is an index of its volume but is not itself the volume. Diversity is most easily defined by use of a formula. Many indices of diversity have been proposed, but the one most commonly used is the Shannon-Weaver diversity index H (Nolan & Callahan, 2006).

The formula for Shannon diversity index is

$$H = - \sum_{i=1}^S P_i (\ln P_i)$$

Where,

H = The Shannon diversity index

P_i = fraction of the entire population made up of species i , i.e., p_i is the proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N)

S = Numbers of species encountered

$\ln$ = natural logarithm

Σ = sum from species 1 to species S

Note: The power to which the base e ($e = 2.718281828\dots$) must be raised to obtain a number is called the natural logarithm ($\ln$) of the number (Sarma & Das, 2015).

To calculate the index

1. We first divide the number of individuals of species found in sample by the total number of individuals of all species. This is p_1 .
2. Multiply the fraction by its natural log ($p_1 \ln^* p_1$).
3. Repeat this for all the different species that we have. The last species is species S .
4. Sum all the ($p_i \ln^* p_i$) products.
5. Now, the value should be multiplied by -1, and then we get H (Sarma & Das, 2015).

High values of H would be representative of more diverse communities. A community with only one species would have an H value of 0 because P_i would be equal to 1 and be multiplied by $\ln P_i$ which would equal to zero. If the species are evenly distributed, then the H value would be high. So, the H value allows us to know not only the number of species but how the abundance of the species is distributed among all the species in the community (Sarma & Das, 2015).

The Shannon equitability index is a way to measure the evenness of species in a community. The term evenness refers how similar the abundances of the different species are in the community and denoted as E_H and calculated as $E_H = H/\ln(s)$

Where, H: The Shannon diversity index

S: Total number of unique species.

The Shannon equitability index ranges from 0 to 1 where 1 indicates complete diversified community. The Shannon diversity index is mostly used for the study ecological diversity of a species but this study adopt diversity to the land use with in the study area to understand the diversity of the land uses. *Table 2* below calculates the Shannon diversity index by using land use type as, species of diversity for zone A and it has relatively low diversity index which shown low Shannon equitability index because of this value zone A has relatively low diverse zone.

Table 2: Shannon Diversity Index of zone A

No	Land use type	No of individuals (n)	n/N	Pi	ln pi	Pi ln pi
1	Administration	5.5	5.5/100	0.055	-2.90042	-0.1595
2	Commercial	2.5	2.5/100	0.025	-3.68888	-0.0922
3	Cultural & social welfare	1	1/100	0.01	-4.60517	-0.0461
4	Education	2	2/100	0.02	-3.91202	-0.0782
5	Green	1	1/100	0.01	-4.60517	-0.0461
6	Health	1	1/100	0.01	-4.60517	-0.0461
7	Infrastructure and utilities	0.5	2.5/100	0.005	-5.29832	-0.0265
8	Manufacturing and storage	5	5/100	0.05	-2.99573	-0.1498

9	Mixed residential	1	1/100	0.01	-4.60517	-0.0461
10	Municipal Services	0.5	0.5/100	0.005	-5.29832	-0.0265
11	Open space	1	1/100	0.01	-4.60517	-0.0461
12	Recreation	1	1/100	0.01	-4.60517	-0.0461
13	Religious institution	2	2/100	0.02	-3.91202	-0.0782
14	Residential	72.5	72.5/100	0.725	-0.32158	-0.2331
15	River	1	1/100	0.01	-4.60517	-0.0461
16	Road network	2	2/100	0.02	-3.91202	-0.0782
17	Transport terminal	0.5	0.5/100	0.005	-5.29832	-0.0265

S (number of Land use) = 17

N (total number of individuals) = 100

Σ (sum) of $p_i \ln p_i$ = -1.2712

$$H = - \sum_{i=1}^S p_i (\ln p_i)$$

$$H = - (-0.1595 + -0.0922 + -0.0461 + -0.0782 + -0.0461 + -0.0461 + -0.0265 + -0.1498 + -0.0461 + -0.0265 + -0.0461 + -0.0461 + -0.0782 + -0.2331 + -0.0461 + -0.0782 + -0.0265) = 1.2712$$

The Shannon diversity index for Zone A is 1.2712 and the Shannon equitability index is calculated with $E_H = H/\ln(s)$. There are 17 land uses ($s=17$) so the calculated index will be $E_H = 1.2715/\ln (17) = 0.448678$.

Table 3 below calculates the Shannon diversity index by using land use type as, species of diversity for zone B and it has relatively low diversity index next to Zone A but still has low Shannon equitability index because of this value zone B has relatively low diverse zone when compared to Zone C and Zone D.

Table 3: Shannon Diversity Index of zone B

No	Land use type	No of individuals		Pi	ln pi	Pi ln pi
		(n)	n/N			
1	Administration	4	4/100	0.04	-3.21888	-0.1288
2	Commercial	6	6/100	0.06	-2.81341	-0.1688
3	Cultural & social welfare	0.5	0.5/100	0.005	-5.29832	-0.0265
4	Education	1.5	1.5/100	0.015	-4.19971	-0.0630
5	Green	2.5	2.5/100	0.025	-3.68888	-0.0922
6	Health	1	1/100	0.01	-4.60517	-0.0461
7	Infrastructure and utilities	0.5	0.5/100	0.005	-5.29832	-0.0265
8	Manufacturing and storage	1.5	1.5/100	0.015	-4.19971	-0.0630
9	Mixed residential	5	5/100	0.05	-2.99573	-0.1498
10	Municipal Services	0.5	0.5/100	0.005	-5.29832	-0.0265
11	Open space	2	2/100	0.02	-3.91202	-0.0782
12	Recreation	1.5	1.5/100	0.015	-4.19971	-0.0630
13	Religious institution	2.5	2.5/100	0.025	-3.68888	-0.0922
14	Residential	68.5	68.5/100	0.685	-0.37834	-0.2592
15	River	0.75	0.75/100	0.0075	-4.89285	-0.0367
16	Road network	1.25	1.25/100	0.0125	-4.38203	-0.0548

	Transport					
17	terminal	0.5	0.5/100	0.005	-5.29832	-0.0265

S (number of Land use) = 17

N (total number of individuals) = 100

Σ (sum) of **pi ln pi** = -1.4017

$$H = \sum_{i=1}^S P_i (\ln P_i)$$

$$H = - (-0.1288 + -0.1688 + -0.0265 + -0.0630 + -0.0922 + -0.0461 + -0.0265 + -0.0630 + -0.1498 + -0.0265 + -0.0782 + -0.0630 + -0.0922 + -0.2592 + -0.0367 + -0.0548 + -0.0265) \\ = \mathbf{1.4017}$$

The Shannon diversity index for Zone B is 1.4017 and the Shannon equitability index is calculated with $E_H = H/\ln(s)$. There are 17 land uses ($s=17$) so the calculated index will be $E_H = 1.4017/\ln (17) = \mathbf{0.494739}$.

Table 4 below calculates the Shannon diversity index by using land use type as, species of diversity for zone C and it has relatively high diversity index from all zones and it has high Shannon equitability index because of this value, zone C has relatively high diverse zone when compared to all other three zones.

Table 4: Shannon Diversity Index of zone C

No	Land use type	No of individuals				
		(n)	n/N	Pi	ln pi	Pi ln pi
1	Administration	5.5	5.5/100	0.055	-2.90042	-0.1595
2	Commercial	8	8/100	0.08	-2.52573	-0.2021

	Cultural &					
3	social welfare	4	4/100	0.04	-3.21888	-0.1288
4	Education	6	6/100	0.06	-2.81341	-0.1688
5	Green	1.5	1.5/100	0.015	-4.19971	-0.0630
6	Health	2	2/100	0.02	-3.91202	-0.0782
	Infrastructure					
7	and utilities	2	2/100	0.02	-3.91202	-0.0782
	Manufacturing					
8	and storage	4.5	4.5/100	0.045	-3.10109	-0.1395
	Mixed					
9	residential	5	5/100	0.05	-2.99573	-0.1498
	Municipal					
10	Services	7	7/100	0.07	-2.65926	-0.1861
11	Open space	3	3/100	0.03	-3.50656	-0.1052
12	Recreation	2	2/100	0.02	-3.91202	-0.0782
	Religious					
13	institution	4	4/100	0.04	-3.21888	-0.1288
14	Residential	40	40/100	0.4	-0.91629	-0.3665
15	River	1.5	1.5/100	0.015	-4.19971	-0.0630
16	Road network	2	2/100	0.02	-3.91202	-0.0782
	Transport					
17	terminal	2	2/100	0.02	-3.91202	-0.0782

S (number of Land use) = 17

N (total number of individuals) = 100

Σ (sum) of $\mathbf{p_i \ln p_i}$ = -2.2523

$$H = \sum_{i=1}^S P_i (\ln P_i)$$

$$H = - (-0.1595 + -0.2021 + -0.1288 + -0.1688 + -0.0630 + -0.0782 + -0.0782 + -0.1395 + -0.1498 + -0.1861 + -0.1052 + -0.0782 + -0.1288 + -0.3665 + -0.0630 + -0.0782 + -0.0782) =$$

2.2523

The Shannon diversity index for Zone C is 2.2523 and the Shannon equitability index is calculated with $E_H = H/\ln(s)$. There are 17 land uses ($s=17$) so the calculated index will be $E_H = 2.2523/\ln(17) = 0.794963$.

Table 5 below calculates the Shannon diversity index by using land use type as, species of diversity for zone D and it has relatively high diversity index next to Zone C but still has high Shannon equitability index because of this value zone D has relatively high diverse zone when compared to Zone A and Zone B.

Table 5: Shannon Diversity Index of zone D

No	Land use type	No of individuals (n)	n/N	Pi	ln pi	Pi ln pi
1	Administration	1.5	1.5/100	0.015	-4.19971	-0.0630
2	Commercial	2	2/100	0.02	-3.91202	-0.0782
3	Cultural & social welfare	1.5	1.5/100	0.015	-4.19971	-0.0630
4	Education	1	1/100	0.01	-4.60517	-0.0461
5	Green	8.5	8.5/100	0.085	-2.4651	-0.2095
6	Health	2	2/100	0.02	-3.91202	-0.0782
7	Infrastructure and utilities	1.5	1.5/100	0.015	-4.19971	-0.0630
8	Manufacturing and storage	5	5/100	0.05	-2.99573	-0.1498
9	Mixed residential	3.5	3.5/100	0.035	-3.35241	-0.1173

	Municipal					
10	Services	2.5	2.5/100	0.025	-3.68888	-0.0922
11	Open space	4.5	4.5/100	0.045	-3.10109	-0.1395
12	Recreation	3.5	3.5/100	0.035	-3.35241	-0.1173
	Religious					
13	institution	2.5	2.5/100	0.025	-3.68888	-0.0922
14	Residential	53	53/100	0.53	-0.63488	-0.3365
15	River	1.5	1.5/100	0.015	-4.19971	-0.0630
16	Road network	3.5	3.5/100	0.035	-3.35241	-0.1173
	Transport					
17	terminal	2.5	2.5/100	0.025	-3.68888	-0.0922

S (number of Land use) = 17

N (total number of individuals) = 100

Σ (sum) of **pi ln pi** = -1.9185

$$H = \sum_{i=1}^s P_i (\ln P_i)$$

$$\begin{aligned} H = & - (-0.0630 + -0.0782 + -0.0630 + -0.0461 + -0.2095 + -0.0782 + -0.0630 + -0.1498 + \\ & -0.1173 + -0.0922 + -0.1395 + -0.1173 + -0.0922 + -0.3365 + -0.0630 + -0.1173 + -0.0922 \\ & = \mathbf{1.9185}. \end{aligned}$$

The Shannon diversity index for Zone D is 1.9185 and the Shannon equitability index is calculated with $E_H = H/\ln(s)$. There are 17 land uses ($s=17$) so the calculated index will be $E_H = 1.9185/\ln(17) = 0.677146$.

3.7.2 To compare the spatial capital of each locality.

3.7.2.1 Study area zones

The site is divided into four distinct functional areas based on the identified spatial capital nature of the localities, because the study area's spatial capital differs by locality. To increase

accessibility and public engagement, the site is separated into four zones based on the nature of land use type, activity, primary transit line, and public space. Zones A, C, and D are predominantly residential areas with little or no public open space; however, Zone B contains mixed residential and commercial corridors with one public open space. Based on accessibility and centrality of public open space, the public space has been introduced in zones A, C, and D.

The public open space on B already exists, but it might be improved by adding infrastructure and landscaping. The public space on A, on the other hand, is a new public space developed specifically for the residential sector. *Figure 31* depicts four public space zones, each of which is divided into various functional sectors.

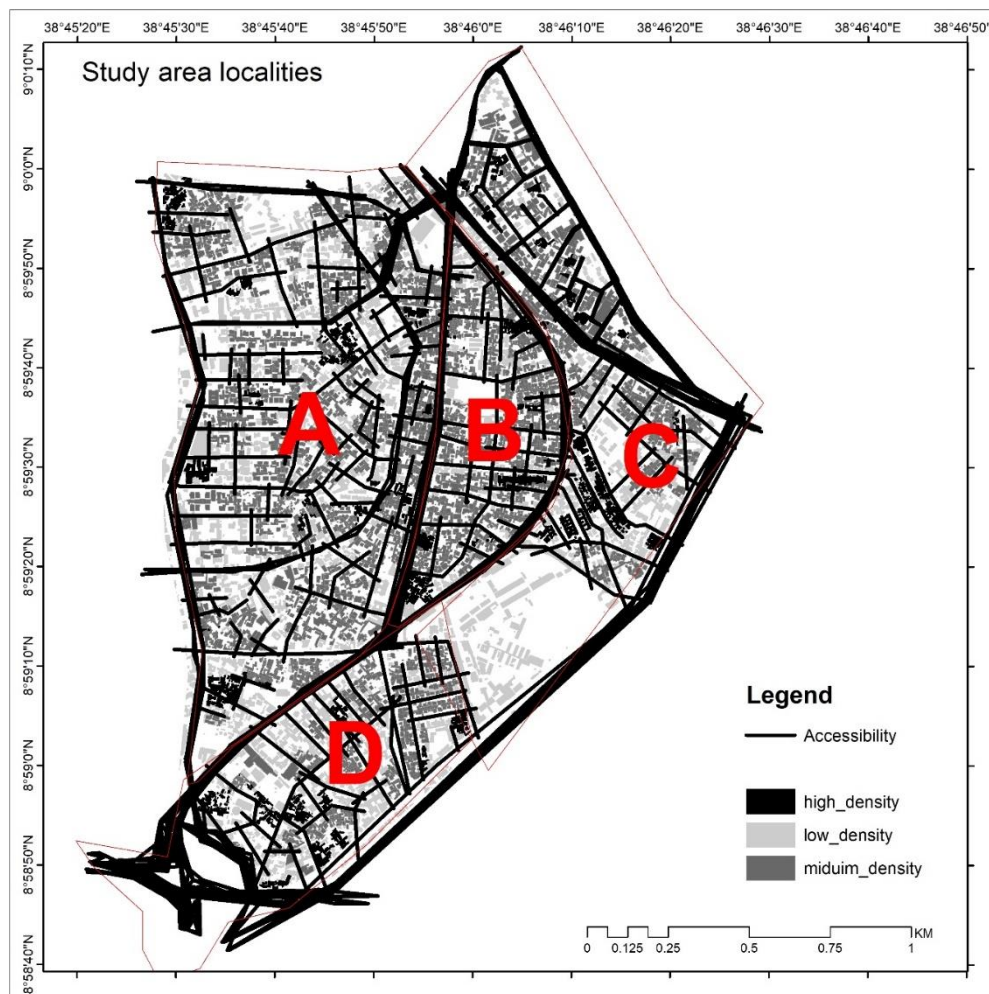


Figure 31: Four public space zones classified by functional areas

i. Zone A

The accessibility axial map in zone A is very good, with four major connections, however there are some dead-end access routes. Many dead-end roads exist in the neighbourhood, reducing the neighbourhood's link to the rest of the districts and surrounding. *Figure 32* below shows that the axial map and parcel density map of zone A.

