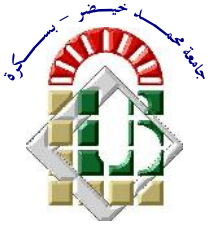
الجمهورية الجزائرية الديمقراطية الشعبية
République Algérienne Démocratique et Populaire
وزارة التعليم العالي و البحث العلمي
Ministère de l'enseignement supérieur et de la recherche scientifique

Université Mohamed Khider – Biskra
Faculté des Sciences et de la technologie
Département : **ARCHITECTURE**
Ref :……



جامعة محمد خيضر بسكرة
كلية العلوم و التكنولوجيا
قسم: الهندسة المعمارية
المرجع:.....

Thèse présentée en vue de l'obtention
Du diplôme de

DOCTORAT D'ETAT

Option : ARCHITECTURE

The Impact of Visibility on Visual Perception and Space Use: The Case of Urban Plazas in Biskra

Présentée par :

Yassine BADA

Soutenue publiquement le 02/7/2012

Devant le jury composé de :

Dr. Farhi Abdallah	**Professeur**	**Rapporteur**	**Université de Biskra**
Dr. Mazouz Said	**Professeur**	**Co-rapporteur**	**Université de Biskra**
Dr. Bellal Tahar	**Professeur**	**Président**	**Université de Sétif**
Dr. Choughi Ali	**Maitre de Conf.'A'**	**membre**	**Université de Sétif**
Dr. Safieddine Djamila	**Professeur**	**membre**	**Université de Constantine**

Acknowledgements

Foremost, I would like to express my deep and sincere gratitude to my advisors Professor Farhi and Professor Mazouz for their supervision, advice and guidance in my research and writing of this thesis.

Many thanks go to professor Bellal Tahar from university of Sétif for his advices and providing me valuable documentations that helped me a lot in my research work. .

My sincere thanks are due to all members of the Jury committee.

My warm thanks also go to my friend and colleague Aomar Dali for his continuous support, advices and encouragement that helped me a lot during the difficult periods.

I gratefully thank Abdallah Labadi for his help and providing me 'a work station' in LAHE Research Laboratory, university of Biskra, that allowed me to finish up with the writing of thesis; my deepest gratitude to Professor Ouamane Ahmed director of LAHE Lab.

Last but not the least, I am grateful to my parents, all my family, my wife, ,my son *Aymen* and my little girl *Ibtihal* .

TABLE OF CONTENTS

CHAPTER III

PERCEPTION AND SPATIAL EXPERIENCE

CHAPTER IV

URBAN SPACE EVALUATION: Methods and Analytical Tools

CHAPTER V

CASE STUDY PRESENTATION

CHAPTER VI

RESEARCH METHODOLOGY AND INVESTIGATION OF THE FOUR PLAZAS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

This thesis springs from the assumption that a functional space is a used space and that people's behavior movement and use is directly related to the visual fields created by the spatial configuration and properties i.e. visibility. It focused on the static use of plazas; people in sitting and standing positions in plazas that constitute the case study. Plazas are very important to the city as space for communal life, and place linked to the image of the city. The goal is to explore why some plazas are preferred to others and also why some parts of the same plaza are busier and more preferred by people than others. Therefore the purpose is to examine the correlation between the spatial use and the isovist properties space for instance plazas.

Many fields such as sociology, environmental psychology, and urban design researches carried out studies to understand man-space, man-environment interaction and man's spatial experience. They have mostly focused on one hand visual perception and cognition and on the other on people's behavior and spatial properties of the environment. Many theoretical concepts and evaluative methods and tools were developed to investigate this issue.

This thesis relied on space syntax as theoretical framework and analytical method to look into the four plazas from Biskra that represent the case study. This choice is based on the fact that space syntax deals principally with the topological aspect of space and provides techniques and tools that allow considering and measuring quantitatively the environment through a myriad of variables. In addition, it permits through Depthmap program to perform and calculate the spatial properties related to vision and visibility that, it seems, are the most important and the most appropriate to the topic and the goal of this thesis. Besides all that, space syntax showed its efficiency in many fields' studies and the encouraging results, principally those inherent to the relationship of people behavior (space use).and the spatial configuration.

This investigation work showed interesting results on how people use, choose and colonize space (static activities) in correlation to spatial properties such as visibility. However these results of this investigation are neither exhaustive nor final. A follow up is needed to deepen

the understanding of this issue. This would certainly contribute in the built-up of a theoretical knowledge and guidelines for space design in general, and specifically in plazas' design. It is a major input in urban design process related to people needs. This will be efficient in designing not only plazas but in any gathering public space; either having to design new urban layout or a layout of an existing plaza.

GENERAL INTRODUCTION

SYNOPSIS

Since antiquity public well being has been a primary motivation for creating and improving public space; urban space such as agora, forum, plazas and streets. In order to fulfill its role, as a place for community life, urban space should respond to people's needs; to serve contemporary living. Due to its importance in the city life, the design, the function and the use of urban space nurture everlasting discussions and critics from people (users) and scholars from different fields. Architects and urban designers might be blamed by being concerned by aesthetic ends rather than real people's needs. Sociologists consider them as lacking the understanding of the relationship between the designed/built environment and the social behavior (Lang, 1994). Therefore to design better and more responsive urban spaces requires more thought to be put into their design; understanding man-space interaction.

A. PROBLEM STATEMENT

Architecture and urban design aim to build space for humans and their needs. A space that takes in private and public activities of everyday life. How it is used by people is, to some extent, an indicator of its success – this, with the belief that a functional space is a used space.

Urban space, i.e. plazas that are intended to be spaces for people's social encountering, cultural and entertainment activities present some drawbacks. A glance over any city's plazas would show that some of them are overused and others underused; some preferred by people to others. And at the same time within the same plaza one would notice that some parts or locations are more used (crowded) than others while others remain extremely underused or abandoned.

This situation is the same for the public plazas of the city of Biskra i.e. the four public plazas spread over different urban fabrics of the city of Biskra, at the vicinity of the city center. These plazas that represent the case study of this thesis present the same problem of use stated above. This is noticeable by moving about the city; just through direct observation.

Plazas are both spaces for dynamic and stationary activities. Dynamic activities that include people's movement; walking around or just crossing the space to a given destination or engaging in corporal activities such as playing physical games. Stationary activities correspond to activities either achieved in standing or sitting position e.g. relaxing, talking, watching, reading and so on. This latter is the major activity since public plaza is for social encountering and relaxing.

Considering purposely stationary activities, the four plazas present the same problem. This is noticeable by moving about the city; just through direct observation. Some of them are more used than others and some roughly underused. Moreover within each of the four plazas there are parts crowded and preferred for stationary activities, thus are livable while other parts are deserted or scarcely used. The persistence of this kind of problem and its misunderstanding might impact negatively on both urban spaces; dysfunction of the city and on urban design as a field; producing spaces that are not responsive to people's real needs. The increase dysfunction of urban space, intended to promote the quality of urban public life, may have negative effects people's life. Behavioral sciences that deal with man-environment relationships showed the importance of the impact of the built environment on the individual‘s behavior, emotion and social life; mainly when the matter is about public spaces.

On the other hand, the misunderstanding of this problem would not help to evolve design thinking and process in considering efficiently the human aspect (human behavior in space) as a determinant feature in public urban spaces design. It is known that urban design task is to create space and space configuration that enhance people's movement and people's social encountering and copresence.

In a sum up, the problem of Plazas' use could be stated by this thesis as:

1. An uneven use of urban plazas within the same urban district or the city.
2. A jagged usage in term of stationary activities within the same square; some parts are crowded and preferred by people for stationary activities, thus are livable subspaces meanwhile others are underused or deserted.

B. HYPOTHESES

This problem might imply two aspects: the first aspect is related to the space in question as a physical entity, its designing process and the inherent knowledge or design theory. Throughout architecture and urban design history, the main concern has been about the shape, proportion and character that fit the ideal plaza (squares or piazza). In fact, this issue persists till nowadays. Urban space, as the structure of the city, represents the interface of two currents of thought; on one side the traditional (rationalists) that advocates the street and plaza (as structured and enclosed space; traditional) as ideal and the sole urban elements responsive to human spatial needs, and on the other, the modern that advocates the freestanding object-like building where the urban space is the amorphous medium. Large literature has dealt with the issue in a comparative attempt to show which is more efficient to man and the functioning of the city. The point here is not to bring up the issue of the city design or to endorse this concept or the other but to consider how to tackle the issue with the approach to design an urban space.

Plazas design has been dealt with in the same logic. So design feedback is constituted of knowledge about morphological aspect (size, proportion, shape and so on); for instance, among others Sitte, Zuker's guidelines and Krier's urban spaces catalog, of the traditional current. However the development of modern space theory and some built references constituted a potential feedback (morphologically) for plazas design guidelines.

The second aspect is related to people's behavior in plazas and needs. The problem stated above is merely a consequence of a misunderstanding of this aspect and it might be linked to what extent it is implicated in the design process; as a feedback of the design process. The question, that may be asked, is whether there is enough knowledge about people's behavior, interaction with space or not; space use. This, in fact, is the crucial aspect that its understanding and its involvement in design process is a requisite to better plazas design; functional plazas. Therefore, the present thesis will try to engage into the investigation of this latter question of people and space interaction. Its understanding is a step towards designing better spaces, i.e. plazas that fit real people needs. Many research studies have been carried out to improve urban spaces. They started from the assumption that comfort and aesthetics of urban places are the major determinants of their character and their use. So they proceeded to

the examination and evaluation of a wide range comfort conditions – thermal, acoustic, shade/sun, quality of urban furniture, and of aesthetics of space and its components. These ambience- oriented studies use investigation techniques such as the sensory path, the commented walk and sorting (that may also evaluate the phenomenological aspects) (Lynch and Rivelin, 1959). Aesthetics urban space appraisal used in situ survey, multi-impression appraising, and simulation techniques by means of static and dynamic displays to evaluate the visual quality (pleasant, visually attractive, and agreeable) of environment scenes or cityscape and also people's emotional responses (Lynch, 1960; Cullen, 1962; and Nasar, 1988). Nasar (1988) argued that "the environment must be involving to attract human attention, and it must make sense for humans to operate in it". These aspects (comfort and aesthetics) of the urban space are very crucial to the public life quality yet they are not really determinant elements in urban space function (use); how people use and occupy space. In research studies focusing on either comfort or aesthetics are more likely oriented towards people's sensation more than people's behavior; space use.

This thesis believes in the impact of both aspects , comfort and aesthetics, on the urban space use; however, assumes that they are key tools to understand the way urban space function (used) but they remain insufficient the grasp the complexity of people 's behavior. Other factors, we believe, may have a higher impact. Man as sensory organism, experiences and evaluates space through his senses but the major sense that dominates is vision (Gibson). Vision enables him to perceive, evaluate and behave in a given manner in the environment. It allows him to navigate, select his path and locate himself for a stationary activity in the environment. Thus man's behavior and experience of space is composed of two interrelated activities: movement and stationary activity (static) _His behavior is primarily affected by the potential of both the spatial structure and the visuals fields (i.e. visibility) created by the spatial configuration (Gibson, 1979; Hillier, 2004). Thus the space success, as a functional space, is attributable to "how well the spatial configuration fits real patterns of human behavior" (Hillier, 2004). Consequently, it is also assumed that the use of space is governed by two major factors: Its attractiveness in terms of movement, i.e. how easy for people to move in as its being to-movement and through-movement space; and the conduciveness of its visual properties for people's activities.

Man–space or man- environment interaction constitutes a central topic of investigation in many such as sociology, environmental psychology (behavioral sciences), urban design and architecture. To understand how man experiences the environment (natural and built), investigations' focus has been on exploring all the processes of perception and behavior the impact of the physical environment on his behavior. So the guiding goal is to look for any correlation between the physical environment, man's behavior and his visual perception.

Myriad of theories and analytical methods have been developed and used in many researches and studies to tackle this issue. Generally in urban environment research, two aspects are considered: physical properties of the environment (objective) and man with his humanistic characteristics, as an organism perceiver (subjective). However in order to represent and quantify people's experience of real environment, some theories and methods have been developed. Space syntax and isovists theories and methods introduced new way to analyze and to quantify space and also to link its configuration and properties to people's behavior. So they consider visibility, generated by space, as the major property that might influence majorly people's spatial experience.

Space syntax is a series of techniques to analyze spatial configurations. Firstly developed by Bill Hillier (a professor at the Bartlett School of Architecture) and the faculty staff at the University College of London in the 1980s, and then spread out over the scientific world to become a tool for several research topics and design application. Space syntax sees the inhabited space as a configured space. Configuration is a key term that is considered as a tool to subdivide the continuous space into a multitude of set of subspaces (Bafna, 2003). It considers that spatial experience is not affected by and related to the properties of the individual space but to properties of the interrelation between all the spaces. This is called configuration in space syntax; "meaning the *simultaneously existing* relations amongst the parts which make up the whole". Space syntax started with describing spatial configuration and forms by means of simple relational graphs consisting of paths and nodes- called *justified graph* or *j-graph.* The spatial properties of analyzed space are quantified through a series of measures that could be computed space syntax software programs such as DepthMap,Spatialist, Axman , Axwoman,OmniVista, Mindwalk, Confeego and so on (see appendice).

Isovist is a method developed by Benedict (Benidikt, 1979) in dealing with the spatial environment by providing a description of the space from the point of view of the individual experiencing the space; as he perceives it (visually), interacts with it, and moves through it. So many descriptors can be derived reflect local physical properties of the experienced space.

Turner (1997) pursuing the goal of representing and quantifying the individuals perception of the real environment improved the Benedikt's isovist method to take into consideration the properties related to space and its relation the whole spatial environment and internal visual relationships between locations with the isovists. From this, Turner developed a software package (DepthMap) capable of performing *Visibility Graph Analysis* (VGA). VGA entails a grid onto a space, and uses it to measure the relative mutual visibility among all the cells of the grid and consequently provides all spatial properties through 2D analyses. Lots of measures could be calculates either syntactic or isovist

To investigate into the problem stated earlier about each plaza's use and a comparative study between the four plazas use, the thesis relies on space syntax, isovist methods and in-situ survey. The analytical approach is based on two types of procedures. The first one consists of quantifying the spatial properties of each plaza in terms of syntactical and isovist values and graphs, using Depthmap program. The second one consists of an in-situ investigation of people's behavior within each plaza. So the investigation applies an overlapping of the three methods; overlapping of values and graphs.

To sum up, this thesis' hypotheses may be stated as:

1. The uneven pattern of use of a plaza is correlated to visual properties of its parts or subspaces; the visibility connections of each part to the others parts of the plaza: people location choice for stationary activities, either standing or sitting positions depends on the potential of the visual field provided by the plaza and its surrounding urban configuration.
2. The use of a plaza within the urban environment is linked first to its attractiveness in terms of visual access; the degree to which the plaza is seen from the urban environment and the configuration of the urban structure in which it is embedded, how it is linked to urban structure; its accessibility, i.e. how easy for people to move in as

its being to-movement and through-movement space; and the conduciveness of its visual properties for people's activities.

C. OBJECTIVES

To investigate how people use space: how do they choose locations to achieve a stationary activity in plazas? What is the choice criterion (spatially) they use to occupy some parts and avoid some others? Is there a correlation between the visual perception and spatial use?

CHAPTER I

URBAN SPACES: Concepts, Analyses and Design Theories

INTRODUCTION

Since the first human settlements cities are mainly characterized by their spatial pattern of outdoor spaces that constitute both the space for communal life; cultural and social activities, movement, and means of transport. This pattern of spaces has undergone a myriad of changes through history. Urban space has been always the center topic of the city, and it is extremely related to its character. Thus any theory of architecture, urban design or urban planning dealing with how the city should be, would forcibly affect the urban space and shape its character.

The first sign of systematic city planning in the history of civilization, an orthogonal grid plan of strait streets, had appeared in Indus cities as early as c.2400 ‘designing cities. Most classical Greece city relied on orthogonal street pattern stemming from practical needs for the measurement of right angles to parcel out land; orthogonal geometry attributed to Pythagorean geometry. Greek architects and artists alike were preoccupied with volume. The physical mass of individual buildings or sculpture, interest in spatial modeling, as it developed slowly from the fifth century, was centered on the agora’ (Morris, 1986).

Urban space still constitutes the main substance when talking about the city and its functional diversity, social, cultural, economical and political. Nowadays, the task of urban design is focusing on how to create the spatial pattern that will encourage people to use and to develop the city in a particular way.

I.1 DEFINITION OF URBAN SPACE

Urban space is all the spaces between buildings in towns and other localities (Krier. R, 1979). It is an outdoor space defined as an exterior space in architecture and an architecture without a roof (Ashihara, 1970); Urban space is created and defined by buildings which constitute boundaries between internal and external space (Zevi, 1978). Places and objects define space, giving it a geometric personality (Tuan, 1977). It is the “void «between buildings for outdoor activities and for movement; to take in public life in the city. It facilitates the coming together of people in other terms the social dimension which is the essence of the ‘urba’ in cultural

sense (Carmona, 2003). Urban space assures the diversity of human contact that is the essence of the city (Oldenburg, 1999). It is considered as the armature of the city. Since antiquity the "living public space" was the 'organizer «of human establishment, the forum for the Romans, the agora for the Greeks and squares for the western cities, Rahbat and sahat for the Arab cities (Moughtin, 1996).

Urban space is a public space. The term 'public space' is used to designate a location which is designed in a such way that everyone has the rights of access, encounters in it between individual users are unplanned and unexceptional, and their behavior towards each other is regulated by rules of common norms of social civility (Huat and Edwards, 1992)

Public space is the stage upon which the drama of communal life unfolds. The values that characterize the public space are *responsiveness*, *democratization* and *meaning*. *Responsiveness* consists of serving the needs of their users in terms of comfort, relaxation, active and passive engagement, and discovery; *democratization* consists of protect the rights of users groups. They are accessible to all groups and provide for freedom of action but also for temporary claim and ownership. *Meaning* consists of making connections between the place and people personal lives; memories. A continuously used public space with its many memories can help anchor one's sense of personal continuity in a rapidly changing world (Carr et al, 1990)**.**

Urban spaces could be classified according to their shapes and activities they encompass. They are subdivided into two categories: space for movement and space for non-movement or stationary activities. Two basic elements of urban space could be discerned according to form parameter streets and squares (plaza, piazza, agora and forum). Obviously, this does not lessen the importance of other open public spaces of the city such as parks and gardens and many other open spaces. Streets and squares or plazas constitute the basic elements of urban design and planning and are considered as the armature of the city and have been the center of several theories of urbanism, urban design and city planning since the antiquity.

The movement systems are basically defined by the urban space; the pattern of streets network as the primary means of movement and by squares. Hence, they characterize the urban area or the city. The scale and the type of movement systems have an influence on the urban form and the pedestrians' experience of it (Marion and Clara, 2001). The network of

urban spaces of the medieval city or the Arab city, with winding streets, are only passable on foot or on other animals; this unique experience is bound to the urban form that aimed to this type of movement. By contrast, the straight streets or boulevards such as central boulevards of Paris are best appreciated at vehicular speed. And finally, modern cities, with high-rise buildings, are best appreciated when approached from an urban highway; here to illustrate the car in exhilarating speed.

So the quality of the experience depends on the speed at which he or she moves. The faster he or she travels the less detail is perceived. From a car it is only the general massing of buildings and major landscape features which impinge on the perception (Moughtin, 1996).

Many ancient urban settlements evolved from movement systems forming a crossroad or from two systems crossing each other. Cities that have grown over a longer period of time have a less clearly articulated structure, as a result of accumulated different systems; thus, a composite urban form characterizes the city. Nevertheless the systems of movement have a clear and close relation to district, parts of the center and subcenter.

Urban space constitutes the principal core and the urban ‘armature’ to create the spatial pattern that will encourage people to use and experience the city in a particular way. Bill Hillier (1996) coined the experience of urban space with the term ‘by product’ of movement which are optional activities, offered by the configuration and subsequently by the visual permeability of the urban space, in addition to the basic activity of travelling from origin to destination (to be developed in the next chapters). It is also intended to display buildings and monuments (Moughtin, 1996); to experience ‘visually’ the city. Aesthetic and visual consideration were present since earlier cities, in the Design of Rome creating a new configuration of open paces proposed by Donato Bramente and later by Michelangelo and in the roman the main roads generating the vistas on the religious and the civic buildings set on the forum, the heart of the city. Salingaros (1999), in his information theory, addressing the interaction between human beings and the built environment, states that urban space send out information that is generated by surrounding surfaces: building façades, the pavement, and local nodes such as trees and street furniture. So the quality of urban space is linked to the informational content of surrounding surfaces. Hence this visual-artistic aspect of urban space

still represents an important factor and a permanent ‘challenge’ in designing successful urban spaces.

Through History of the city urban space has been encompassing many types of outdoor public spaces, called open spaces. The concept of Modern architecture and urbanism has overturned all the heritage of urban spaces (squares and streets) and their design for other spaces that some called SLOAP (space left over after planning) an un-built space with no relationship with the built environment, however in Postmodern architecture era urban spaces status stayed at its modern conception in the despite of the rationalists urge, led principally by Robert and Leon Krier, to revive the urban spaces heritage as the sole spaces for public life in the city.

Nowadays the concept of sustainability, driven by environment quality, public health and people’s wellbeing, strengthens the need of a better quality of public life. As man is considered as the center of any development, an interdisciplinary research work, assembling architecture, urban design, environmental psychology and sociology has been going on to find out how people colonize space. This encompasses issues of perception and behavior in order to identify what kind of spaces is the most appropriate for public life. The outcome is to providing guidelines, recommendations and laws to improve public spaces as the “armature” of the city life.

I.2 URBAN SPACE TYPES: concepts throughout the city’s history

I.2.1 Ancient urban space

The agora and the forum are the first ‘designed’ urban spaces and constitute a permanent reference in designing spaces for public life. The agora was one of the basic elements and the core of the Greek city. Wycherley observes “as the focal point of the planned city, the agora was as near the middle as possible, or in harbor cities alongside the port. However, with the unplanned cities a natural place for the agora was between the main gate and the entrance of the acropolis – Athens clearly illustrates this. It was in fact no mere public space, but the central zone of the city, the living heart. “It was constant resort of citizens and it did not spring to life on occasions but was the daily scene of social life, business and politics”

(Morris, 1986). It was designed to include public welfare, visual and environmental enhancement, economic development.

The Greeks and The Romans first paved and straightened streets to provide for movement and safety and they built their agora and forum to provide convenient and noble centers for public life (Munford, 1970).

The agora comprises several markets, the stoa, theatre, gymnasium, courthouse and prison, and temples. The agora was a place for religious, educational, political, oratorical, philosophical and artistic activities go on; a place where the profane and the sacred met on a daily basis. To the Greeks, preoccupied by the intellectual matters, communal life was preferred to home life. As a result, they put their best, architecturally into temples and public buildings; the houses are secondary. As in Priene, that would picture the Greek city, the agora is in the center occupying two complete housing blocks and parts of others, on both sides of the main street running from Western gate.(Morris, 1986)

Paul Zucker (1970) in *town and squares* mentioned that "Aristole was the first philosopher to deal with aesthetics problem in general…..but never discussed city planning from an aesthetic point of view". He pointed that for the Greeks, the agora, as urban space is the product of putting two or more building in the same site. And Greek architects and artists were preoccupied with volumes; the physical mass of individual buildings or sculpture. However, interest in spatial modeling, especially with the agora, started slowly since the fifth century (Morris, 1986).

In imposing and maintaining their authority throughout their vast empire, the Romans built many military camps: the *castra,* following strictly rules of castrementation. These camps became the basis of numerous towns. They were principally laid out according to the gridiron, within a square or rectangular perimeter. Two main cross streets form the basis of the street structure, the *decumanus*, through the *center* of the town, and the *cardo,* intersecting the decumanus at right angle. The secondary streets structures that form the building blocks, the *insulae*, complete the grid layout. The forum area is usually located on one of the angles of the intersection of the *decumanus and* the *cardo.* The forum is usual a colonnaded courtyard with a meeting hall built across one end. The main temple, the theatre, and the public path, were located near the forum in the center of the town (fig: I.1). In Pompei the forum best

illustrates the forum space, "constituted a pedestrian precinct with gateways preventing vehicular access. With the presence of three theaters next to it, the forum area provided the main shopping and commercial facilities, a place for leisure and culture" (Morris, 1986 p. 52). So the main preoccupation of the roman emperors was how to amuse the urban mass and build recreational facilities .e.g the Colosseum.

In the renaissance period, consideration for aesthetics was at its utmost. Harmony and the allied concept of order and symmetry, as guiding principles in the arts and science, became pivotal in the history of later urban thought (Alexander, 2003). That period knew the emergence of the renaissance urbanism. The major goal was to emphasize on the connectedness and to the visual order of all parts of the city to achieve a certain harmony. This was remarkably carried out during Sixtus V (1585, 90) in Rome's plan that aimed to integrate into one main street system the various works of his predecessors by connecting the main churches and other key points in the city ; to create an aesthetic unity out of the often disparate buildings forming the streets and public spaces.

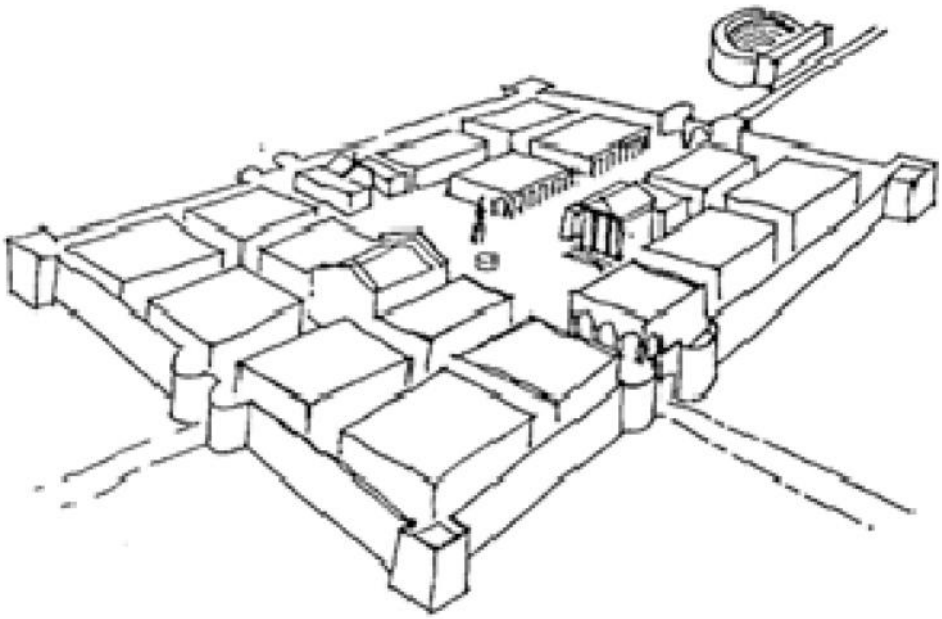


Figure I.1: A typical Roman Town (Marion and Clara, 1986)

Besides that more attention was put on the quality of urban spaces; streets and squares. This more interest given to spatial void quality, established, in the thought, the concept of a space created by several buildings designed in relation to one another e.g. the piazza della Signoria (fig: I.4) and piazza Annunziata. Paul Zucker(1970) considers that in contrast to the medieval period, where the arcade belonged to an individual building, in the renaissance arcades expanded the space of the square, integrating volume of structure and spatial void.