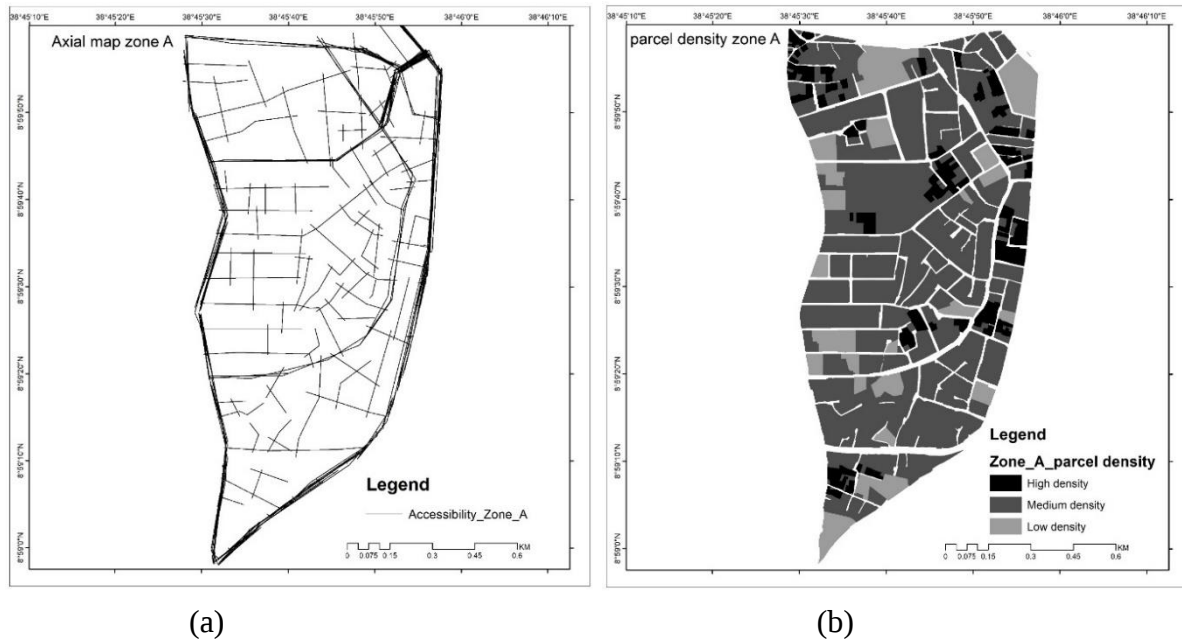


Figure 32: Axial map (a) and parcel density map (b) of zone A

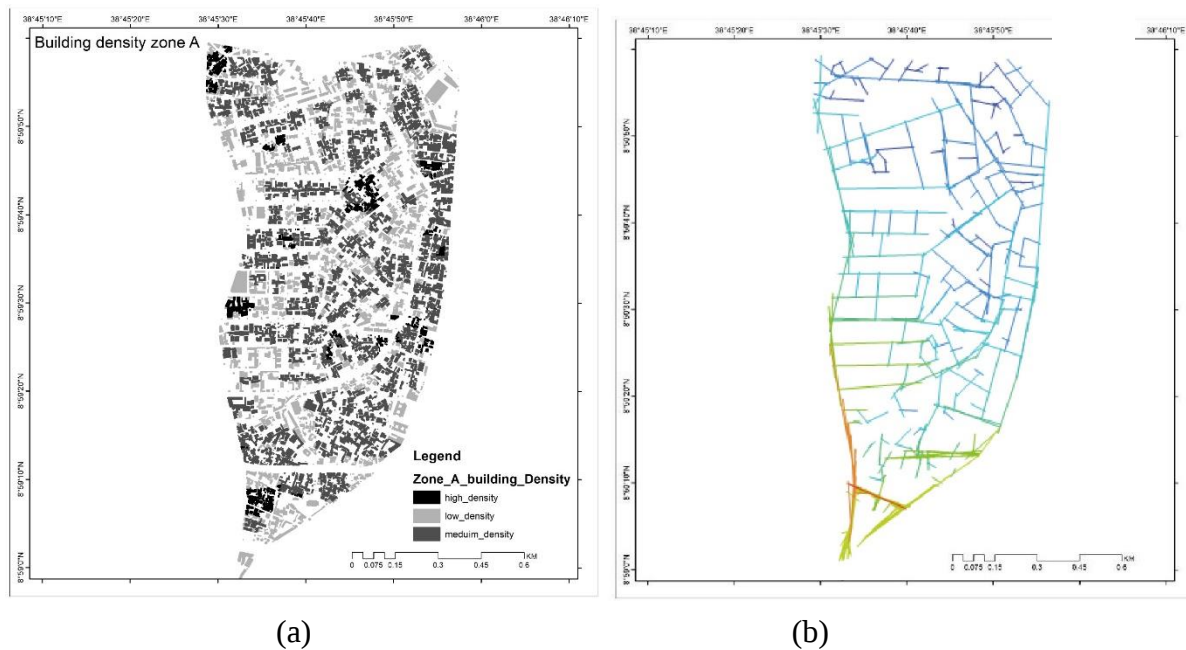


Figure 33: Building density and spatial integration map of zone A

The parcel density of zone A predominantly medium-density development, with some high-density parcels in specific areas as shown in *Figure 32*. The building density per parcel is similar to the parcel density, which is moderately dense, with certain areas having low development density. The spatial integration of Zone A reveal that the majority of the area has medium connectivity, with high and very high connectivity in the south and southwest. Zone A, on the other hand, is characterized by poor and extremely low connectivity in the north east direction. *Figure 33* shows the building density and spatial integration of zone A.

ii. Zone B

The axial plan of Zone B shows two major connections with many access routes, making this zone more accessible. It's more user-friendly and well-connected. Zone B's accessibility is depicted in *Figure 34*. Zone B's parcel density is nearly identical to zone A's, which is dominated by medium density, and zone B's parcel density is demonstrated in *Figure 34* below.

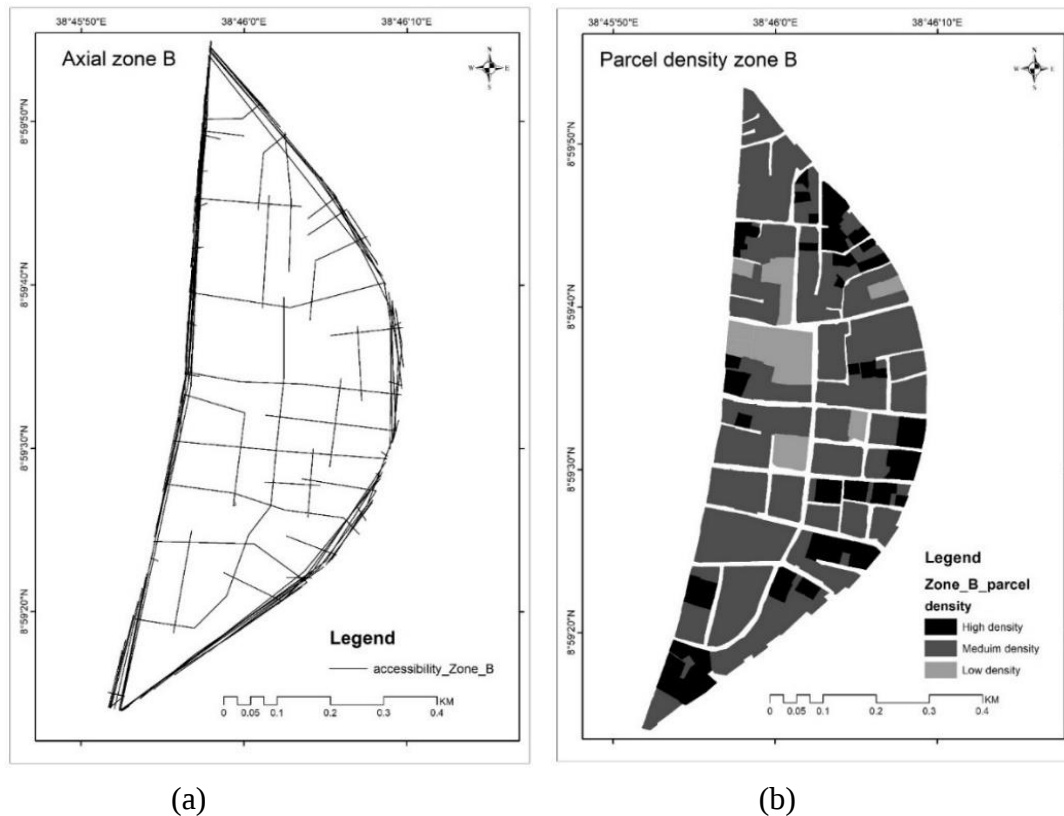


Figure 34: Axial map (a) and parcel density (b) map of zone B

The average building density per parcel within Zone B is moderate, with low development density in some areas. Zone B's spatial integration is better than Zone A's, in which a path connecting east and west border roads making this zone more connected, however there are also some dead-end roads in this zone. *Figure 35* below depicts the building density and spatial integration of zone B.

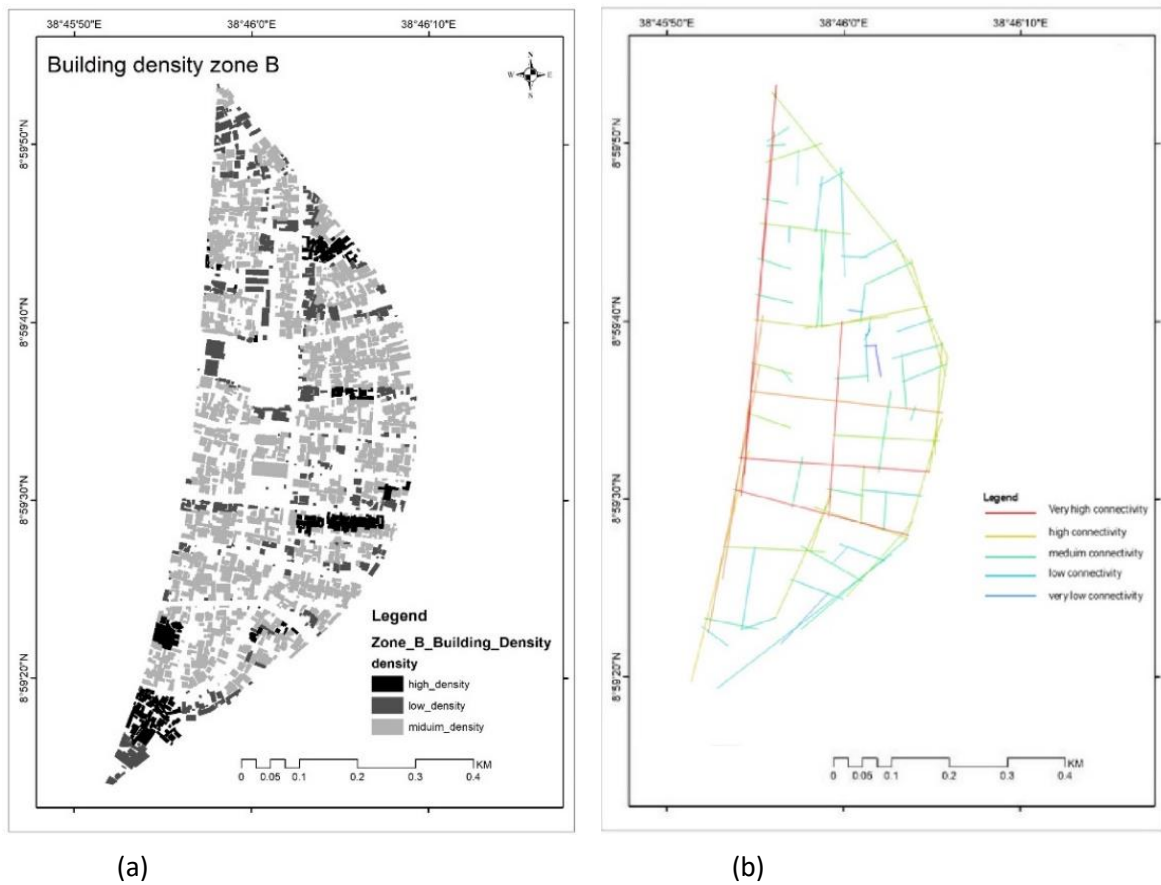


Figure 35: Building density (a) and spatial integration map (b) of zone B

iii. Zone C

As illustrated in *Figure 36* of the axial map below, zone C has improved accessibility, with three major connections and numerous access roads, making the location accessible and active.