Three design components marked the strategy: first, the primary straight street; second, gridiron based districts, third, enclosed spaces (squares, plaza and places).

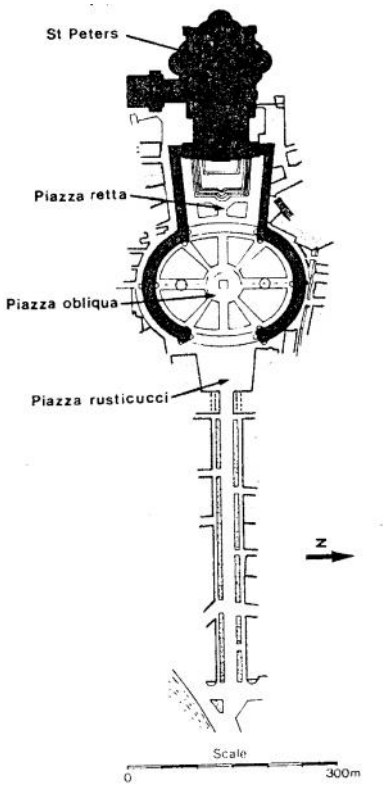


Figure I.2: Plaza St Peter's Rome (Moughtin, 1996)

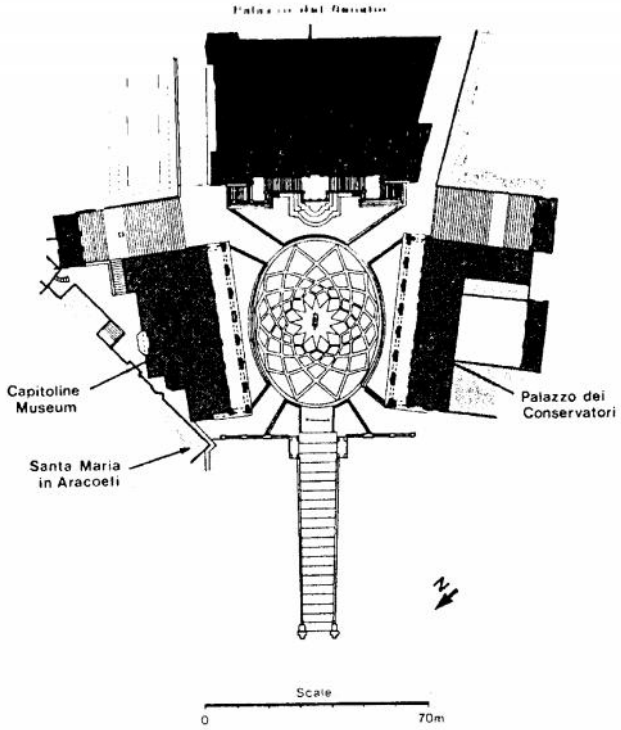


Figure I.3: Plaza Del Campidogli (Moughtin,1996)

I.2.2 Squares: concepts from the city's history

From its origin the square has been a biological organ of the city. A square is an open area at the meeting of two or more street in a town or city. It is an area "framed with buildings and an area designed to exhibit buildings to the greatest advantage" (Moughtin, 1996, p. 32). It is the setting for civic or religious buildings which give and symbolize the character of the square; sometimes reflect the duality of power; religious and political (fig: I.2 and I.3). It is meant to be a place for community life: social, commercial and cultural. Consequently, it is a place for meeting, entertainment and festivities for the inhabitants. Krier considers the square as the first urban space discovered by man as result of grouping a cluster of houses around an open space. He believes that the square is a structuring space that therefore becomes the framework of human activities; but not just a left over space (Krier, 1979,). Its importance by being the focal point and the basic structuring element of any town organization was being advocated by Zucker (Zucher, 1959).

Throughout history, public space, such as the agora in the Greek city, the forum in the roman city and the square in the western city, has formed the background to public life, for commercial and social exchange. Till the Renaissance there still existed a vital and functional use of the town square for community life and also, in connection with this, a relationship between square and the surrounding public buildings'. Nowadays, such spaces, for instance squares are under threat and facing others challenging spaces such as interior public spaces since indoor and private activities are prospering.

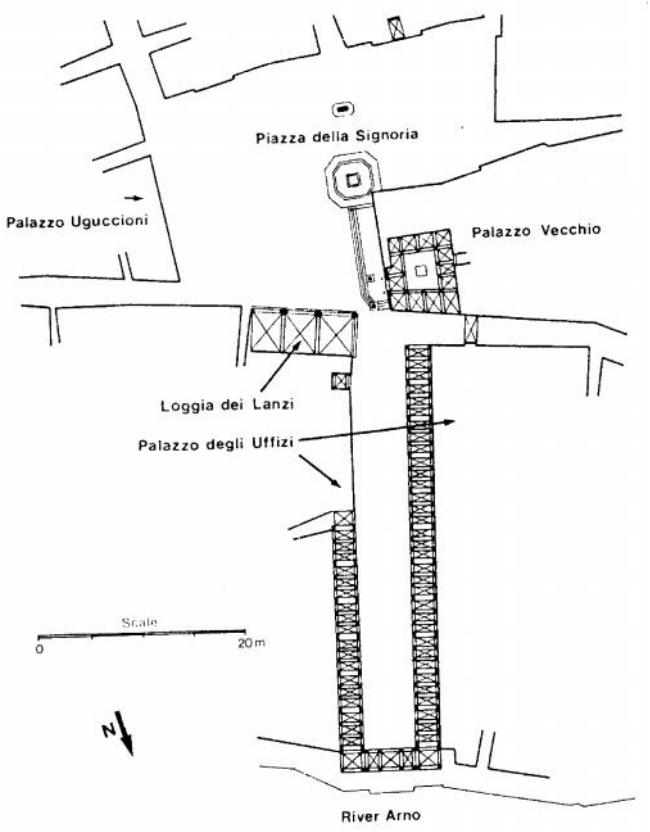


Figure I.4: Piazza Della Signoria, Florence (Moughtin, 1996)

I.2.2.1 Form and function of the square

Square could be categorized by either form or function. Activity is very important for both the livability and the visual attraction of the square. The form of the square was of a great consideration. Vitruvius set size of the forum to be 'proportionate to the number of inhabitants, so it may not be too small a space, a space to be useful, nor to look like a desert waste for lack of population'. Alberti talked about a network of squares and stated that 'there ought to be several squares laid out of in different parts of the city ' (Tiranti, 1956, p 161)

There have been a number of attempts to classify the form that squares may take. Paul Zucker was able to distinguish five archetypal forms: the *closed* square; where the space is self contained, the *dominated* square; where the space is directed towards the main building, the *nuclear* square; space is formed around a center; the *grouped* square, where spatial units are combined to form larger composition, and the *amorphous* square; where the space is

unlimited. However, two types of squares are distinguished by Sitte (1986); the deep type and the wide type, with enclosure as perquisite of the square. The grouped squares were of great attention for Sitte principally about the manner in which squares could relate to each other to the urban fabric in general.

The spatial quality of the square has been designers' high concern in searching for rules and guidelines to conceive such a space since antiquity. A lot of aspects have been suggested such as size, proportion, situation, form, degree of enclosure and type of boundaries and components.

Doxiadis argued that **"**man is related to his physical environment in several ways such as: through its physical dimensions; through his senses; through his movements" (Doxiadis, 1968)**.** In a study of comparison between several squares of different periods he concluded that the maximum size of a single square should be 2.1 hectares, of 145 meters of depth; considered as the limit to see and hear another person. However, in 1961, Philip Thiel, a sociologist, in his research known by his method of experience notation, stated the uni-dimensional range for a successful plaza was 60 to145 meters. Camillo Sitte (1986) stated that "the height of its principal building taken once can be declared to be roughly the minimum dimension for a plaza; the absolute maximum that still gives a good effect being the double of that height". Three design components marked the strategy: first, the primary straight street; second, gridiron-based districts, third, the enclosed spaces (squares, plaza and places). Cullen (1961) introduced the notion of enclosure and its perception. Spatial Enclosure was the principal characteristics of the all public spaces in western cities and towns; squares in all Europe, piazza in Italy; place in France. This enclosure is affected by three main types of buildings: religious or civic, residential, market and related commercial buildings. Perception is related to the person's position in the environment. Cullen argues that "the person's sense of position, his unspoken reaction to the environment which might be expressed as, 'I am in it or above it or below it, I am outside it, I am enclosed or I am exposed'. These sensations are basically interlocked with human behavior and their moody expression is demonstrated in claustrophobia and agoraphobia" (Cullen, 1961, p. 29). He adds that "closure is the cutting up of linear town system (streets, passages, etc) into visually digestible and coherent amounts whilst retaining the sense of progression" (Cullen, 1961, p. 106). Meanwhile Spreiregen (1965) argues that "the feeling of enclosure, whether channel or reservoir, is largely

determined by the relation of viewing distance to building height as seen by our normal frontal view". So the notion of enclosure is extremely linked to visual aspect that is not only confined to the boundary of the square but to other environing spaces. In a more developed vision, Hillier's space theory defines space as a unit or a part dependant of the whole (other spaces) and that its properties depend of its 'linkability' or connectivity to the whole called configuration. Hillier argues that the quality or the importance of space (in term of use) is related to its isovist (visual) properties and that human space is no limited to the properties of individual spaces, but relates to the interrelation and interconnection between the many spaces that make up the whole spatial layout (Hillier, 2005).

So the situation of square within the layout is important for its value and use. The concept of center has been of great significance since antiquity i.e. the forum in the Roman city. Hence the concept of center of the square, as a focal point and generator of other spaces has a great importance to man's perception of the environment. The environment of schemata for the general organization of space based upon this subjective idea of center is extended into the notion of externalized center as a point of reference in the environment. This is advocated particularly by architectural theorists; Schulz, Christopher and Lynch. Schulz affirms that man's space is subject centered and promotes the center as place for action. Therefore the meaning of place emerged. For him the place is an achievement, a goal is what we experience in term meaningful events of our existence, and orients ourselves and takes possession of the world. Movement departs from it, toward it, or around it. (Schulz, 1971)

Lynch in his study of the perception of urban structure, the image of the city, found the node to be one of the elements by which a city is recognized and understood. In short, the node is, is an important element which gives the city 'imageability' or a strong image. As he says "nodes are points, the strategic spots in a city into which an observer can enter, and which are the intensive foci to and from which he is travelling and the conceptual anchor points in our cities" (Lynch, 1961, p. 40). Alexander (1965) makes much the same point every whole must be a centre in itself, and must produce a system of centers around it. Unwin (1909) argues that in any composition there is a need to emphasize parts and subordinate others and the best way to achieve this in town is when the main square, the centerpiece of the public realm, is reach by all the streets. He suggests that the center should dominate the town in size and grandeur; consequently it would give meaning to its existence as a place distinct from other places.

I.2.3 The Street: concepts and functions

I.2.3.1 Definition

The word *street* has its origins in the Latin *strata* (meaning "paved road"), a public way or road along with the houses or buildings abutting it (American Heritage dictionary). The street with its linear shape provides principally the connection and the communication between all spaces and buildings, for people and vehicles. The street associated to other open spaces 'voids' constitutes the urban space which is the armature of the city. Thus, in addition to its motion character, it is a social space for public life and community provisions. The street could be viewed as transport feature such as a road, or as an urban design feature consisting of a group of buildings, sequence of spaces, and their related functions.

The street assimilated to a path implies direction and a goal and mark man's existence; in this matter Schulz argues "Man's taking possession of the environment always means departure from the place where he dwells, and a journey along a path which leads him to a direction determined by his purpose and his image of the environment. Sometimes the path leads him to a known goal, but often it only indicates an intended direction, gradually dissolving into the unknown distance. The path, therefore, represents a basic property of human existence, and it is one of the great original symbols" (Schulz, 1971, p. 43). The path is imagined as a linear succession towards a goal and not necessarily a straight line. This is well defined by Kurt Lewin (1951) who introduced the term 'hodological space' (from the Greek word hodos meaning way), 'space of possible movement'. He argues that Hodological (Greek word: hodos means a way) space consists of 'preferred path' according to many purposes such as 'short distance' 'security' minimal work' 'maximum experience' and so on.

However, concerned with the 'the imageability' of the city Kevin Lynch considers the path one of the five urban elements by which the city is memorable. He argues that "paths with well known origins and destinations had stronger identities, helped tie the city together, and gave the observer a sense of his bearings whenever he crossed them" (Kevin Lynch, 1960).

I.2.3.2 Character of street

Besides the activity character of the street in terms of community services such as shopping, entertainment and so on, its interactions with the surrounding and how it is experienced and perceived by the users is what matters the most. The character of the street is generally understood as a product of its interaction with the surrounding, streets network, buildings, monuments and other urban spaces. A street without this intended interaction and a goal becomes rather meaningless, on the contrary would play the role of a simple connecting element of the environment.

In the classification of streets Vituvius compared the street scenery to the backdrop in a theatre. He described three street scenes 'the first one called *tragic*, the second, the *comic*, the third, the *satyric*. *Tragic* scenes as outlined with columns, pediments, statues, and other objects; *comic* scenes exhibit private dwellings, with balconies and views representing rows of windows; *satiric* scenes are decorated with trees, cavers, mountains and other rustic object within the landscape' (Sebastiano, 1982, p. 56) (fig:I.5). However Alberti distinguishes two categories *tragic* and *comic theater* scenes, the straight streets entering the city and the winding streets within the city leading to the center. The straight streets with its scale and agreeable views express power, though the winding streets by their geometry and their overstated length give the impression that the city is bigger (Leoni, 1955).

Nowadays, street could be related to lots of terms such as street, path, avenue, highway, way, route, road, boulevard and promenade. All these terms stress the movement role, consisting of connecting places to each other; communication between places. Accordingly, the genuine and the present street definition could be seen a three dimensioned space between two lines of adjacent buildings.

I.2.3.3 Functions of streets

The meaning and the role of the street has shifted from being a place for both movement and social encounter activities to only a means of movement and transportation in the modern era of architecture and city planning. This situation is well illustrated by le Corbusier as 'three-dimensioned space between two lines of adjacent buildings' (Le Corbusier, 1961, p.121). Consequently, the city is seen as an ensemble of urban functions that is linked by

transportation; streets are for vehicular traffic. This led to neglecting the other role of the street consisting of being a place for social life since the antiquity. Jane Jacobs in her book "*The death and life of Great American cities"* revolted against the urban forms resulting from the principle of the modern thinking developed by the CIAM. In studying the urban environment of many American cities, she noticed the harm caused to the quality of life and emphasized on the reciprocal relationship between the street and the quality of life "Streets and their sidewalks, the main public places of the city, are its most vital organs. if a city's streets look interesting, the city looks interesting; if they look dull, the city looks dull" (Jane Jacobs, 1961, p. 39). Pursuing this social fact, the street links buildings within the street itself and brings the different parts of the city together "thus has to bind together the social order the *polis,* or what it is called the urban community. Its expressive function also includes its use as a site for causal interaction, including recreation, conversation and entertainment, as well as its ritual observances" (Guttman, 1986).

Nowadays, with the emergence of new concepts tied to sustainability such as New Urbanism , the tendency is to regenerate the role of the street not only as a space for movement (transportation) but as a space for public life where pedestrians are favored to the vehicular.

I.2.3.4 Physical properties of the street

Streets could be classified upon dimensional, geometrical shape its connection to urban space network; polar qualities straight, curved, long or short, wide or narrow, enclosed or open. They are also categorized according to scale, proportion, contrast, rhythm and connections to other streets and squares. They are not only the framework of public open space to link different places of the city, but also form "an enclosure which is place to stay, not just a place to pass through" (Alexander, 1977, p 168)

Throughout the city history, streets are always associated to movement and vistas. Streets with Long vistas conceived to embrace great ceremonial routes and state festivities. These are well illustrated in Haussmann's work in Paris, Sixtus V in Rome (fig: I.6), and L'Enfant in Washington. Vistas are worked out either by axial city planning or through geometrical manipulation. Norberg Schulz argues that in the towns of the past, oblique angles and curved lines created a "closed perspective" enlivening the prospect. For him the street in the past

constituted the 'universe' that reflects the character of the district and the city and presented to the visitor in a condensed form.

The street is mostly the space created by the surrounding buildings generating scenery displayed through movement. However the street is not "a building frontage but a space about which dwellings are grouped to form a series of street pictures; or alternatively the street is a space that may be expanded into wider spaces such as closes or squares" (Gibberd, 1955, p.230).

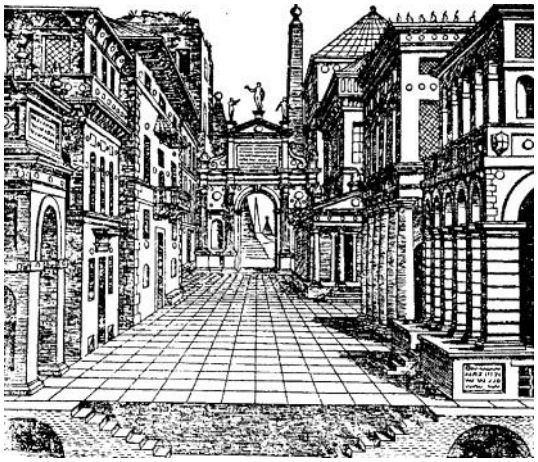


Figure I.5: The tragic scene, Vitrivius(Sebastiano,1982)

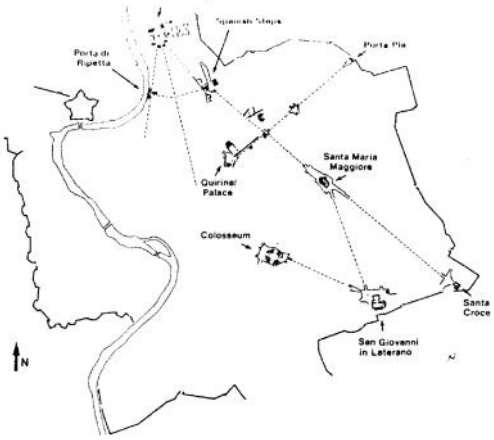


Figure I.6: Rome and Sixtus (Moughtin,1996))

I.3 CONCEPTS OF SPACE: definitions from different fields

I.3.1 Space

Space has been the subject of study and investigation of several fields besides architecture and urban design such as psychology, sociology, geography, mathematics and so on. So the following writing will focus and emphasis on the sides inherent to the spirit of the work.

Over time, the concept of space has been explored differently, for instance, in social psychology, anthropology, ethnology, architecture and so on. The term 'space' for the most often is coupled to the term 'place' to convey the lived space

The term space stems from the classical term 'spatium'; distance or void (Goetz, 2001) Aristotle argues that place has neither form nor materiel " a place, or a space, cannot have a

body…space to be as like a receptacle….the body's container." (Kim, 1979, p.22). For Heidegger "a space is something that has been made room for, something is cleared and free, namely within boundary" (Heidegger, 1971)**.** Space contains make sociality happens and induce to certain behavior and attitude (Goetz, 2001); an experience of the space.

I.3.2 The architectural space

Over the history of architecture and urban design space was " the space between buildings"; more consideration to the matter, boundaries that define the space, quality is attribute to the quality of its boundaries Geoffrey Scott address the issue " the habits of our mind are fixed on matter. We talk of what occupies our tools and arrests our eyes…space is 'nothing' a mere negation of the solid, and thus we come to overlook it" (Scott, 1977 p. 226). In the same thinking Bill Hillier argues that "it is rarely space itself that is addressed, in the sense of the space we encounter in the world we live in, but the reduction of space to spatiality of some other agency and process." So space is a three dimensional environment where objects and events occur with relative position and direction. Meanwhile Schulz sees that architectural space has its center and direction of its own and that the spatial structure is not identified by its activities and functions or geometric properties but much more by 'goal' and 'path'; that imply movement by which man experiences his environment. He argues that these two concepts constitute the basis of structuring of any architectural space to be experienced; they constitute the basic properties of human existence.

I.3.3 The social space

There are two definitions of the notion of social space. The purely sociological definition identifies social space as a person's relations to other men or other social phenomena (Sorokin, 1928), and the psychologically oriented definition considers that it is determined by the individual's perception of his social world (Theordrson, 1969).

Henri Le Febvre was the pioneer of proposing that all human space is fundamentally social. He argued that it is misleading to conceive space as an abstract mental category rather than a

complex socially produced phenomenon; space is both material and imagined. Space is not only the setting of social and relation, but rather as produced by them and defining them. According to him, socially produced space could be seen from different perspectives, *the perceived space*, the *conceived space*, and the *lived space*. He defines the *perceived space* as the sensible space that is perceived by the senses; eye, the ear and the touch, representing both the medium and the outcome of human activity; *the conceived space*, as a space of representation involving the complex systems of codes, signs, and discourses we have about space; *the lived space*, as the directly lived space of inhabitants involving the interaction of embodied individuals with their local surround and it is a poly semantic space, transcending to the other spaces (Stephenson, 2003).

These spaces are necessarily bond to each other to compile the experienced everyday life. For Lefebvre, the everyday life is linked mainly with 'structured' elements established by pieces of activities and functions associated with society (Lefebvre 2002, p164). He calls these structured elements 'praxis' and that the everyday life is a repetitive occurrence of these praxis; repeated actions. According to him, full appreciation of what he considered as the symphony of space must include all three spaces.

Though Buttimer (1980) considers social space as a framework within which subjective evaluations and motivations can be related to behavior and external characteristics of the environment. Thus, Chombart de Lauwe (1952) identified two components of social space: an objective component which is the spatial framework, and the subjective component which is the perceived space. However in Giddens' theory of structuration, space is an important element for social integration and organization. He stated that "space is not an empty dimension along which social grouping become structured" (Giddens, 1984, p 368).

Unlike Lefevbre and scholars who define social space as a space of people who deal with material things Space syntax deals with the physical, architectural, urban space. Space syntax theory attempts to explain the relation of society to space; a social logic of space (hillier). Space is seen more on its configurational aspect. So configuration is an important concept of space syntax that means interrelations between 'spaces', as a system of elements related to one another, the local and the global (part/whole) (Hillier, 1984). This relation between the

local and the global and the relations between the locals themselves is that give the configurational properties of space and consequently the embedded social information.

This tendency to correlate the pattern of human activities and spatial morphology has been the goal of many research studies. These studies spew out many concepts: action spaces, activity spaces, behavior fields and other concepts related to spatial movements. Besides, some notions dealing with spatial experience are afforded by the concept of territoriality (Altman1975), personal space (Sommer, 1969), and proxemic behavior (Hall, 1966).

I.3.4 Space and psychology

In the main stream psychology space is not considered in its physical aspect, rather focus is made on people's attitudes and behavior. However, Kurt Lewin considered space that people and their body occupy. So for others, space is seen as a neutral medium, a passive background of human action, interaction and discourse.

Space could be defined on many levels. Schultz in his studies of space existentialism, differentiates five space concepts: the *pragmatic* space that encompasses man with his natural environment; the *perceptual* space that serves orientation, the *existential* space that ties man to his social and cultural identity, the *abstract space* is that which offers the tools to describe the others, the *cognitive* space is the mental representation of the physical world; as stated by Piaget "space consciousness is based upon operational schemata". This experience with things and those individuals need more than one schema to allow them a satisfactory perception of diverse situations. Schemata are formed during mental development interaction between man and his environment. According to Schulz, 'space' is a key part for man's orientation in the world. Space is experienced by action as referring to 'inside and outside'; the structure of our existence that is also tied to existential meanings such as safety, privacy and so on. He further adds that space is not only for orientation but also where 'action, affective behavior, instinctive behavior, cultural and social and communication …are developed' (Schulz, 1980). Thus space is not bound only to its components but extends to the intangible phenomenon of feelings; the context of existence.

However, Joedick (1985) (Franz, 2005) in studying architectural space, regard it as “thing between” something that arises from the perception of its boundaries. Hence the impression of space is a construction of human perceptual (mainly visual) and cognitive system that actively forms relations between objects or relations.

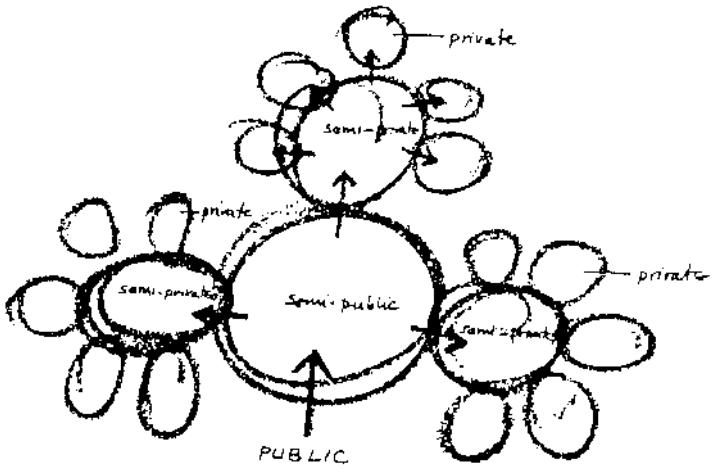


Figure I.7: Newman’s defensible space, spatial hierarchy (Lang, 1987)

I.3.5 Notion of space and place

The terms ‘space’ and ‘place’ present some definition ambiguities from a discipline to another. Joedick (1985) argues that Spaces are part of the material out of which places can be built. Dealing with physical structure, topology, orientation and connectedness, spaces offer opportunities and constraints. Places, on the other hand, reflect cultural and social understandings. Places can also have temporal properties; the same space can be different places at different times. While spaces have up and down, left and right, places have yesterday and tomorrow, good and bad. However, Tuan (1977) argues that the notion of space is in experience, the meaning of space often merges with that of place. “Space” is more abstract than “place”. What begins as undifferentiated space becomes place as we get to know it better and consider it with value. Architects talk about the spatial qualities of place; they can equally speak of the locational (place) qualities of space.