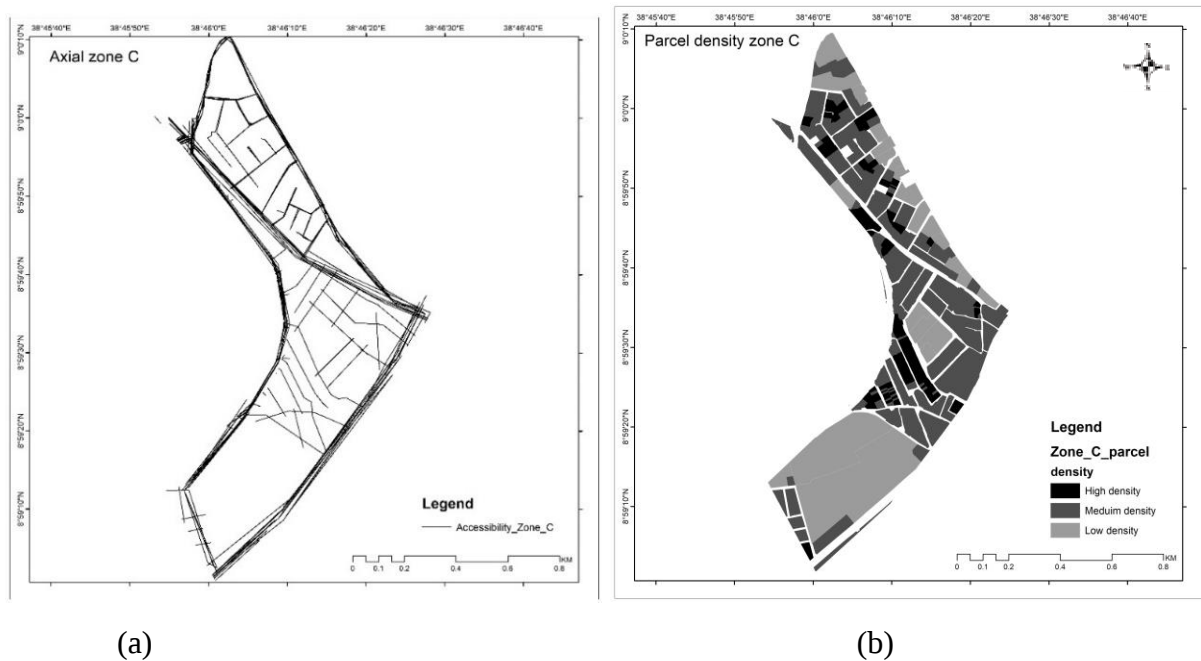


Figure 36: Axial map (a) and parcel density map (b) of zone C

Zone C is dominated by medium and low-density parcels. On the site, there is a vast parcel service area. In zone C's southern direction, low parcel density areas can also be found. When compared to other Zones, Zone C has a low density of structures, low connectivity and road integration, and the majority of the roads are characterized by dead ends, all of which have a significant impact on overall connectivity. The number of buildings and their spatial integration in zone C are depicted in *Figure 37* below.

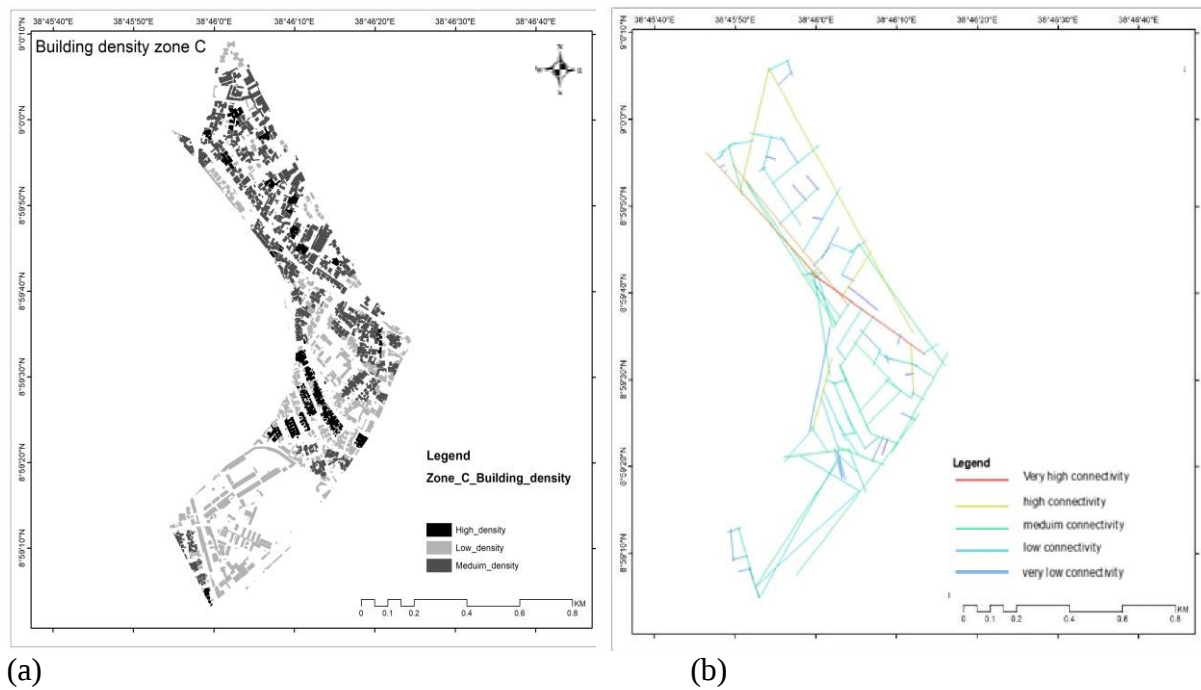


Figure 37: Building density (a) and spatial integration map (b) of zone C

iv. Zone D

Zone D, as indicated on the axial map, has high accessibility, mainly along the site's borders, where multiple roads connect site's left and right ends, which results increasing accessibility, and this zone is characterized by moderate building density, as shown in *Figure 38* below.

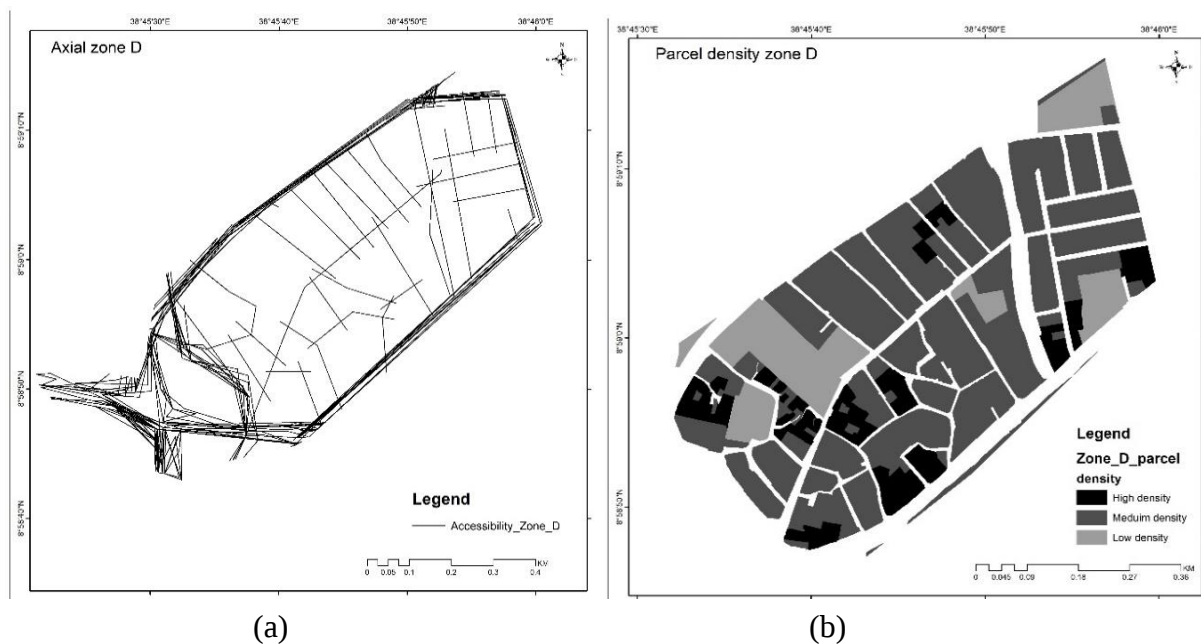


Figure 38: Axial map (a) and parcel density map (b) of zone D

The spatial integration of zone D is generally low connectivity and integration, but in the south west border (Around Gotera round) of the site. There is high integration in which most of the roads are connected in this area which results very high connectivity and integration. However, in the north east direction the roads are not well connected to each other which results low integration of roads. The spatial integration map of zone D is illustrated in *Figure 39* below.

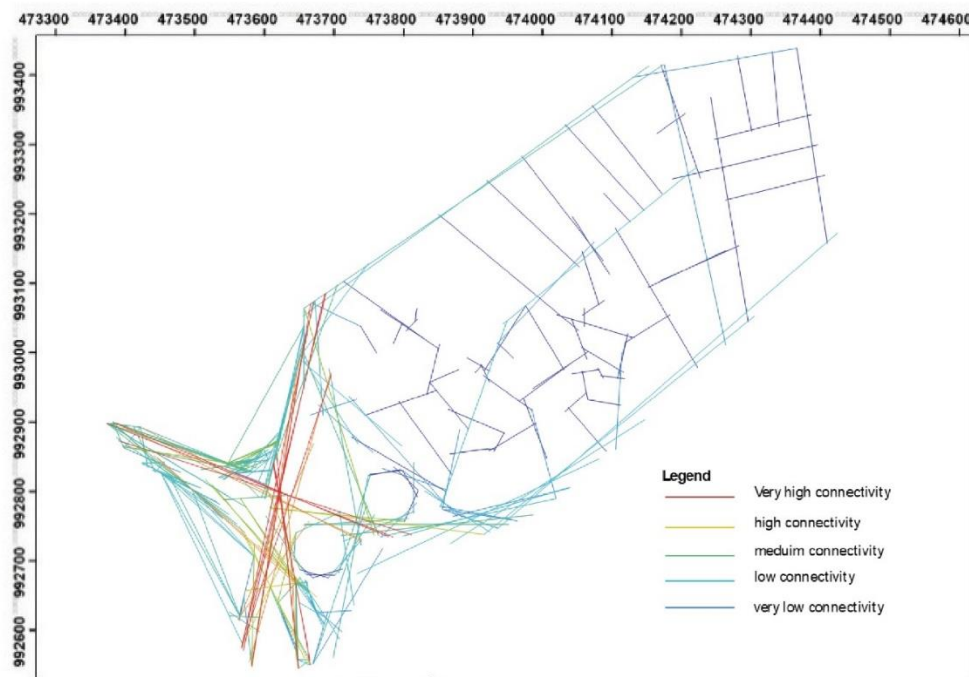


Figure 39: Spatial integration map of Zone D

CHAPTER FOUR

RESULT

4.1 Map the study area based on the spatial capital of different localities.

Because the research area's spatial capital varies by locality, the site is divided into four distinct functional areas based on the identified spatial capital nature of the localities. The site is divided into four zones based on land use type, activity, primary transit route, and public space to improve accessibility and public interaction. Zones A, C, and D are mostly residential, with little or no public open space; however, Zone B has a mix of residential and business corridors, with one public open space. The public space has been introduced in zones A, C, and D based on accessibility and centrality of public open space. *Figure 40* zone depicts four zones of the study area classified based on spatial capital of different localities.

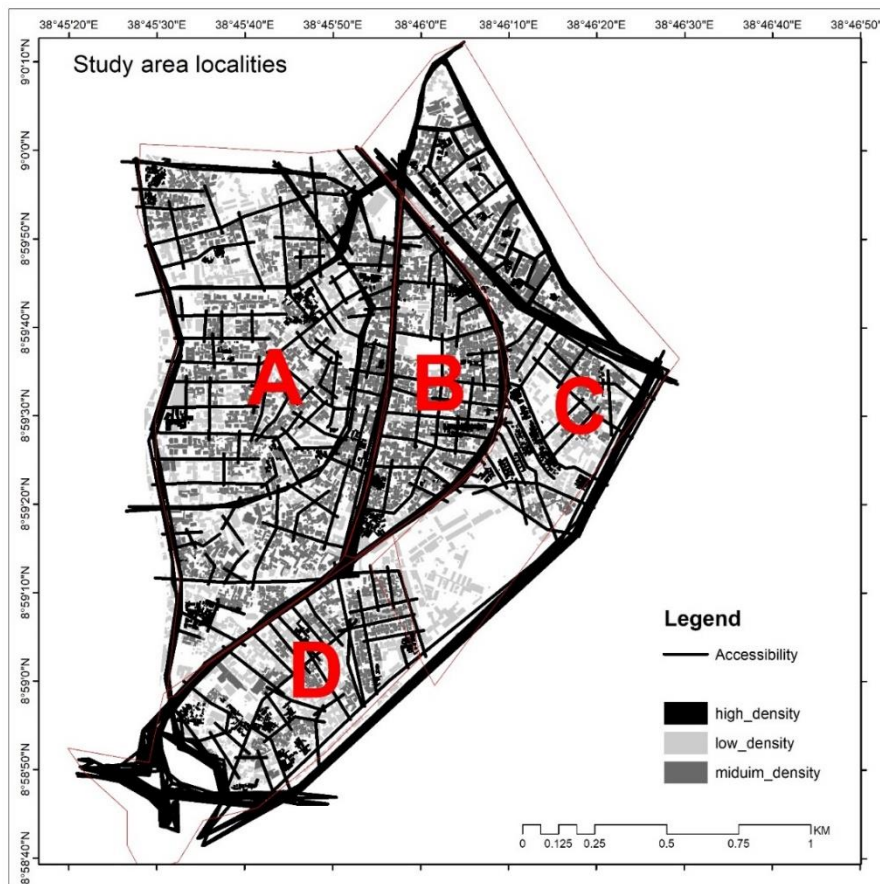


Figure 40: Four zones of the study area classified based on spatial capital

4.2 Compare the spatial capital of each locality.

4.2.1 Result of four zones

Table 6: Comparison of four zones

Zone	Accessibility	Parcel density	Building density	Open space	Spatial Integration	Land use dominated
A	Low	Very high	Very high	3.2%	Medium	Residential
B	High	High	High	7.1%	High-medium	Residential
C	Medium	Low	Low	2.4%	Medium	Mixed
D	Medium	Medium	Medium	6.1%	Medium	Mixed

The accessibility of each zone is calculated in DephmapX software illustrated in *Figure 34 b*, *36 b*, *38 b* and *40* and all the study area zones has very medium connectivity unlike the overall study area. So, by calculating the length of each connectivity representing line, zone A has high connectivity which is about 83 % of the study area is characterized by high connectivity. Unlike zone A zone D has very low connectivity and characterized by dead end roads. *Figure 41* below shows the overall summary of all zones.

According to norms and standards of Addis Ababa Structure plan the house hold density per hectare in core areas is 125 – 380 house hold. Son zone A has high building and parcel density which is about 452 house hold per hectare. Unlike zone A Zone D has moderate low density which is about 217 house hold per hectare. The remaining zones have medium building and parcel density which is illustrated and summarized in *Figure 41* below.

According to norms and standards of Addis Ababa Structure plan, 12% – 25% of the area should be left for greenery and natural open space. Unlike the standard the study area has very low open space especially zone C has only 2% of open space and Zone B has moderately high

open space from all zones and still 7% of open spaces which is below the standard. So, the study area is characterized by very low open spaces and illustrated and summarized in *Figure 41* below. All four zones are compared as shown in the *Figure 41* below which consists of open spaces building density, parcel density and accessibility.

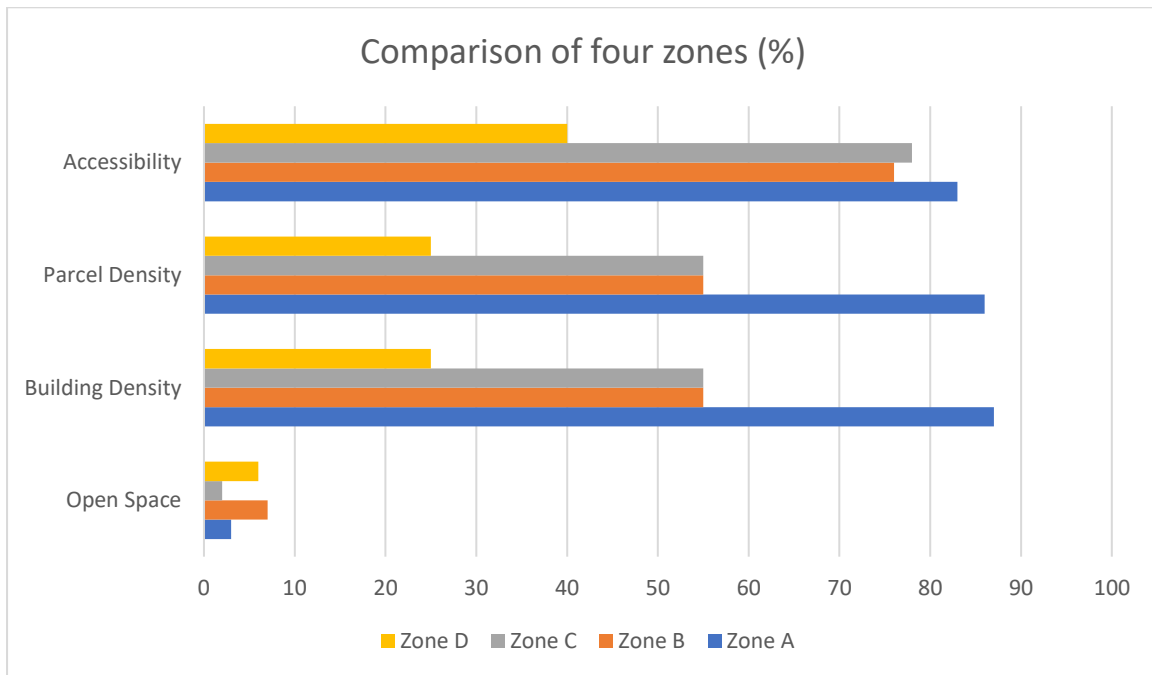


Figure 41: Comparison of four zones

4.2.2 Comparison of diversities of zones

The Shannon diversity index for four zone in Meskel Flower area is calculated and from this it shows that the four zones with highest and lowest land use diversity in the study area and illustrated in *Table 7* and *Figure 42* below. From the overall summary Zone has poor diversity from all zones. Diversity index less than 1 to be below average and greater than 1 to be above average or to be a good diversity. So, all zones have good diversity from these we conclude that the overall study area has good diversity.

Table 7: Shannon Diversity Index of Different zones

Zones	Shannon diversityindex (H)	Shannon equitability index (E_H)
A	1.2712	0.448678
B	1.4017	0.494739
C	2.2523	0.794963
D	1.9185	0.677146

The Shannon diversity with high values would be representative of more diverse communities. A community with only one species would have a *Shannon diversity* value of 0 because P_i would be equal to 1 and be multiplied by $\ln P_i$ which would equal to zero. So, the overall distribution of diversity in the study area is good and Zone C is more diverse from all other zones, and zone A has relative low diversity from all other zones.

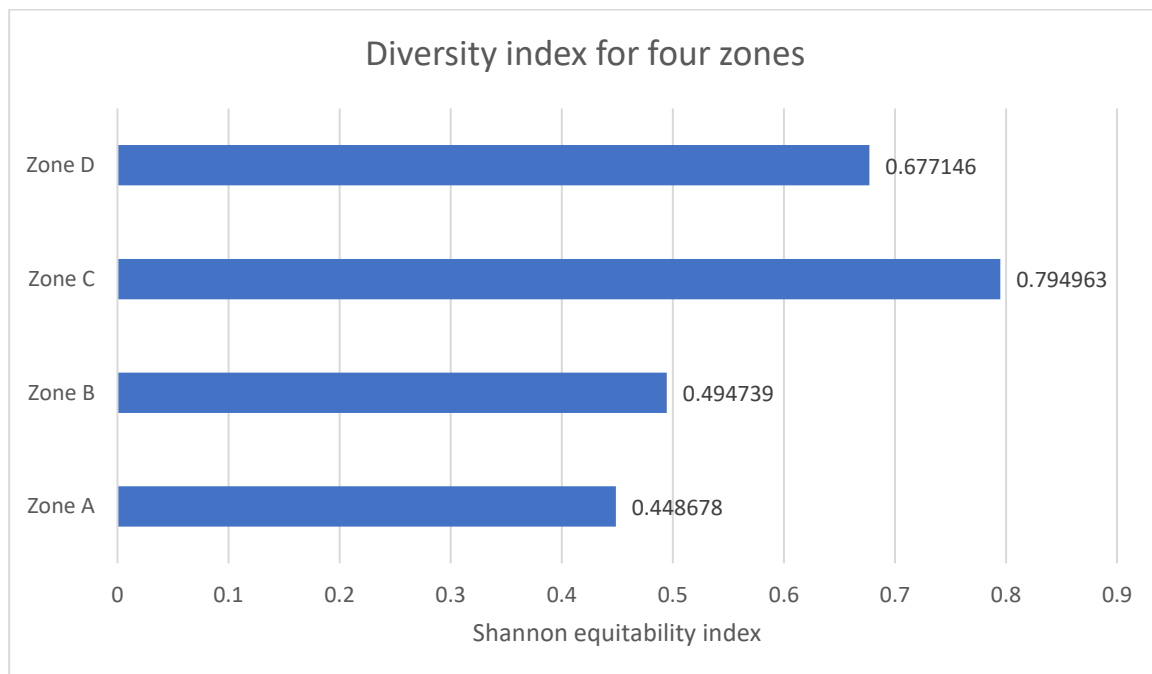


Figure 42: Diversity index for four zone

4.2.2 The major finding from the space syntax analysis

1. Based on the above analysis and results illustrated in each four zones, the current state of the study area is highly diversified, in relation to the number of actors/ plots.
2. The linkage and integration of public spaces with people's primary uses are poor. Additionally, there is low open space when compared to the standard.
3. Roads within residential areas have poor connection and are characterized by dead ends.
4. Density and accessibility are not equivalent in ratio; as density rises, connectedness must rise as well, with a high depth of function influence.

4.3 Propose appropriate urban design solution of place making for the existing spatial capital of selected areas of the district

In response to current land use problems, an overlaid street integration and open space map was created. Because the current land use plan lacks function integration, the new proposed overlaid map seeks to convert unused space into usable open spaces in order to accomplish the intended mixing of activities, with an emphasis on open spaces. Another problem that has been identified is the lack of accessibility and land use integration in existing open areas.

Since the existing main corridor in the centre of the study area is highly influential and affects all other three zones which has high integration value, connectivity and it is still under performing. It is also not providing the targeted purposes and most of them are leftover spaces without any function, because of this illegal settlement and slum housing development in those open space areas is high. When compared to the standards of Addis Ababa Structure plan there

are fewer open spaces in the study area. Accordingly, new open space also recommended in the proposed street integration and open space map.

As a result, the new street integration and open space map seeks to pave the way for highly integrated and accessible open spaces. As shown in *Figure 43* below, the new overlaid street integration and open space map is proposed to achieve the desired mixing of functions and accessibility based on the standards, which provides responses to the problems that were collected and analysed.

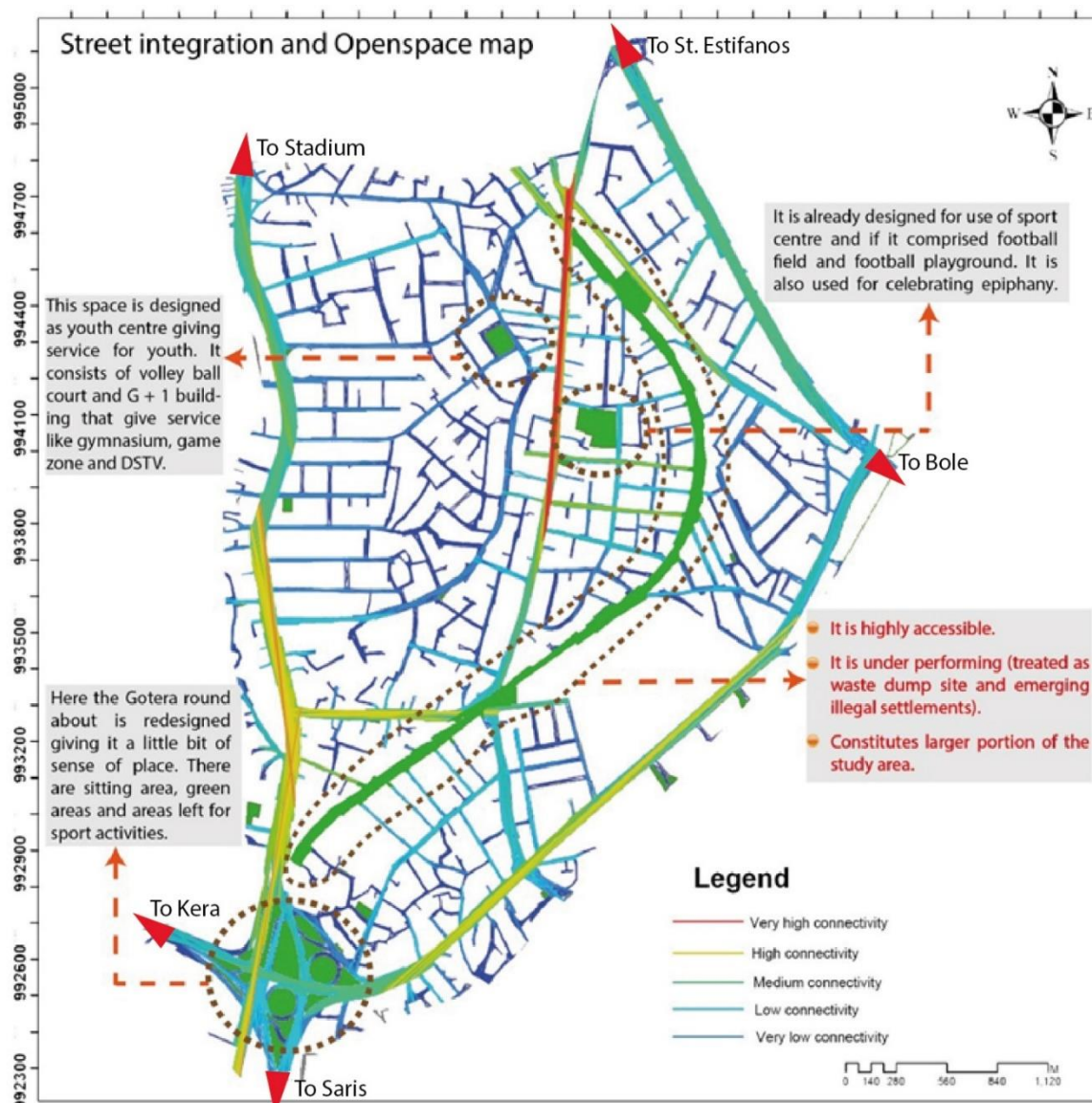


Figure 43: Conceptual Street integration and open space map

4.3.1 Design proposal

Finally, the sample design proposals based on the above overlaid map, with placemaking as the main focus area. The following design outputs are primarily based on the following main concept.

- Following the concept tactical place making introducing phased approach to change that begins with small stage and often at low cost.
- Avoiding complicated design structures and focus on what community needs.
- Rather than redesigning or completely changing the existing neighbourhood plan, it focuses on renovating or adding to it.

The design proposals focus on the abandoned corridor (old rail way) at the center of the study area. The proposals focus on addressing walkability issues which is essential for creating a sense of place. This is achieved by establishing bicycle lanes, natural shade and buffers (trees, shrubs), emphasizing on non-motorized movement over motorized movement, and preventing illegal settlements.

The areas selected for the design proposals are nodes that are found on the existing corridor (old railway) with major issues that affects the overall study area and is located in the center which is connected to other roads. The design proposal contains site plan and 3D views of selected areas that are shown from *Figure 44 – 47* below. The design proposal gives response for the existing issues like accessibility, illegal settlements and walkability.