A place is a setting that permits all human activities; entertaining, social and cultural, and to provide community economical services. A place is sometimes larger than the built territory; however, the boundaries are defined by a sense of being inside a region, a town, a neighborhood (Chastain**,** 1998)

'Place' is as much a *psychological* phenomenon as it is a physical one. It is rooted in human social action and cultural conceptions: a *place* is a *space* activated by social interactions, and invested with culturally based understandings of behavioral appropriateness. Or, as Bertrand Russell (1914) proclaimed: "Indeed the whole notion that one is always in some definite 'place' is due to the fortunate immobility of most of the large objects on the earth's surface. The idea of 'place' is only a rough practical approximation: there is nothing [physical] logically necessary about it and it cannot be made precise" (Russel, 1914, p 86). Tuan (1977) defines a place as it is a center of meaning or field based on human experience, social relationship, emotions and thoughts. He considers that place includes the physical setting, human activities, and human social and psychological process rooted in the setting. The sense of place first is bond to the experience of the setting (as a physical space with specific properties) and second to the social relationship in the setting on the basis of attachment rather than to the physical landscape itself. Canter considers the sense of space as a upshot of three elements: the physical setting, activities linked the setting and the individual's meaning attached to the setting (fig: I.9)

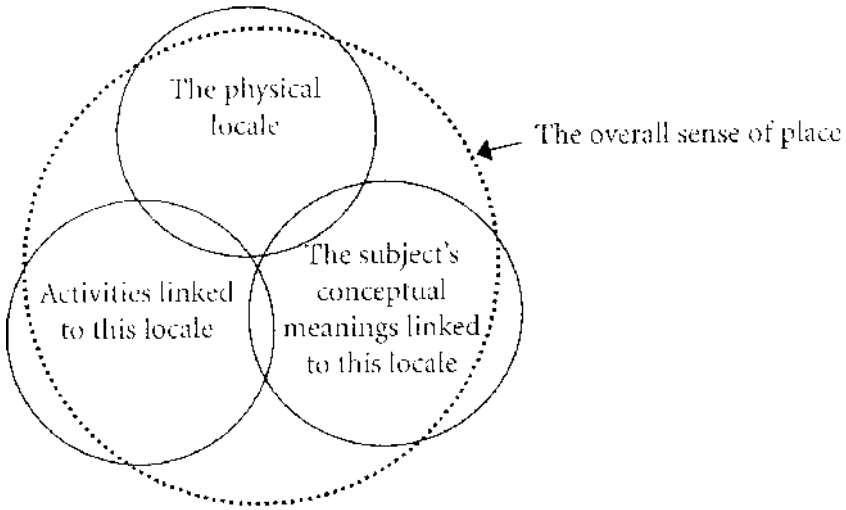


Figure I 8: Sense of place, Canter (Groat, 2002)

I.3.6 Space in space syntax theory

Hillier criticized the fact that space is always tied to other fields interests instead of being dealt with as an entity, such as 'use of space', 'production of space' and 'concept of space' 'personal space' notions linked to human sciences. He pursued his critics even to concepts that define space by its physical forms and boundaries such as 'spatial enclosure' rather than as 'a thing in itself'. He starts from the idea that human behavior consists of a 'pattern' of activities that occur not just in space but they generate a 'spatial pattern' – a configuration. He concluded that 'the existence occur in the relations between configurations of people and configurations of space' (Hillier, 1994).

For Hillier (2005) space is a matter of relatedness and argued that space syntaxes seeks first of all to address space as relatedness, as it is, and might be created by buildings and cities, and as it is experienced by the people who use them, rather than reducing it to the spatiality and to sociocultural drives in individuals. He argued that space depends primarily on 'how deploy physical elements'; the arrangements of boundaries and walls – this constitutes the everyday life real space that is 'rarely itself that is addressed'. Yet at the same time space goes beyond the architecture definition as being an enclosure resulting from physical things such as boundaries to its relation to other spaces, relatedness. He distinguishes between space as 'independent' entity as an entity related to a structure (whole), "Architectural and urban space seems quintessentially to be composed of relational patterns because the relations between things do not seem to exist in the same sense that the things themselves exist". So space syntax addresses space not in isolation but in relation to other spaces. Talking about urban space, he stated the city is composed of two cities: the *physical city* and the *experiential city* in which the spatial network and the space is the common medium'. The *physical city* refers to buildings and all physical objects and *experiential city* the space between them for movement, that spatially merge into one.

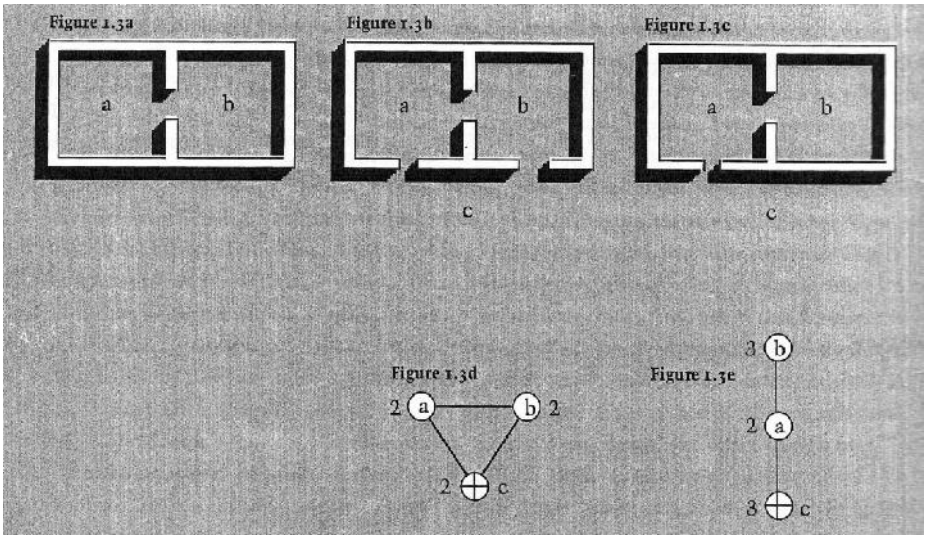


Figure I.9: J. graphs of three different relationships of two spaces. (Hillier, 1996)

I.4 URBAN DESIGN AND SPACE

I.4.1 Urban design field

The term 'urban design' was coined in North America in the late 1950's replacing the somewhat outmoded term 'civic design' that focused largely on the sitting of civic buildings and their relation to open spaces. Initially concerned with aesthetics and layout of building, urban design has become dealing with the quality of the public space – both physical and sociocultural – and how to make places for people to enjoy and use (Carmona, 2003). In a sum up, dimensions of urban design are 'morphological' 'social' 'perceptual', 'visual' and 'temporal' for the purpose of making of places for people.

Urban design is a two-word word, take separately: 'urban' suggests the characteristics of towns or cities, while "design' refers to such activities as planning, arranging and pattern making. It can be used to refer to all the products and the process of development. Tibbalds (1988) attempted to sump urban design as 'Everything you can see from your window', however, Gosling and Maitland (1984) describe it as the 'common ground' between architecture and town planning.

Urban design concerns the arrangement, appearance and functionality of towns and cities, and in particular the shaping and uses of urban public space. Urban space that either called 'void' between buildings in an amorphous way (modern) or in street and square network (traditional), it is the space for public life (movement and activity). It is the main 'substance' of study not only for urban design but also for many fields and theories such as sociology, psychology, geography and so on. But in term of concepts of the built environment, as matter of structure and form, two opposite types *the modern*, amorphous open space holding freestanding buildings; and the *traditional*, based on street and square network craved from a solid block. These two opposite concepts constitute the center of an everlasting debate in urban design on what is the most responsive to man and his wellbeing.

The traditional refers mainly to the planned cities of the renaissance period where city design 'became to a greater degree a work of art, conceived, perceived, and executed as a whole' **(**Gehl, 1996 p.43). Examples of consciously designed developments include public squares (e.g. the place Vendome and place des Voges in Paris); street systems (e.g. Sixtus V's plan of Rome, Haussmann's remodeling of Paris),; the extensions to existing cities (e.g. The Cerda Plan for Barcelona). However the modern refers to period after the emergence of the modern movement in architecture and urbanism. It is worth to precise that the modern urban design field can be considered as part of the discipline of urban planning. The writings and the research works of some scholars such as Camillo Sitte, Kevin Lynch, Gordon Cullen, Jane Jacobs, Edward T. Hall, and more recent ones Christpher Alexander, and Bill Hillier and Julienne Hanson have been considered as the seminal base for urban design theory.

Camillo Sitte (1986) launched a humanistic approach in urban design by correlating man's perception of urban space to two main concepts proportion and vista resulting from irregularities of medieval cities. He stressed the visual experience of urban spaces. In the same framework Gordon Cullen (1961) proposed the concept of 'serial vision', defining the urban landscape as a series of related spaces. So he stressed the importance of the relationship between the building and the external spaces, the configuration of spaces, in respect to the moving observer.

Kevin Lynch's work (1961) was concerned by how the city with its urban spaces and components is experienced by people. So it is known the by scientific approach to analyze the correlations between urban components and human perception and evaluation, he introduced the concept of legibility. Thus, he linked people's image of their city to five basic elements: Paths, districts, edges, nodes, and landmarks. Besides that, He is also known by the use of the cognitive or mental map as a technique to find out people‘s image and perception of the city.

Concerned with the quality of life, mainly the public one, Jane (1961) criticized the modern thinking of the city as the prime cause the deserted spaces created by the 'city in the park' notion and the devastated situation of the city life; the rising crime rate, the impoverished social life and so on. Thus, she advocated the resurrection of main public space precedents, such as streets and squares, in the design of cities. And emphasized on the diversity and mixture of land uses to guarantee vitality in urban space.

Bill Hillier and Julienne Hanson (1984) in 'the *social logic of space*' introduced the concept of space syntax a theory and a method to look into the correlation between people behavior and the space layout or structure. So how people use the space, moving or doing activities, is correlated to spatial configuration and isovists constitute the basis goal of this theory. This theory helped to explore others aspects of the city functioning such as predicting how movement patterns in cities would contribute to urban vitality, anti-social behavior and economic success.

I.4.2 Urban design and interdisciplinarity

Urban design is interdisciplinary, involving a wide range of fields. Anthropology and psychology have been closely implicated in urban design, since their subject is man. Oscar Newman developed the concept of defensible space, basically based upon observation of New York City, as a principal of allocation of responsibility for and supervision of territory. He illustrated the strong connection between crime and poor design and drew attention to this fundamental character of city space. Besides that Edward T. Hall (1966) developed the theory of *proxemics* with the precept that human perceptions of space are molded and patterned by culture. He defined personal space and social distance which varies widely with cultural

origins. In the latter, the gestalt psychologists proposed a more rational basis for the discussion of perception. It consists of that 'vision is not a mechanical recording of elements but the grasping of significant structure of pattern' (Arnheim, 1956). They provided a description of the way by which such patterns are recognized. Moreover, they introduced the phenomenon of figure /ground, which was of a particular attention in studies related to urban environment and perception. Six conditions were identified as playing an important, if not exclusive, role in producing visual forms: the law proximity, similarity, closed forms, 'good' contour, experience, (Katz, 1951)

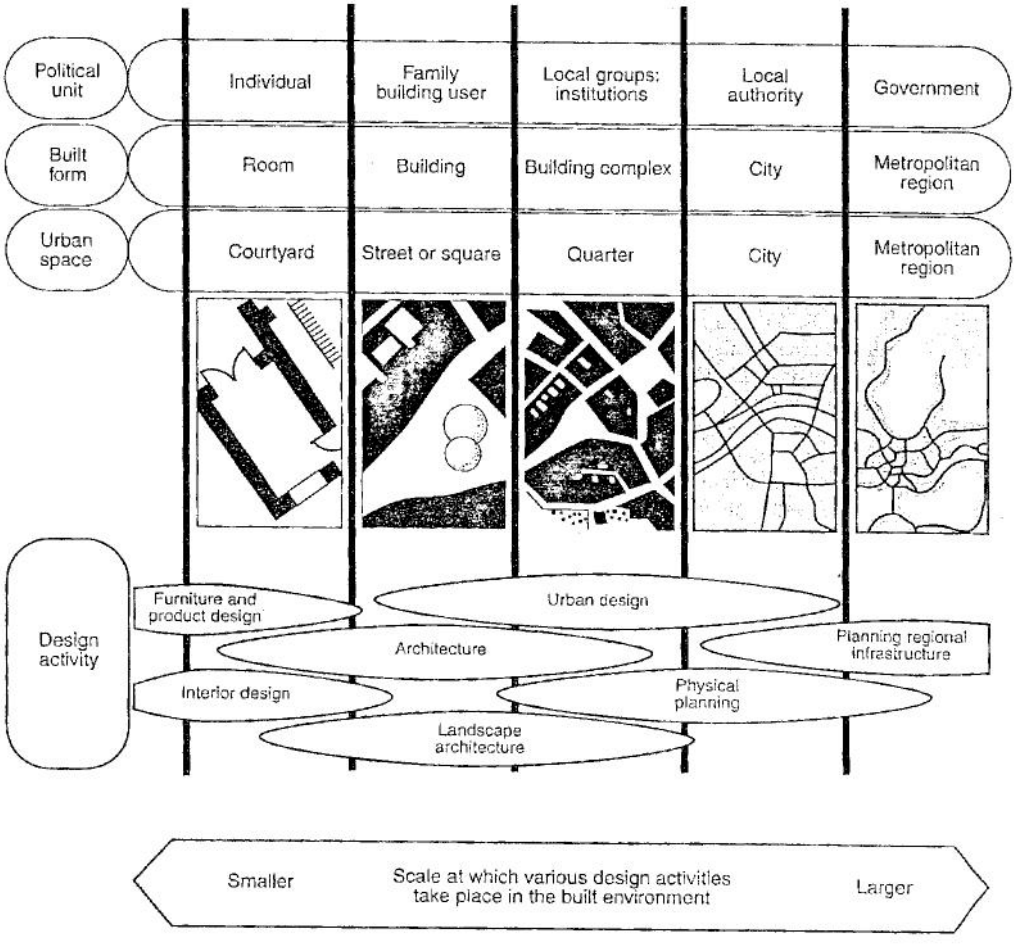


Figure I.10: scale of urban design (Marion and Clara, 2001)