4.3.2 Design proposal 1

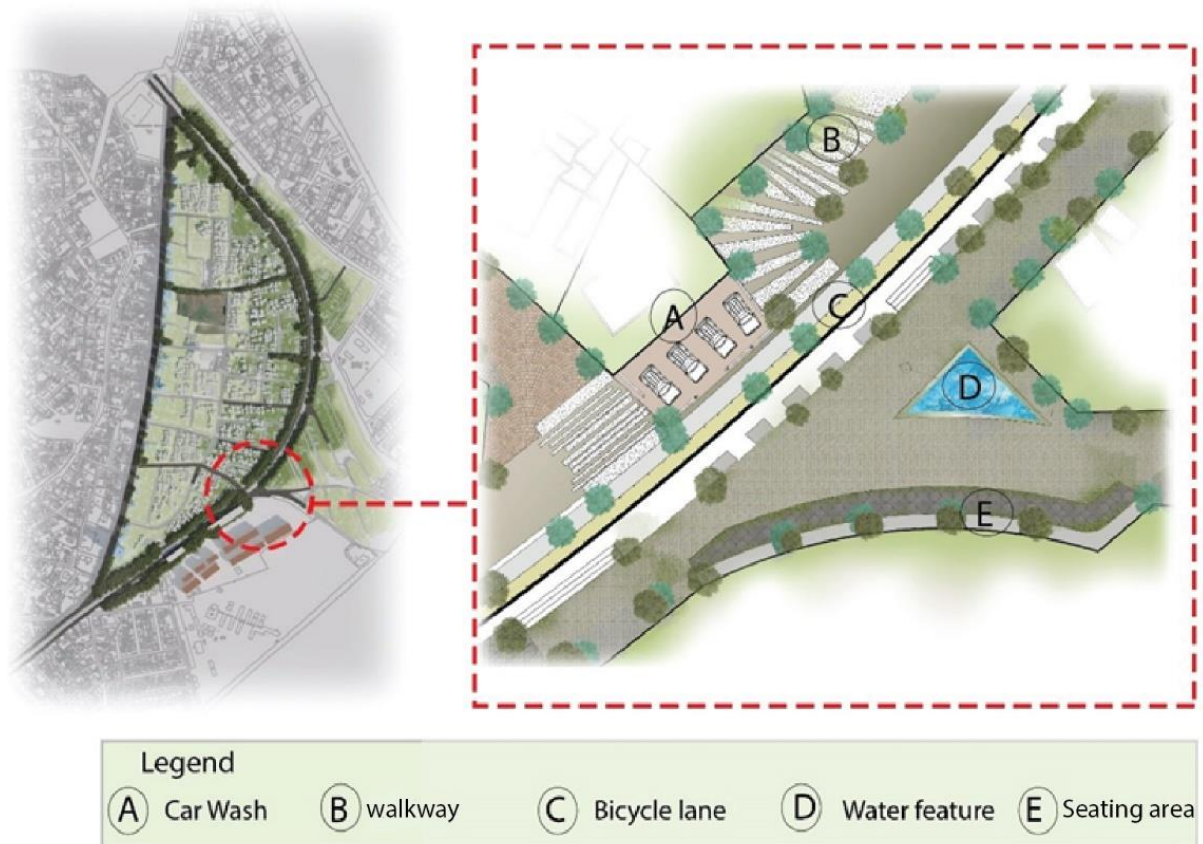


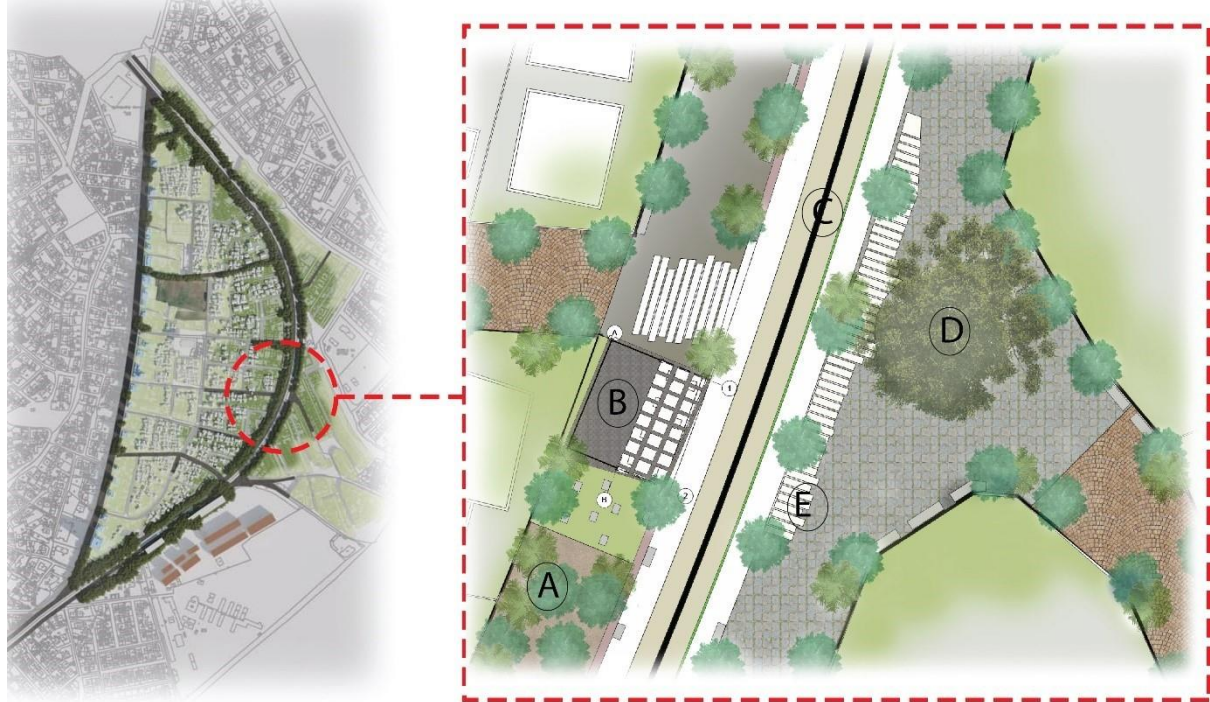
Figure 44: Design proposal, site plan and 3D view

Similar to all the areas throughout the corridor (the old railway) this particular node has accessibility issues created by the illegal settlements. It is also treated as a waste dump site by the residents around the area. So, while keeping the existing programs in place, the issue of walkability is addressed. This is accomplished by providing shade, using environmentally friendly materials, adding bicycle lanes and pedestrian walkways to help connect each node along the corridor, and employing intervention strategies that complement the neighbourhood's existing fabric.



Figure 45: Site 3D view existing and proposal

4.3.3 Design proposal 2



Legend

- (A) Green Area (B) "Sheger Dabo" (C) Bicycle lane (D) Seating area (E) Walk way



Figure 46: Design proposal, site plan and 3D view

The general concept is similar to that of the design proposal 1, and the main added concept is that one of the existing programs of this node is the "Sheger Dabo" shop. The “Sheger Dabo” project is the main target area for implementing this design.



Figure 47: Site 3D view existing and proposal

CHAPTER FIVE

DISCUSSION

5.1 Map the study area based on the spatial capital of different localities.

Public space is a place that is open for public use and recreation for everyone. The research area is a high densely developed area with low public space distribution. The distribution of public space is less than 2% from the total land use which is very low when compared with the standard of Addis Ababa Structure plan, which is 12% – 25% of the area should be left for greenery and natural open space. The existing public space location is not well connected and accessible for the major population. The quality of these public space is very low and don't give targeted function well, because of the public integration and connectivity is very low.

Neighbourhood is the place surrounded by the similar or related character. The neighbourhood of the site is high density with old slum development. The neighbourhood mainly residential with low access of open space, unclean and unsafe movement area. It is identified by the problem of pollution, low quality of road, old and slum housing.

According to Mariana, et al., (2017), the most significant aspect in ordering the neighbourhood layout is the connectedness between activities, which can improve their productivity and quality of life by employing the space syntax theory. The research methodologies include analyzing the integration, choice, control value, and entropy in the activity configuration utilizing the syntax plug-in in Grasshopper program. The results reveal that the cluster centralized plan is the most effective and efficient for elderly housing. Unlike Mariana, et al., (2017) this paper uses the software of depthMap X for the analysis of the study area which results the existing connectedness and accessibility of open spaces in the study area.

After wards, the study of Purti, et al., (2020) uses the space syntax approach to assess the passive interactions that occur in settlements and then compares them to direct observation. The degree of connection, integrity, and intelligibility value of a spatial configuration utilized in the spatial layout of an urban space or a settlement, as determined by space syntax approaches, is represented by an axial map. The case study approach was applied in Purti, et al., (2020) study, with Semanggi as the case area. Furthermore, Purti, et al., (2020) study makes advantage of direct observation during specific periods is thought to be particularly useful in filling in the gaps in analysis that space syntax could not (Putri, et al., 2020).

5.2 To compare the spatial capital of each locality.

The spatial connectivity shows the quality of the street connected and accessed by many nearby street or open access. Different methodology has been used to develop spatial connectivity. In this research the spatial connectivity has been developed with the space syntax software. The result shows that there is low accessibility in the two zones namely zone A and zone D, while zone C has medium accessibility and, Zone B has relatively high accessibility.

Spatial integration is another concept specially evaluating the connectivity and accessibility with the load of activity takes place on that street. The integration is developed by space syntax software. The main finding of the present study shows that Zone B has relatively high spatial integration and Zone A and zone D has low spatial integration, while zone B has medium spatial integration.

Diversity not only allows different types of people to interact, but it also allows for the introduction of varied functions into a neighbourhood. It is vital to encourage cities to become more diverse. The degree of mixed usage of space, functions, and types of inhabitants is

referred to as diversity and it also influences accessibility. While density refers to the number of developed units in a particular area of land. A residential or commercial development's density is expressed in dwelling units per acre, whereas population density is expressed in residents per acre. The housing density in the study area is characterized by unplanned and random settlement this leads the study area uncomfortable for users and make the places less accessible because of unplanned proportion of users. Zone A and zone B are characterized by high density but low diversity. Contrasting with Zone A and Zone B, Zone C and Zone D has low density and relatively high diversity with other zones.

According to Zhang, et al., (2019) in their study they try to identify dwellings of China and South Korea reflect the basic living space of the two peoples based on mobility and integration of spaces. In their study, Zhang, et al., (2019) selects the representative examples of traditional buildings in China and South Korea, based on the space syntax theory analysis software such as depthmapX and axwomen are used to analyze the similarities and differences between the spatial specific variable values, including integration, connectivity and control value and through the above analysis, combined with the correlation between space and cultural connotation: and the main finding shows that

- The quadrangle dwellings in China has a relatively shallow spatial structure compared to the Jeong-On's Traditional House in Korean, but the identifiable spatial structure in the two cases is similar.
- The quadrangle dwellings are different from the courtyard in the Jeong-On's Traditional House in the entire space structure, and its connection center is the corridor space. The corridor plays the role of transition space in the interior space of the courtyard, and divides the spatial hierarchy according to the depth.

- South Korea is a space of dual power structure, which is influenced by class and gender in the formation of spatial structure, while China has a very vertical order, but in a highly controlled space, the influence of class and gender can be ignored.

The study of Zhang, et al., (2019) mostly focus on architectural concept or building level comparison, however the present study mostly focusses on urban neighbourhood level open spaces.

5.3 Propose appropriate urban design solution of place making for the existing spatial capital of selected areas of the district.

The overall analysis shows that the site in general has medium density and diversity (primarily dominated by residential development) with low spatial integration and accessibility (mainly characterized by dead end roads). This all-results low spatial capital with in the study area.

Camur et al., (2017) the study used depth map software for determining parameters of spatial layout strategies, for analyzing and evaluating pedestrians' views on public safety. The Space Syntax Method was used to determine the connectivity, integration, and depth of the area in the Tarbiat city blocks, and these parameters are provided as graphical and quantitative data.

Finally, Camur et al., (2017) study shows plans and policies to promote the safety of pedestrians in Tarbiat, Tabriz, based on the modelled parameters and identification of diverse case features. Finally, the research of Camur et al., (2017) recommends that ideas be shown to promote pedestrian safety after examining the space syntax and spatial integration of the Tarbiat city blocks. The current study adds new concepts, such as proper use of open areas and the development of a land use plan for the study area.

As a result, overlaid street integration and open space map is proposed to make the way for highly integrated and accessible open spaces. Based on the standards, within the study area a new land use plan is recommended to accomplish the desired combination of functions and accessibility. Because the existing land use plan lacks mixing of functions, the new proposed land use plan incorporates additional land uses to provide the desired mixing of land uses, with an emphasis on open spaces. Lack of accessibility and land use integration are two further issues that have been identified. As a result, the new planned land use plan takes into account such issues, aiming to reduce the number of dead-end roads as much as possible.

CHAPTER SIX:

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Globally, cities are expanding as a result of growth in human population specially in urban areas, so sustaining cities that support human well-being is currently the major challenge to address. The aspects of the built form that concern planners are sense of place, neighbourhood belonging, access to services, mixed communities and time in influencing change in built form. Spatial capital by planning practice is a useful trope that helps planners to bring together a series of urban events that could offer considerable insight into the operation of power in the urban environment.

Spatial planning help designers and planners to draw greater attention the combined effects of people seeking positions within place which add relational sense of place in planning and design. This research covers different aspect of urban life and it emphasize the use of place or place plus mobility which create powerful social advantage through place plus mobility.

Additionally, public spaces with in the study area has very low integration and connectivity with the primary usage or need of people which results low spatial capital of each locality. Moreover, most of the roads located around residential settlement have very low open space which is about 3.5% which is very low according to the standard of norms and standards of Addis Ababa structure plan. Finally, the open space and public spaces are not equivalent ratio within the study area.

6.2 Recommendation

The Addis Ababa city administration should devote greater attention to the planning and implementation of highly integrated roadways in each sub-city as a location for street design and in-depth analysis for improving road linkages and accessibility. Furthermore, the city road authority should devote more attention to future proposed roads in order to achieve high integration and connectivity by conducting additional research on space syntax and placemaking, which this study did not cover, such as a detailed pedestrian count and a study of what people require in open spaces based on their daily activities before implementation of such projects.

The existing Commercial streets are highly integrated roads and located in the central part of the study area. So, the land with high connectivity and accessibility has high land values and rent values in which most of the commercial streets in the study area is characterized by retail, shops, café and restaurants, game zones and many other activities. So not only the activity of the place is influenced by the good integration of roads but also better land value which results better income for city administration or society.

To understand how people use public spaces and what impact they have on society's life, a more detailed space syntax analysis of current public places is required. This research can help determine what kind of improvement is needed and how to maximize the benefits of high-quality streets and public spaces. So, using this study as a preliminary step for additional research, it is suggested that more research be conducted in the current study area.

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Appendix

Appendix 1: Publishable manuscript

Space- syntax as a tool for place making by restructuring public spaces within mixed-residential areas of Addis Ababa, the case of Meskel flower district

Daniel Seleshi (MSc.), Alazar Assefa (PhD)

Placemaking is a process that inspires people to reinvent or reimagine public spaces as the heart of every community. The existing open spaces are not providing the intended services and most of them are leftover spaces without any function and some are even used for emerging slum housing. The general objective of this study is identifying spatial capital of the neighbourhoods and redesign open. Software like GIS, AUTOCAD and depthmapX are used for data analysis. The main finding from this paper is, the Study area is poorly connected in relation to the required function, the linkage and integration of public spaces with people's primary uses are poor and roads within residential areas have poor connection and are characterized by dead ends. So, the overlayed street integration and open space map was developed in response to creating functional open spaces to achieve the desired mixing of functions and accessibility based on the standards, which provides responses to the problems that were collected and analysed. This study attempts to provide sample design proposals of selected areas or nodes of the overlayed map, with placemaking as the main focus area.

Keywords: Axial map, Accessibility, DepthmapX, Diversity, Spatial capital

1.0 Introduction

Globally, cities are expanding as a result of growth in human population specially in urban areas. The need for place making is necessary, because of its useful to improve the physical environment. There are some perspectives which indicates that placemaking would contribute

to social developments. Most sociologists make the point that most social problems are related to physical environmental quality (Karacor, 2015).

The aspects of the built form that concern planners are sense of place, neighbourhood belonging, access to services, mixed communities and time in influencing change in built form. Spatial capital by planning practice is a useful trope that helps planners to bring together a series of urban events that could offer considerable insight into the operation of power in the urban environment Invalid source specified.

The term spatial capital focus on how people engage with place and it is common in planning practice. Spatial planning help designers and planners to draw greater attention the combined effects of people seeking positions within place which add relational sense of place in planning and design. Spatial capital cover different aspect of urban life and it emphasize the use of place or place plus mobility which create powerful social advantage through place plus mobility (Mace, 2017).

Addis Ababa is a capital city and economic center of Ethiopia, which plays the leading role in practices for vital and diverse urban life. There are a lot of problems and challenges emerge in this process such as commercialization of public space. So, the main district of Addis Ababa needs critical spatial intervention for regenerating public street life and neighbourhood level open space of Addis Ababa especially in the central business district and this study is intended to Kirkos sub city of Wereda 02 and 03.

With cities expanding globally and human populations becoming increasingly urban, sustaining ecosystems that support human well-being in cities is both increasingly challenging and urgent. City residents can take on important roles in the stewardship of public parks, trees, and

waterbodies in their neighbourhoods, and sense of place is often brought forward as a motivation for engagement.

Kirkos sub city is one of the 11 sub cities in Addis Ababa among one of the densely populated sub cities in Addis Ababa with a population density of 150 persons per hectare. in order to maintain balance between the population and the natural environment there need to be an intervention mechanism. The situation for the past 10 years of achieving balance between society and nature in kirkos sub city particularly to the study area (Meskel Flower) is highly off. Here are some empirical evidences in specific areas of the study area.

- The open space inside the study area has many existing problems in which they are not providing the targeted purposes and most of them are leftover spaces without any function, because of this irregular settlement and slum housing emerging in those open space areas.
- When compared to standards, there are fewer open spaces in the study area. As a result, the quality and function of existing open space is poor, for example the newly planned St. Yared Square in the study Area is underperforming.
- The abandoned corridor (old railway) had a great potential for integrating the society to the natural environment but no work has been done to achieve that.

2.0 Materials and methods

The study area is located in the capital city of Ethiopia, Addis Ababa city, Kirkos sub city, woreda 02 and 03 which is located around Meskel flower covers a total area of 527 km². Kirkos sub city of Addis Ababa is situated at elevation of 2352m and it is located at longitude 38°76'29.88"E and latitude 9°0'24.49" N. Based on national census conducted by the Central Statistical Agency of Ethiopia (CSA) in 2012, Addis Ababa town has a total population of 4.8

million people. Woreda 02/03 is a relatively more urbanized area when compared to other part of the city. It has a very diverse demographic group.

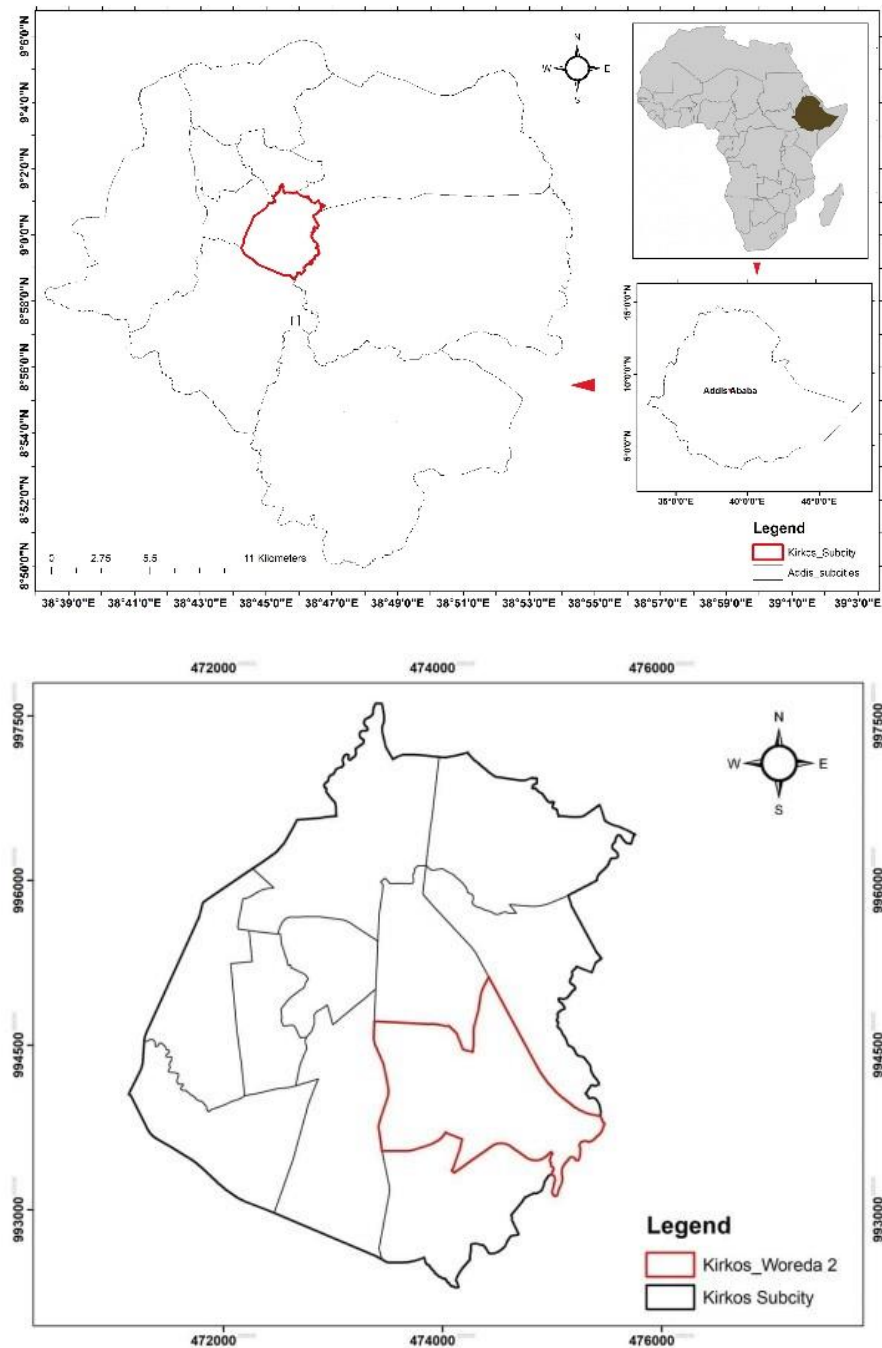


Figure 1: Location map of the study area

2.1 Data types

There are different types of data used for this study in which the data are organized are qualitative and quantitative data types, in which most of the data are both numerical and non-numerical or the data collected are in the form of words, sentences and numbers. The data types which include, street network, land use maps, which helps to produce most of the spatial connectivity analysis used for this study which includes Connectivity (socials vs public space), commercial streets etc.

2.2 Data sources

The data was collected from both primary and secondary data sources. The primary data for this study was collected by site observation. The secondary data sources which include Kirkos sub city, books, journal articles from Addis Ababa planning commission.

2.3 Method of data collection

Collecting and studying previous data from Addis Ababa urban plan commission concerning place making, commercial street and determine the drawbacks of the studied design system and analyze and design the neighbourhood plan in the case areas are will studied. Software like GIS, AUTOCAD and depthmapX are used. In addition to these another published written documents and additional data sources will be used for the study as an input.

2.4 Data analysis tool

The street network of the study area was analyzed using depthmapX software and the overall process of the data analysis is shown in the *Figure 2* below.

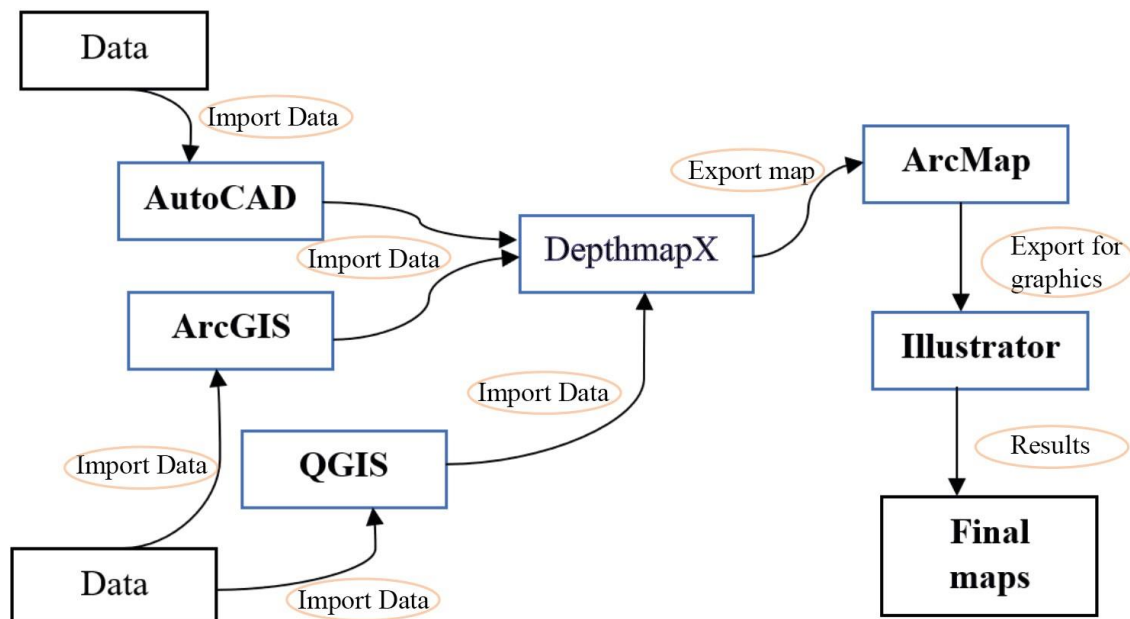


Figure 2: The workflow of space syntax analysis using the DepthmapX

2.5 Materials

i. Existing Street network

The street network has a number of routes and distribution which results a good accessibility in the study area. *Figure 3 (a)* below shows the existing street network of the study area.

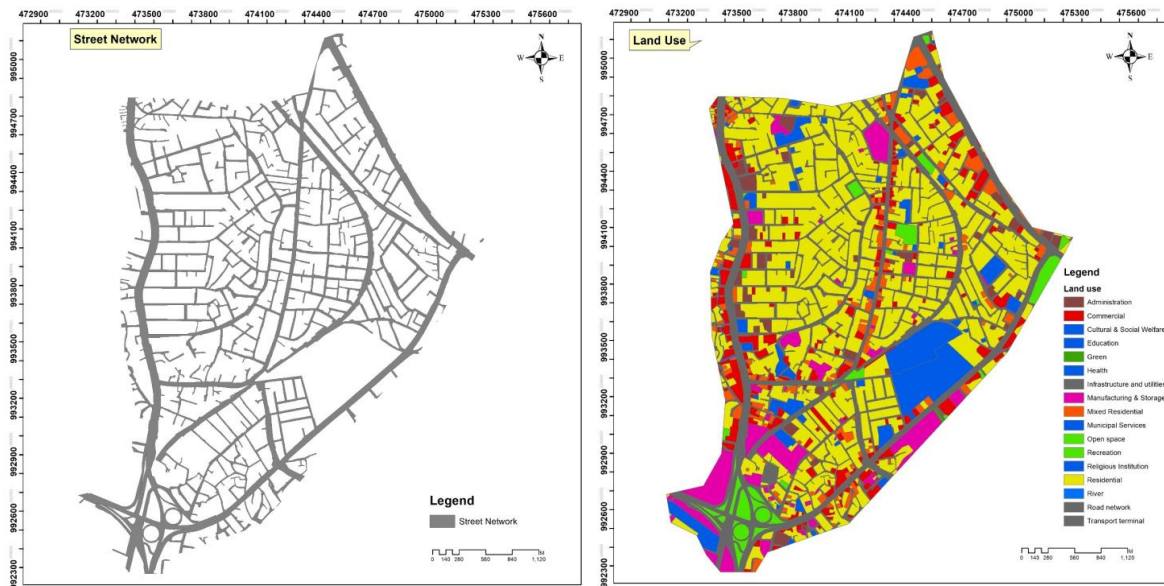
ii. Existing Land use

The existing land use in the study area is mostly dominated by residential; the main street is very active and good connection. *Figure 3 (b)* shows the existing land use of the study area.

The existing land use have less distribution of variety of public space and recreational area.

iii. Connectivity (socials vs public space)

There is a very low connectivity of public space in the study area with the main streets that has good social access. *Figure 3 (c)* shows the distribution of public space and social affairs. The distribution of public space is low as compared on the area of the site.



(a)

(b)



(c)

Figure 3: Existing Street network, existing land use map respectively and Connectivity of public space and social

3.0 Results

i. Commercial Street

Figure 4 (a) shows commercial street with surrounding commercial and mixed-use building activity, the main street in the center and right side has high value of as commercial street.

ii. Public space

The distribution of public space found in the study area is low. There is no enough public space found. *Figure 4 (b)* below shows the public space and its distribution throughout the site.

iii. The spatial connectivity and integration of street

The map below on *Figure 4 (c)* shows the spatial integration of the street. The integration is done by space syntax depth map. The main street in the center has high integration with the surrounding street and neighbourhood. To design the active street based on spatial integration the street in the center of the site has good value.