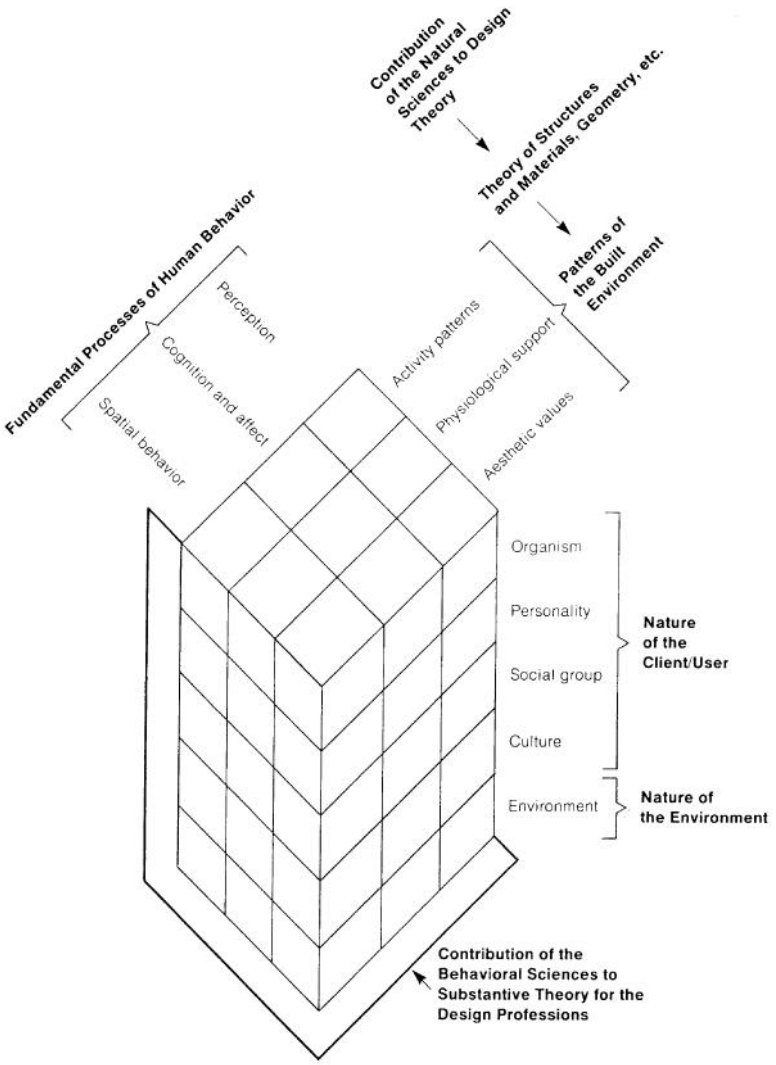


Figure I.11: Positive substantive theory (Lang, 1987)

I.4.3 Theories in urban design

The term theory has many meanings. According to Lang (1987) it could be a set of ideas or statements, a model as structure representing the perceived world and a prediction as the outcome of a given action. Urban design may handle different scale of the built environment from urban furniture to squares and city's districts, and may call for an interdisciplinary work (fig: I.10)

In design fields theory may involve the theory of the process itself. How to proceed to tackle certain issues, what is the main focus, what are the variables to be considered and what are the tools e.g. Lang (1987) distinguishes two main design theories: positive and normative.

He stated that positive theory consists of using positive statements, assertions about reality. Positive theory consists of two components: substantive theory and procedural theory. Substantive theory deals principally with person-environment issue. It requires an understanding of the natural and the built environment and their relationship to people's live. For instance in design, positive theory tends to show the importance of the behaviors aspect in the built environment and to include it in the deign process (fig: I.11). However procedural theory is more concerned with the process of designing (fig: I.12)

Normative theory is defined as 'what has been consensually agreed upon, the norms of a given time' or 'what to be – what a good world is' (Lang, 1987, p.17).

Urban design considers many aspects of the city and the urban space such as *urban structure*, dealing with the composition and the relationship of different components; *urban typology*, dealing with spatial types and morphologies; *legibility*, dealing how people perceive and apprehend space. It seems to have three main approaches: a 'visual.artistic' orientation that focuses on the visual qualities of building and space; a 'social usage' approach that focuses on the social aspect in correlation to space and activities, and a 'morphological' approach, that focuses more on the study of forms of spaces and buildings inherited and accumulated in the city, their logic and transformation related to contextual aspects, through history (Bob Jarvis 1980).

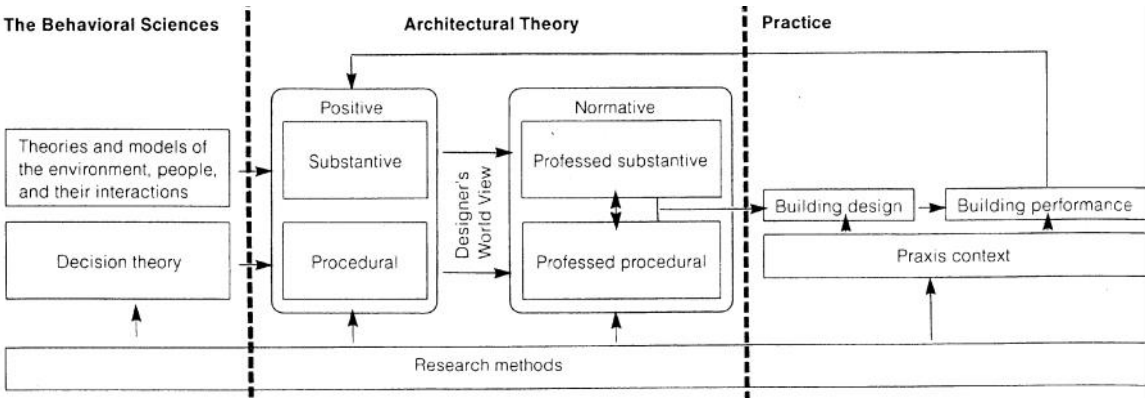


Figure I.12: Behavioral sciences and design theory(Lang, 1987)

I.4.3.1 The visual –artistic approach

It is a product-oriented approach that focuses on the visual qualities and aesthetic experience of urban spaces, meanwhile the cultural, social, economic and spatial factors and process used to successful urban places were completely considered. Many scholars nurtured this approach such as Unwin, Sitte, Cullen, Lynch, among others. This vision is expressed in Unwin's *town planning in progress* (1953); well illustrated in the emphasis on the pictorial composition of front gardens. Sitte (1945) launched a humanistic approach in urban design by correlating man's perception of urban space to two main concepts: proportion and vista resulting from irregularities of medieval cities. He stressed the visual experience of urban spaces. This was pursued by Gordon Cullen in the 1940's by developing his personal and expressive response to the environment. He mixed analysis of urban space with some poetic touch 'the quality of Thereness which is lyrical in the sense that it is perpetually out of our reach, it is always there' (Cullen, 1966, p. 34). Cullen dissected in great detail the form of the urban realm as the viewer realm as the viewer moves through it. Yet his approach has been criticized of being just his own interpretation with no consideration to other people reaction to the same environment.

Lynch in the 1960's, on the contrary, studied people perception of towns and places. However, was interested with 'imageability', that is, the elements of the urban structure that present a strong image to perceived sturdily by the eye or mind of the of the viewer and the user of the city. So the main work was focused on human experience, use and activity. He developed techniques to observe people interaction with the environment to find out 'how they picture it to themselves, what they feel about it, what it means to them' (Lynch, 1960).

I.4.3.2 The social usage approach

The social usage tradition emphasized the way in which people use and colonize space. This approach considers urban environments as social settings rather than works of three dimensional art. This approach is principally inspired by the behavioral sciences; anthropology, sociology, and psychology. So the contribution concerns the study of perception, cognition, social relationships and man (person).environment relations. The goal of Human behavior and his interaction with the physical environment is the center of investigation of behavioral sciences in order to build a substantive knowledge (Lang, 1987).

Nevertheless Lynch, Whyte, Constance Perin, and Christopher Alexander, among others, contributed enormously to the humans/space interaction. Though Christian Norberg-Schulz put stress upon the unique qualities of place and the importance of symbolism inherent to it.

Lynch is considered to be tackling both issues: the visual and the behavioral aspect related to people /space interaction (cited earlier).

Whyte‘s research work consisting of analyzing urban spaces, mainly plazas, in New York city (1980) introduced the direct observation as the basic methodology to study how people behave and inhabit these spaces. His findings are considered as an important reference for the issue of how people use, and select space (locations) for their activities.

On the other hand Christopher’s contribution is mainly in including social and behavioral matters in the design process. Therefore, he introduced the term tendencies (observable pattern of behavior) to replace the idea of ‘need’ of people. He states that the environment is supposed to carry out these tendencies as well as conflicts between these tendencies. However, he argued that these conflicts must be treated by the geometrical relationship of the environment features as the sole key to design success. He advocates for the integration of social and environmental criteria into design process.

Constance Perin (1970) stressed the importance of analyzing human behavior and invented the term ‘behavior circuit’ to refer to the observation of people’s everyday activities and behavior in order to ‘to learn what resources physical and human are needed to support, facilitate or enable them’.

To sum up, these theories and researches tend to stress the importance of the realities that people live and experience their everyday activities as a feedback to designer to integrate this in the design process and to create better space, more human and responsive, to these realities, instead of concentrating solely upon the physical environment.

I.4.3.3 The urban ecology: the Chicago school

The Chicago school was characterized by an empirical research on the city of Chicago. The emphasis was on the ethnic, racial intermixture, social problem, urban form and local communities (Martin Bulmer, 1986). Among the pioneers of the school theory, Robert, E. Park and Ernest W. Burgess are the most prominent. They embraced many concerns of the American sociology such as urban decay, crime and race relations. Their approach could be defined as rather 'pragmatic' than 'theoretical' since it is based on naturalistic observation where the city is considered as laboratory to explore social interactions. Therefore they introduced the term *urban ecology* which includes every aspect of city life from race relations to ethnic neighborhoods. They believe that the best social investigation is to be a 'true nature'; to consider 'man in his natural habitat'. They developed the concept of 'natural areas' of the city that they defined as transitional urban structures in which social differences maintain themselves as distinct patterns, sheltering different life styles and customs, each 'natural area' in the city is suited for specific functions and social class (Zake, 2004) So there is a strong emphasis on context that enables to examine social phenomenon in relation to each other in physical space.

The school of Chicago considers the social structures as a complex web of dynamic processes, as an eco system, progressing to maturity. For them, land, culture and population are an undividable whole that permits to understand the varied land use and development within the city. Burgess developed this geographically exploration approach and set the theory of ever expanding or maturing, concentric circles of land use within the city. However some others focused on micro level, to see why some zones attracted some specific population or favored particular patterns of use. In this matter, Parker argued that space as enabling individual action could at the same time act as barrier to communication. Hence he considers that struggles over space are struggles for status. The school of Chicago sociological investigations consider that the city life as extremely tied to geographical layout of population. This geographical based analysis would permit to reveal lots of question on land use and social relations.

I.4.3.4 Morphology approach

Morphology is the study of urban form and settlements. It consists of the analysis of the emergence, the evolution and the transformation of the city and to identify its various components. Its origin goes to Otto Schulter, a geographer considered as the pioneer of morphology. He pictured the city as a wider landscape. His work was on distinguishing, characterizing and explaining urban landscapes.

Conzen (1960), a geographer, was the first to put forward a tripartite division of urban form: the town plan (the site, streets, plots and block plan of buildings), building fabric (the three dimensional form), and land and building use. He studied many German towns and produced many graphic documents tracing the historical development of urban form. He put much emphasis to the historicity of the urban landscape: its historical expressiveness. He considered the city as an accumulation asset more than the present functional value. He stressed the importance of the urban landscape as being the predominant environment and a source of numerous experiences. Moreover as being principally a visually experienced and an omnipresent space it constitutes the major source of knowledge for people. Later on, Collin Rowe (1960**),** in the goal to learn from precedent, initiated an approach overtly relating new developments to a city's historical structure and traditional typologies of urban space; exploring figure ground diagrams in analyzing studies.

I.4.3.4.1 The open space in urban morphology

The street pattern consists of the 'public space network' between the urban blocks. As shown above, Leon and Rob Krier work emphasized on street and square as the ideal space for public space and that the ideal form for these spaces is within the models of the traditional city. Arguing that historical city centers offer 'desirable models of collective life', they studied elements presented by the traditional city, 'the street, the square, and the quartier in term of their use of 'urban space as the primary organizing element of the urban morphology'. So they look for generic types related more to form than to function; as assembled in a catalogue way in Rob Krier's book *urban space* (1979) (fig: I.13).

It seems that street pattern (exterior public space: streets and squares)) is the most important as being the space for movement (to experience the urban landscape), connection and public life. Some characteristics related to this pattern of space such as 'permeability' and 'accessibility' are of major importance and measured in urban morphology studies. Permeability means that to what extent an environment would permit a choice of paths either through it or within it; the opportunity degree for movement. In the other hand 'accessibility' is related to 'visual permeability' which is the ability to routes through the environment with some hints on route choice. In contrast ' physical permeability' is the ability to move through an environment.

I.4.3.5 Typomorphology

Aldo Rossi and the Italian rationalists school (1960) developed another morphological approach to urban design in resurrecting concepts of architectural types and typologies. In his book the architecture of the city (1982), he referred to the architectural type as a morphological and means form in contrast to building type which generally refers to function. Besides Rob and Leon Krier pursued the same way by studying architectural and morphological types that are effectively formalized and systematized. Other approaches were inspired from Rossi (1980) developed new concepts. Saviero Muratori, an Italian architect, interested in the historic city and promoting its significance in architecture, and Carlo Aymonino developed the concept of 'typo.morphology' concerned with the design of the city.

For all the approaches, buildings, monuments, and open spaces are the main components that constitute the structure of the city. They are under continuous transformation and inter-influence through time. This dynamic interrelationship let this field called 'urban morphogenesis "by many urban morphologists".

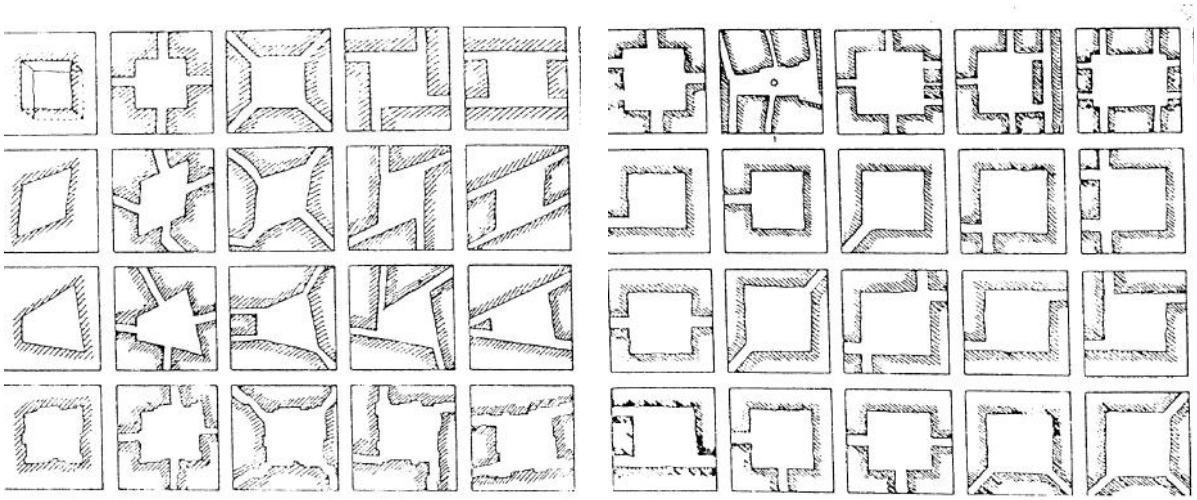


Figure I.13: Rob Krier's catalog of four-sided squares (Gosling, 1984)

I.4.3.6 Morphogenetic approach

This approach relied on the mapping of the various physical forms within urban areas using different techniques; Hugo Hassinger (1916) used color mapping the architectural styles in Vienna, Walter Geisler (1918) mapping the land and building use and the number of stories. Geisler work is mainly characterized by the classification of the sites, ground plans and building types of German towns. All these studies were the inspiration of the work M.R.G Conzen, a geographer, in studying twelve towns near Berlin and particularly the town of Whitby (England). This work focused more on the historical periods related to morphological periods.

I.4.4 Postmodern urbanism and urban design

The term was first applied for architecture by Charles Jencks in 1975. For him postmodernism is a "double coding"; a combination of modern techniques with traditional 'know how' in order to architecture to communicate with the building. Postmodern urbanism is considered as a reaction to modern urbanism and its negative consequences on man and his wellbeing. It could be summarized as: reaction to modernism's rupture with the past by returning to historical aspect; reaction to decontextualism by a contextualsim; importance of site/place,

genius loci, visual reference and urban legibility ; and a reaction to total rationality of function zoning, 'form follows function' by emphasizing on human scale, mixed-use (Ellin,1999). So, in fact postmodern urbanism raised a series of questions, a vision, related to post. Industrial era rather than gave regulated solution. Consequently many trends and ideas followed up this vision that concerned with man and his existence (social and cultural) such as historic preservation, reuse concept (Krier brothers)), participatory design, and new urbanism. Besides this, there is a shift from object oriented design to environment oriented design with emphasis on principles of environment experience (fig: I.14). Behavioral sciences have been of great contribution to environmental design, through both theoretical knowledge and researches' results.

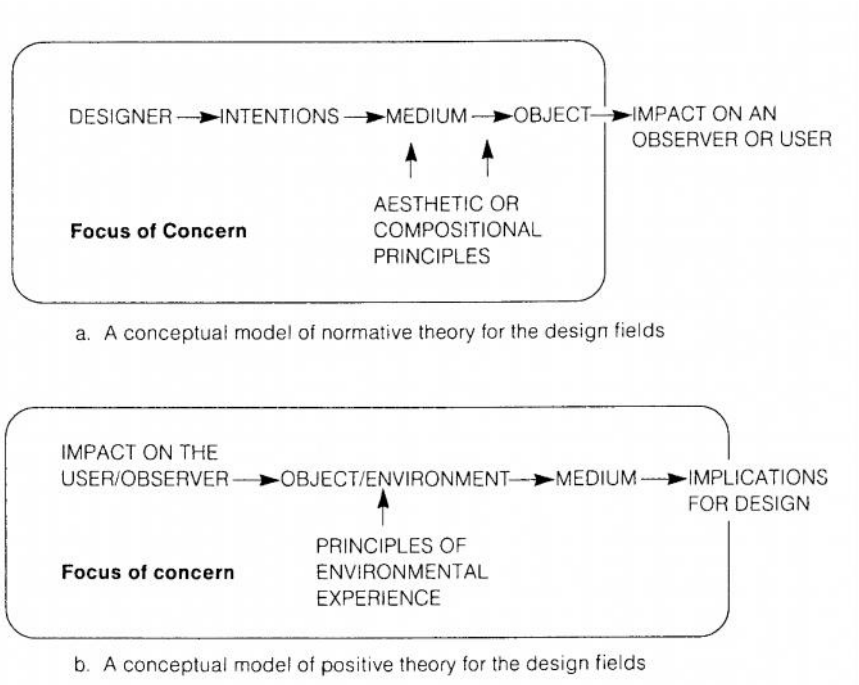


Figure I.14: Positive and Normative theory (Lang, 1987)

I.4.4.1 New urbanism

New urbanism as a trend had its roots in the work of visionary architects, planners, and developers in the 1970s and 1980s as a reaction to what had been built on the modern thinking (industrial era) which cited previously to more human and enjoyable living space. New urbanism held his first congress in Alexandria, Virginia, 1993, in which the major

principles, inspired from traditional town planning, were set, walkability, by freeing streets from cars (pedestrian) and creating friendly street as put by peter Calthorpe (2005) 'to encourage uniform street walls and dignified, orderly public places; connectivity of streets, hierarchy of streets mixed use and diversity, human scale and sense of place'. One of the principal goals in new urbanism is to promote community life and gathering of people by reconsidering public space (squares and streets) of the traditional towns. Many attempts to concretize this vision with incorporation of some ecological concern have been developed such as the community of Civano in Tucson, Arizona.

I.4.4.2 Sustainable urban design

The emergence of Sustainable development concept has shifted urban design thinking to many issues; morphological, perceptual, social, visual, functional and temporal. Sustainable development aims to people development (wellbeing, economics, and cultural) without compromising the natural environment, natural resources, and public health. Therefore sustainable urban design adopted the major sustainability principles such as energy conservation; environment protection (pollutions) and public health. Throughout the world various regulations and construction restrictions have been set up to meet sustainability principles and to monitor urban development and building constructions either on local, regional or national level. In the UK the Urban Task Force created by Rogers in 1999 focused on four issues, increase densities, reducing car use, creating high quality environments, and urban regeneration. However, in France HQE standards treat a bunch of elements ranging from the impacts on the outdoor environments to the creation of pleasant indoor environment (Thwaites, Porta, Romice and Greaves, 2007).

I.4.5 Space syntax theory and urban design

Bill Hillier and Julienne Hanson in "The Social Logic of Space «(1984) and the introduction of the concept of Space Syntax to predict how movement patterns in cities would contribute to urban vitality, anti social behavior and economic success; a spatial configuration that best responds to city functioning.

This theory contributed to many concepts linked to urban design such as urban structure – How a place is put together and how its parts relate to each other accessibility– Providing for ease, safety and choice when moving to and through places. *Legibility and* wayfinding– Helping people to find their way around and understand how a place works *Animation* – Designing places to stimulate public activity. *Function and fit* – Shaping places to support their varied intended uses.

CONCLUSION

Sine antiquity urban spaces have gotten a specific importance as being spaces for public life, the armature that provides character and symbolism to the city. A particular attention has been given to gathering places such as the agora, the forum, the pizza, the plaza, the square and so on. Many scholars attempted to define the ideal 'place' in terms of architectural aspect (shape dimension, proportion, sense of enclosure, furnishing) and functional character. Later, the importance of urban spaces has been related some issues related to people's navigation and imageability of the city (Lynch.) and to people's perception. Visual perception in general has been of great importance either in urban space experience (Sixtus, Sitte, Cullen) or as a human process in itself, in apprehending the environment (Gestalt)

Till nowadays these issues are still going on and nurture various theoretical debates on what kind of urban space is appropriate to the contemporary city and consequently to people's public life. It seems that there are three major trends of thinking. First, those who believe that the medieval town squares and the ancient cities provide model of function to emulate and offer important lessons in urban space's form; basically in a morphological way (shape, sense of enclosure and so on) as advocated by the rationalists such as Robert Krier and his urban spaces catalog. Second, there are those who still pursue the architectural modern thinking and principles about urban space layout, a continuous, loose and amorphous space where buildings are the major elements of the environment. a genuine opponent to the ancient city's layout.

The third group, that it is not restricted to scholars and designers from architecture and urban design fields but including many scholars from various fields, is not fixed on a specific

'model' of urban space or a definite layout. Because they believe that neither the ancient 'model' nor the modern 'model' are appropriate to the contemporary city needs. many spaces modeled after ancient examples showed a failure in term of use, because they were designed to fulfill architectural rather than human comfort needs. Therefore, this group is concerned with people's actual needs and behavior. However this group presents two major trends: one that tries to conceptualize a 'model' of a life style with a set of principles that respond the best to the human needs without defining a specific 'model of space' or a particular space – an eclectic approach – such as New Urbanism.

The other group, including principally scholars from behavioral sciences, is fundamentally theoretical. Besides its concern with the definition of space, it emphasized on the understanding of man-space interaction, how man behaves and experiences space and how the spatial properties affect him. Therefore, this group put much emphasis on man as a perceiver organism (five senses), where visual perception is considered as the major medium in man-space interaction.

However, space syntax, introduced by Hillier (1984) as a theory and a method to look into the correlation between people's behavior and the space layout addresses explicitly space How people use the space, moving or doing activities, is correlated to spatial configuration. Thus visibility (isovists) constitutes a major element of this theory. In fact, Bill Hillier tackled principally the concept of space by criticizing the other concepts of space as for instance 'personal space' or 'spatial enclosure' (that define boundaries) space by its physical forms an rather than space itself as entity. He argued that human behavior consists of pattern of activities that occur not just in space but generate a 'spatial pattern': a configuration.

All these theories and concepts have somehow contributed to urban design theory. Urban design theory, as being the field in charge of creating urban space, is reviewing its theory of process in order to be more responsive to people genuine needs. The trend is towards a 'substantive theory' that deals principally with man-environment issue that requires an understanding of the natural and the built environment and their relationships to people's life, instead of a normative theory that deals with "what has been consensually agreed upon, the norms of a given time or what to be – what a good world is' (Lang, 1987, p. 15).