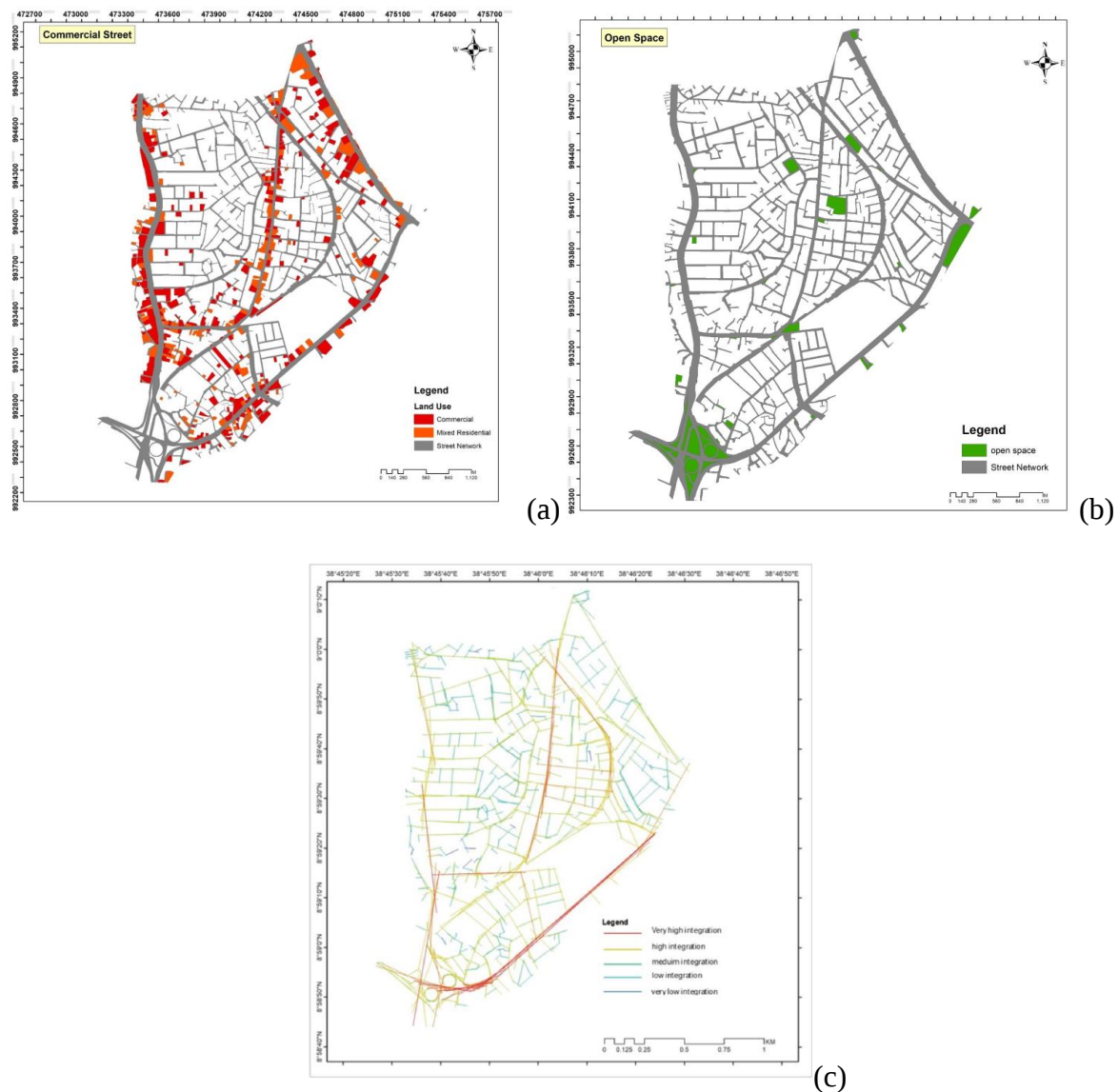


Figure 4: commercial street (a), public space (b) and Spatial integration of the study area (c).

iv. Spatial connectivity

Figure 5 (a) below shows the spatial connectivity of street in the study area. The red color shown in the central part on the Figure 5 (a) represents high connectivity and the blue color shows the low connectivity and mostly characterized by dead end roads.

v. Integration Value

Space Syntax used to measurement and understand of social behaviour. Connectedness and integration are two of the most important elements. Figure 5 (b) below shows the distribution of spatial integration, correlating. The accessibility measure developed in space syntax research has been further developed into place syntax-analysis (PPS, 2018).

vi. Building density per plot

The number of developed units in a given area of land is referred to as density. Dwelling units per acre, for example, are commonly used to measure residential density. For this study, the measurement has been done high density the density with greater than 80%, medium density within 50- 80% low density with in less than 50%. The Figure 5 (c) and Figure 6 (a) below shows the plot density.



(a)



(b)

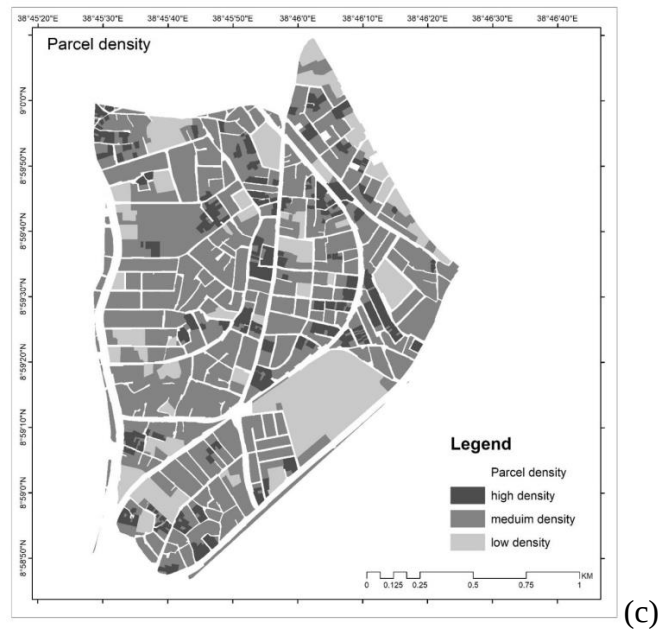


Figure 5: Spatial connectivity (a), Integration axial map (b) and Parcel density (C)

vii. Integration of axial map and building density

As shown on the map on the *Figure 6 (b)* below the axial map overlies with the building density per plot, in which it tries to identify the major active street covers and the attached development with low setback and high density. The development high accessible commercial activities have been takes place within the main street.

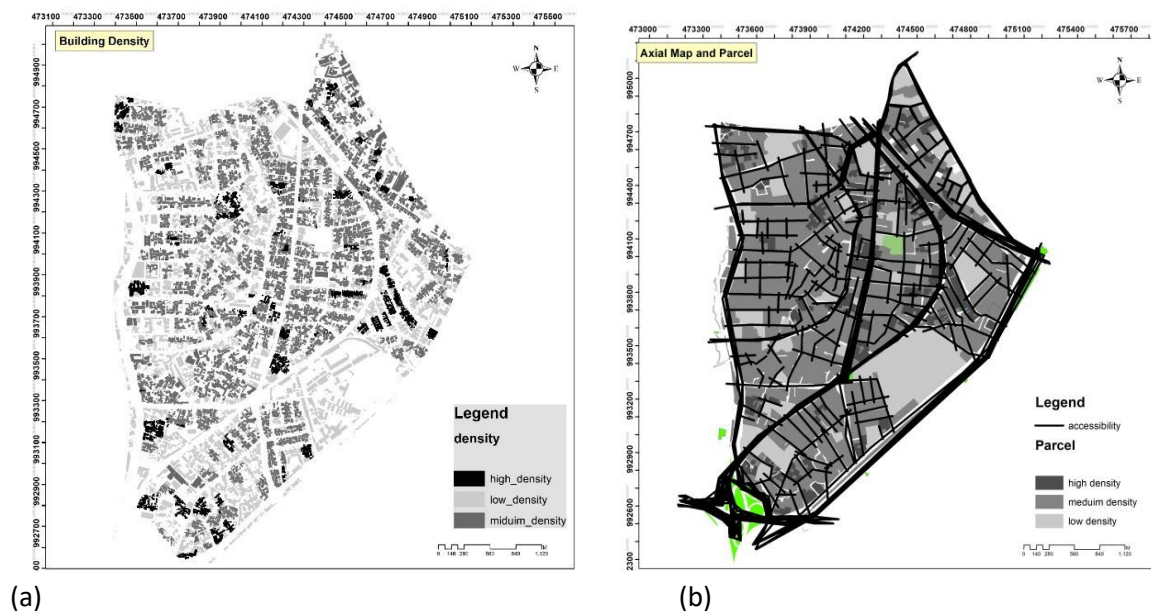


Figure 6: Building density per parcel and Integration of axial map and building density

3.1 Study area zones

The site is divided into four distinct functional areas. Residential land usage dominates these four zones. The site is divided into four zones to propose public space for improving accessibility and public interaction. Zones A, C, and D are largely residential zones with no public open space; however, Zone B comprises both residential and commercial corridors with one public open space. On the basis of accessibility and centrality of public open space, the public space has been introduced in zones A, C, and D.

The public open area on B is existing, but it can be made more accessible by adding infrastructure and landscaping. However, the public space on A is a new public designed for the residential area. *Figure 7* below shows that four public space zones classified by distinct functional areas.

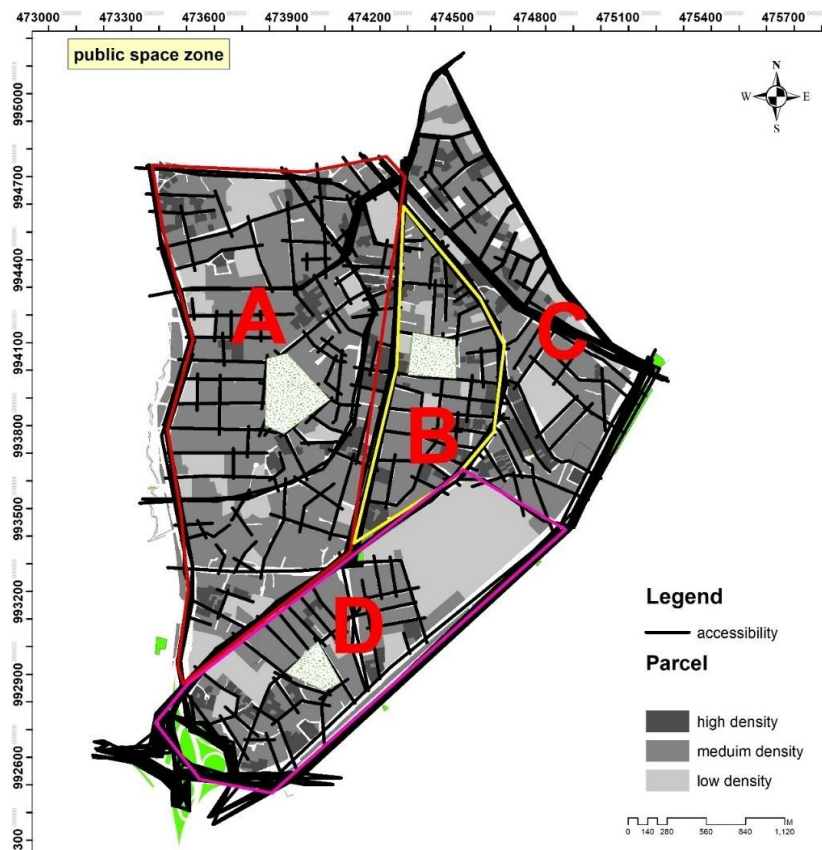


Figure 7: Four public space zones classified by functional areas

Table 1: Comparison of four zones

Zone	Accessibility	Parcel density	Building density	Open space	Spatial Integration	Land use dominated
A	Low	Very high	Very high	3.2%	Medium	Residential
B	High	High	High	7.1%	High-medium	Residential
C	Medium	Low	Low	2.4%	Medium	Mixed
D	Medium	Medium	Medium	6.1%	Medium	Mixed

3.2 The major finding from the space syntax analysis

1. The current state of the study area is highly diversified, in relation to the number of actors/ plots.
2. The linkage and integration of public spaces with people's primary uses are poor.
Additionally, there is low open space when compared to the standard.
3. Roads within residential areas have poor connection and are characterized by dead ends.
4. Density and accessibility are not equivalent in ratio; as density rises, connectedness must rise as well, with a high depth of function influence.

Since the existing main corridor in the centre of the study area is highly influential and affects all other three zones which has high integration value, connectivity and it is still under performing. It also is not providing the targeted purposes and most of them are leftover spaces without any function, because of this illegal settlement and slum housing development in those open space areas is high. When compared to the standards, there are fewer open spaces in the study area. Accordingly, new open space also recommended in the proposed street integration and open space map.

As a result, the new street integration and open space map seeks to pave the way for highly integrated and accessible open spaces. As shown in *Figure 8* below, the new overlaid street integration and open space map is proposed to achieve the desired mixing of functions and accessibility based on the standards, which provides responses to the problems that were collected and analysed.

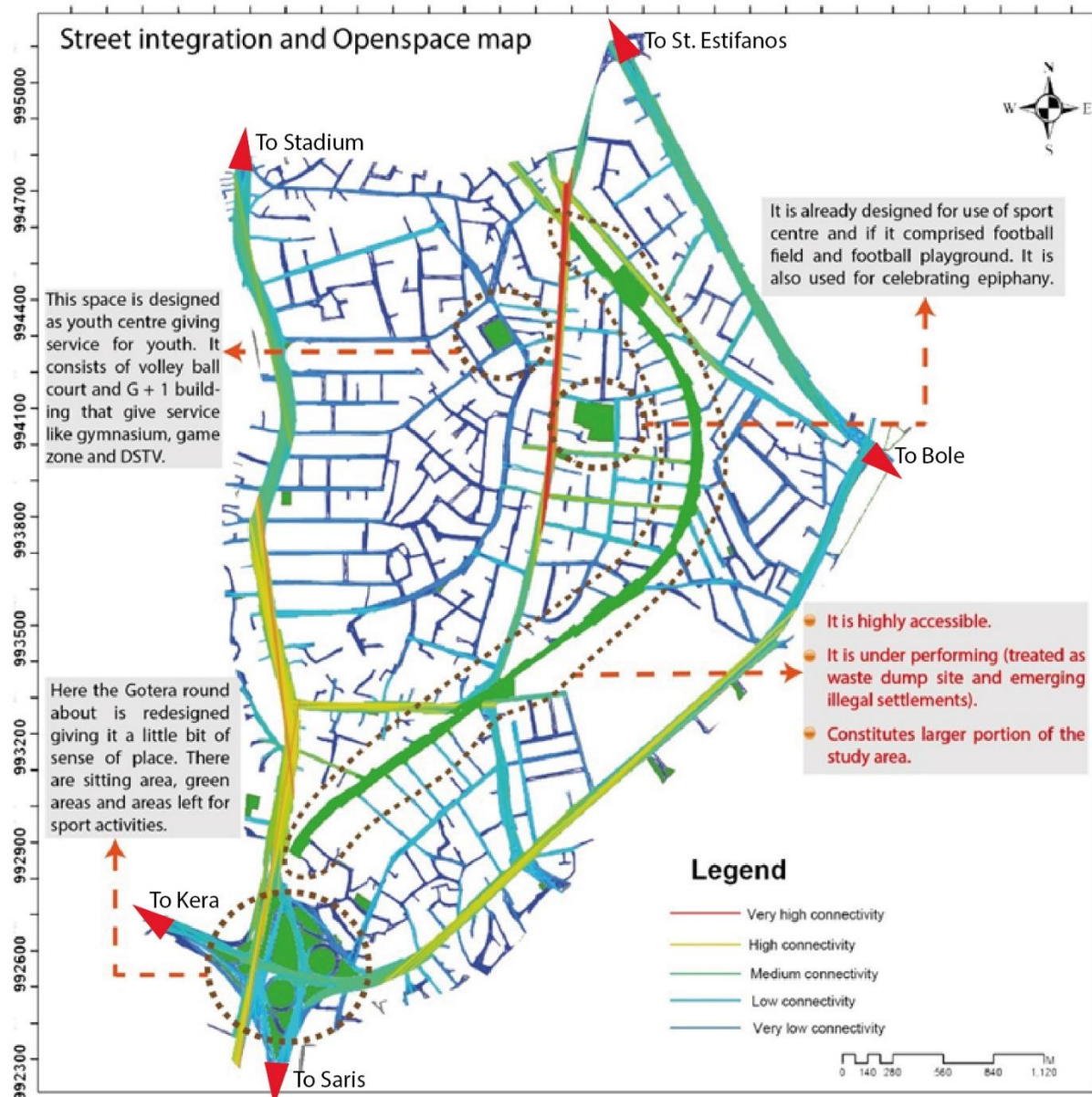


Figure 8: Overlaid Street integration and open space map

4.0 Discussion

Public space is a place that is open for public use and recreation for everyone. The research area is a high densely developed area with low public space distribution. The distribution of public space is less than 2% from the total land use which is very low when compared with the standard. The existing public space location is not well connected and accessible for the major population. The quality of these public space is very low and don't give targeted function well, because of the public integration and connectivity is very low.

Neighbourhood is the place surrounded by the similar or related character. The neighbourhood of the site is high density with old slum development. The neighbourhood mainly residential with low access of open space, unclean and unsafe movement area. It is identified by the problem of pollution, low quality of road, old and slum housing.

According to Mariana, et al., (2017), the most significant aspect in ordering the neighbourhood layout is the connectedness between activities, which can improve their productivity and quality of life by employing the space syntax theory. The research methodologies include analyzing the integration, choice, control value, and entropy in the activity configuration utilizing the syntax plug-in in Grasshopper program. The results reveal that the cluster centralized plan is the most effective and efficient for elderly housing. Unlike Mariana, et al., (2017) this paper uses the software of depthMap X for the analysis of the study area which results the existing connectedness and accessibility of open spaces in the study area.

The spatial connectivity shows the quality of the street connected and accessed by many nearby street or open access. Different methodology has been used to develop spatial connectivity. In this research the spatial connectivity has been developed with the space syntax software. The

result shows that there is low accessibility in the two zones namely zone A and zone D, while zone C has medium accessibility and, Zone B has relatively high accessibility.

Spatial integration is another concept specially evaluating the connectivity and accessibility with the load of activity takes place on that street. The integration is developed by space syntax software. The main finding of the present study shows that Zone B has relatively high spatial integration and Zone A and zone D has low spatial integration, while zone B has medium spatial integration.

Diversity not only allows different types of people to interact, but it also allows for the introduction of varied functions into a neighbourhood. It is vital to encourage cities to become more diverse. The degree of mixed usage of space, functions, and types of inhabitants is referred to as diversity and it also influences accessibility. While density refers to the number of developed units in a particular area of land. A residential or commercial development's density is expressed in dwelling units per acre, whereas population density is expressed in residents per acre. The housing density in the study area is characterized by unplanned and random settlement this leads the study area uncomfortable for users and make the places less accessible because of unplanned proportion of users. Zone A and zone B are characterized by high density but low diversity. Contrasting with Zone A and Zone B, Zone C and Zone D has low density and relatively high diversity with other zones.

The overall analysis shows that the site in general has medium density and diversity (primarily dominated by residential development) with low spatial integration and accessibility (mainly characterized by dead end roads). This all-results low spatial capital with in the study area.

As a result, the overlayed street integration and open space map is proposed to make the way for highly integrated and accessible open spaces. Based on the standards, within the study area a new land use plan is recommended to accomplish the desired combination of functions and accessibility. Because the existing land use plan lacks mixing of functions, the new proposed land use plan incorporates additional land uses to provide the desired mixing of land uses, with an emphasis on open spaces. Lack of accessibility and land use integration are two further issues that have been identified. As a result, the new planned land use plan takes into account such issues, aiming to reduce the number of dead-end roads as much as possible.

5.0 Conclusion

Spatial planning help designers and planners to draw greater attention the combined effects of people seeking positions within place which add relational sense of place in planning and design. This research cover different aspect of urban life and it emphasize the use of place or place plus mobility which create powerful social advantage through place plus mobility. From the overall analysis the major findings of this research are; the existing study area is characterized by very low connection with necessary functions and services.

Additionally, public spaces in with in the study area has very low integration and connectivity with the primary usage or need of people. Moreover, most of the roads located around residential settlement have very low connectivity to main roads and less accessible for users. Finally, the density and accessibility are not equivalent ratio, if the density increases the connectivity must be high with high function influence depth.

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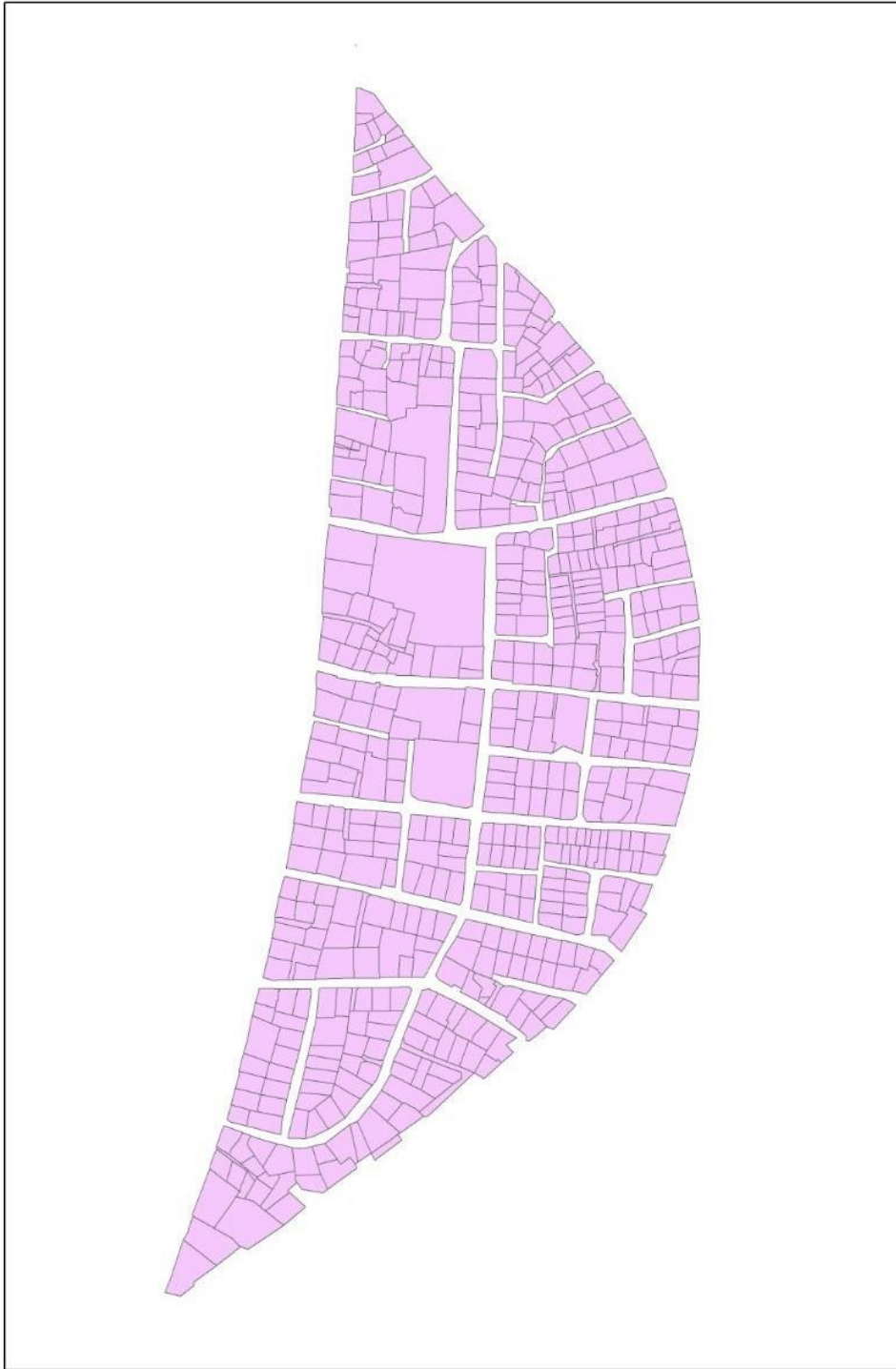
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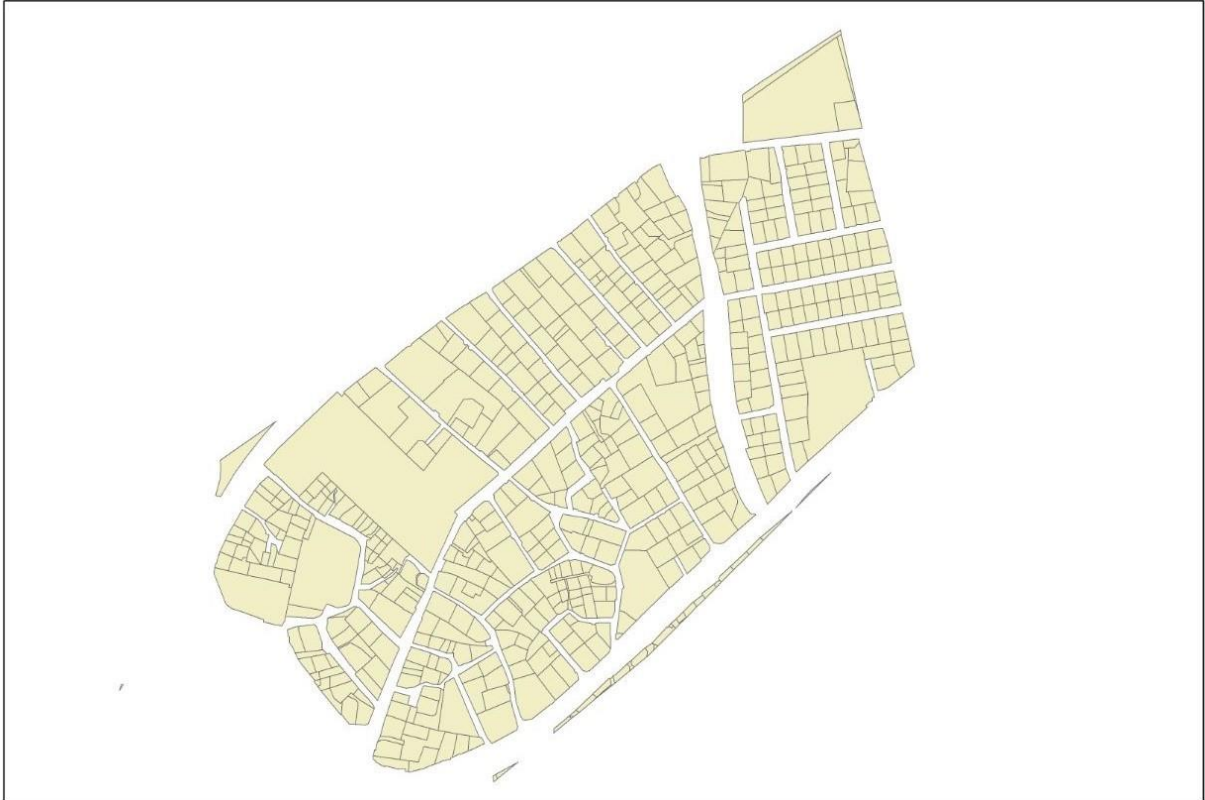
Appendix 2: Overall map of the study area input for depthmapX



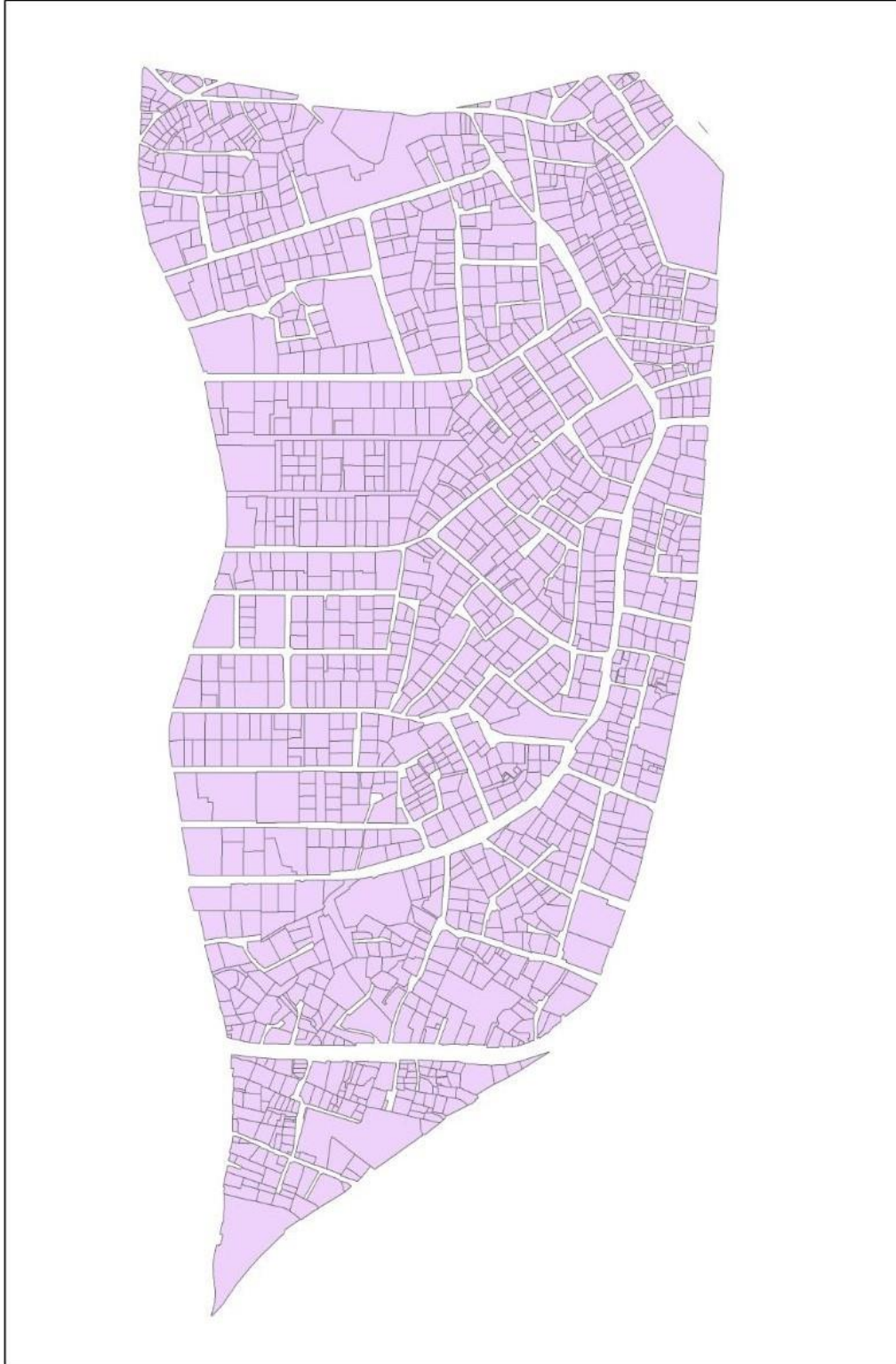
Appendix 3:Overall map of the study area of Zone B input for depthmapX



Appendix 4: Overall map of the study area of Zone D input for depthmapX



Appendix 5: Overall map of the study area of Zone A input for depthmapX



Appendix 6: Overall map of the Study area of Zone C input for depthmapX