CHAPTER II

URBAN SPACE USE: People's behavior and Spatial Interaction

INTRODUCTION

Activity pattern of use of the built environment has been of great concern since antiquity. Vitrivius stated that a building must fulfill three basic purposes – *utilitas, venustas, and firmitas*, Sir Henry Wotton (1624) considered *commodity, firmness, and delight* and Schulz talked about 'building task' to express commodity.

These purposes are not confined only to architecture (interior space) but concern urban space too; as exterior living space. People's use of space could be classified into two levels: activities and movement or as defined by Hillier; static people (activities in the location) and moving people (getting from space to another destination).

To understand how a given space is used by people, in terms of selecting location to do certain activities, may necessitate looking for answers primarily, to how people perceive, experience and navigate in space. And also to explore if there is any relationship between the environment's physical properties and the way it is used by people; what attracts or repulse people. To find clues of answers to these questions, it is necessary to go over other fields that tackle man-environment interaction such as psychology, sociology, geography (this would be the substance of the next chapter). However, this chapter will go through urban space use relying on some works findings either of in situ investigations or theory research related to urban space.

II.1 URBAN SPACE FUNCTION /ACTIVITIES

II.1.1 Urban space function

Urban space is meant to be a place for human exchange, providing the channels for movement, the roads for communications and the common ground for gathering and relaxation. Ashimara classifies exterior spaces into two categories space for movement and space for non-movement which encompass relaxing, looking at the scenery and so on.

Since antiquity public well-being has been a primary motivation for creating and improving public space. The Greeks and the Romans created their agora and forums to provide convenient noble centers for public activities (Mumford, 1970).

In order to fulfill its role as public space, urban space should respond to people's needs in terms of comfort, relaxation, active and passive engagement and discovery (Carr et al, 1992). Besides it has to have meaning which is very important to people's 'memory' connection with the place, their personal lives and the larger world (Francis and Hester, 1990). It should also provide accessibility to all social groups; democratic. Comfort, which is a requisite for urban space use, could be sorted into environmental related to climate, acoustic, and lighting factors, comfort of useful urban furniture- such as seating places, and physiological one. It could be extended to the type and quality of provided services, and the aesthetic aspect of both the space and its components (Nasar, 2000).

Investigations on how functional are urban spaces such as public plazas tend, generally, to look into either how comfortable are these spaces in term of ambience characteristics such as thermal and acoustic comfort - more "sensory" oriented method, they also tend to check how plazas are respectful to the some spatial properties that are considered as qualitative such as enclosure (Sitte, 1945), good proportion (Alexander, 1977) and how qualitative are the urban features of the plazas such as fountains, benches and so on. Nevertheless, there is no clue about properties of the space itself as entity in terms of its morphology and linkability to the surrounding related to people use and behavior (Campos, 2005).

It is important to clarify that physical properties of space concern not only the comfort aspect but also the architectural aspect such as dimensions and geometrical characteristics. The topological relationship of space to its surrounding is a key parameter to its functionality. It is defined as Connectedness, which is the degree to which a place is connected to its surrounding, is of a great importance for space function; use. Therefore space function is bond to the spatial structure, topological relations and connectedness of space. These spatial properties might make urban space with opportunities to be used or with constraints to be useless. Space function is not coupled only to the physical and architectural properties of the space itself but to its relationship with other spaces of the structure in term of connectedness that may imply visibility matters.

II.1.2 People's urban space use

People's space use has been a topic of interest of many fields. The focus is on man behavior in space according to either man-man relation or man- space relation. The former is mostly advocated by some currents in behavioral sciences that focus on the interpersonal relations and its impact on behavior in space. The latter, mostly related to environmental design, is more oriented towards the man-environment interaction; dealing on one side with man's process of perception ad behavior and on the other with the physical properties of space and its influence on man as a sensitive organism. Most of these approaches are based on observation research; observation of man's behavior in space.

Urban space use and specifically public urban space, i.e. plazas can be subdivided into two main activities movement and stationary activities. Harold Prohansky (1970) referred to everyday behavior (activities) in public spaces as merely of watching, sitting, talking to each other or quietly enjoying it life. Donald Appleyard considered it composed of two main activities; watching and walking.

In an attempt to understand deeply people's use of urban spaces, Gehl (1987) classifies outdoor activities into three activities dependant on different conditions of the physical environment: *necessary activities*; activities less dependent on exterior environment, *optional activities*; activities dependant on exterior physical condition such the weather and place are inviting, and *social activities*; depends on other people presence – inherent to two previous activities. *Necessary* activities are those were required to be carried out despite physical or social obstructions. Individuals involved in activities had no say whether or not to carry out these activities. These include: Going to school/work, shopping, waiting for a bus, etc. *Optional* activities are those activities that are only carried out by wish. They are not activities forced to carry out. Here physical conditions play a major role in determining whether such activities could be carried out or not. Some of these activities include: Taking a walk, standing and enjoying life, sitting, and sunbathing. And *social* activities are those that depend solely on the presence of others in public spaces. They are too an extent affected by physical conditions. They include: Children at play, conversations, passive contact, seeing and hearing people. However Marcus classified Activities into two categories: *dynamic activities* that imply corporal activities and *static activities* such as sitting (relaxing, reading chatting, eating and so

on) and standing (chatting, watching, meeting others and so on) postures. They could be individual or collective. For the static activities the opportunity to see, hear, and meet others can also be shown to be one of the most important attractions (Marcus and Francis, 1997)

Edward T Hall interested on how different cultures use space and physical environment, invented the term *proxemics* which he defined as "the study of man's transactions as he perceives and uses intimate, personal, social, and public space in various settings while following out-of-awareness dictates of cultural paradigms" (Hall, 1974, p. 97). Hall's approach was based on qualitative, non experimental, and descriptive, interviews and naturalistic observations.

William Whyte, a sociologist, attempted to understand why some plazas in New York City were underutilized while others are crowded. In 1970**,** he formed a small research group mostly of students, the Street Life project, which looked why some city spaces respond well to needs of people but some do not. This first hand observation project studied how people inhabit the most intensively used urban spaces in New York City by overlooking three plazas, recording daily patterns, and also talking to people who used the spaces. This direct observation was the basic methodology; White used a set of discreet cameras perched high on the streets to follow pedestrian flow, street encounters and social patterns. The goal was to observe people in a genuine daily situation rather than isolated in social/psychological behavior in laboratory settings.

The main finding of his research is that what attract people most, in sum, are other people. Many urban spaces are being designed as though the opposite were true." So he is convinced that people when using an urban space they select to occupy the dense one; they go where others are, consequently dense area get denser. For ritual 'hang out', sitting and standing, people tend to occupy the curbs (edges of curbs and pillars). Furthermore, concerning plaza use, he found that the freedom to choose where to sit in a public space is more important to an individual than the comfort or aesthetics of a seat concerning. And that the availability of sitting space draws people from that corner to the plaza. So he suggests guidelines for the design of successful plazas and concludes that plaza use is correlated mostly with the amount of sittable space and its proximity to street life (Groat and Wang, 2002). Whyte's work results is that much of what he observed indicated that people search for a great deal more than mere

physiological comfort. In fact, he even showed that pedestrians will sometimes undergo a certain degree of physical discomfort to fulfill their basic psychological – motivation – needs. Pleasure and serendipitous experience appear to account for a substantial part of behavior in urban, especially shopping, environments.

Krier emphasizes on the role of the square as being the first urban space discovered by man. It is meant to be a place for community life, social, commercial and cultural. He believes that the square is structuring space that therefore becomes the framework of human activities; to accommodate the overlapping role as 'movement space' and 'social activities space' (Carmona, 2003)

Several researches confirmed that the main activity for people is to be in contact with others, to be able to see, to hear to experience other people functioning in various situations. This was principally confirmed by Whyte's main finding that what attracts people most is other people. So he is convinced that people when using an urban space they select to occupy the dense one; they go where others are. Thus it could be concluded that 'to see' other people is very important as argued by Whyte 'what is most fascinating about the life of street is the interchanges between people that take place in it' (Whyte, 1988). In another study Cioelek Mathew showed that the great majority of people were found to select their sites for social interaction close to the traffic lines, where more possibility for encounters and 'seeing'.

It seems that people select space according to visual potentiality; how much and how far they can see. In a study of six thousands users in ten Vancouver plazas Joadar and Neil (1978) found that, amazingly, less than 1 percent carried out activities in the open pavement, away from movement lines. This is also explained by the fact that people look for "anchors" to which they can attach themselves, either physically (sitting, leaning against) or symbolically (standing near, looking at).

Alexander argues " those of us who are concerned with the buildings tend to forget too easily that all the life and soul of a place, all of our experiences there, depend not simply on the physical environment, but on the pattern of events which we experience there" (Alexander, 1979). Investigating the pattern of occupancy of public spaces, he points out that their occupancy proceeds around their borders and edges that people prefer (fig.II.1). Once they are full, the occupation goes gradually inwards; which is termed by Gehl as "edge effect".

Alexander argued that people ovoid spaces that either too exposed or enclosed. Nevertheless, Hillier emphasizes that the good locations for unprogrammed static use do not depend on the provision of specific attractions or facilities, but may be associated to "the visual properties of space experienced by the stationary person" (Hillier, B et al, 1990).

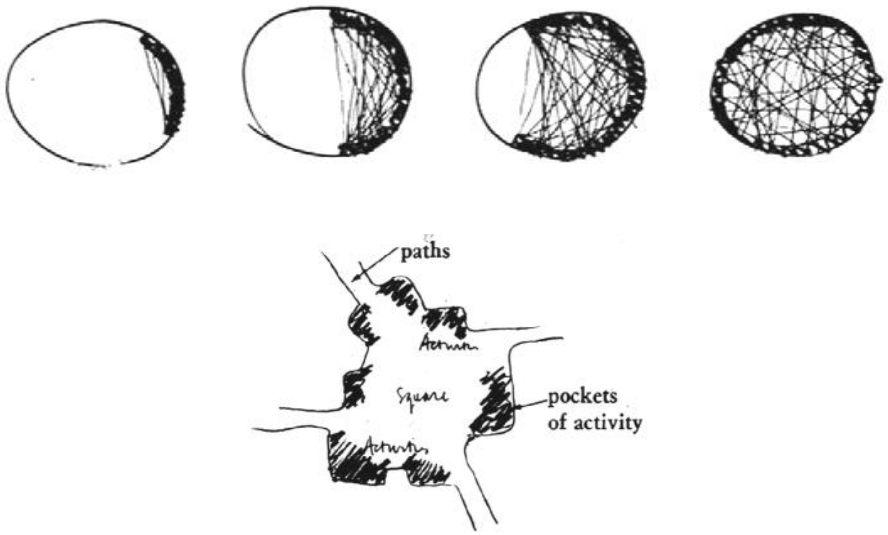


Figure II.1: The edge effect in space occupation (Alexander, 1977).

Investigating the relationship between visual fields and patterns of stationary activities in several London public squares Campos (2005) showed, by using space syntax method, that people seem to avoid very exposed spaces and prefer areas that provide good views but by keeping some level of privacy for unprogramed activity. And she argued that the gradual occupation of public spaces is a local spatial property inversely related to the increasing degree of visual connections between these spaces and the surrounding urban environment rather than following the edge effect.

Jane Jacobs, whose book *Death and Life of Great American Cities* criticized modern planning, investigated into how American cities actually work, rather than how they should work according to urban designers and planners, Jacobs effectively describes the real factors affecting cities, and recommends strategies to enhance actual city performance. She focused on Three levels of city neighborhoods; city, districts, and streets; by exploring different aspects such as safety, social contact, diversity and livability.

She criticized modern urban space by being neither coherent nor diverse. She emphasized on the legibility of the city which she considers and an important aspect that influences the use of spaces. The legibility depends on the public domain as the connective framework between individual buildings. She blames the modern planning of being unable to connect buildings as part of the urban experience as it is in the agora the markets of the past. Consequently being 'divided' and 'fragmented' the modern city affected the urban life, spatially and functionally. Hence she advocated the traditional model of urban space by highlighting the principles of mixed use, diversity of functions, space potentiality that attract different users (socially) and more walking and people encountering spaces. She argues this is the only strategy to enhance actual urban space performance.

Tracking the same thinking, Krier emphasizes on the role of the square as being the first urban space discovered by man. It is meant to be a place for community life, social, commercial and cultural. He believes that the square is structuring space that therefore becomes the framework of human activities; to accommodate the overlapping role as 'movement space' and 'social activities space' (Carmona, 2003).

Some studies showed that contemporary plaza**,** comparatively to old piazza**,** has a very limited range of uses compared to those of the medieval piazza. According to observation studies of modern plaza use, sitting, standing, walking, and their combination with eating, reading, watching, and listening account for more than 90 percent of all use.

To sum up in the studies mentioned above there is no indication on the relationship between physical properties or geometrical form and the space use or livability. There is no hint to the belief that enclosure and irregularity principles which were derived from studies of traditional medieval squares (Sitte, 1989; Unwin, 1909; Zucker, 1959 and Krier, 82) are people preferences or determinant to livability of space. All the findings emphasized on the importance of visual aspect, how the built environment is perceived by people. In tem of activity, it was confirmed that watching or (seeing) is one of the principal activities of people behavior or interaction with the environment (people and buildings). And in term of movement or space exploration, it was clearly stated vision (visual perception, visibility, and the environment's visual field) is the main feature that guides people's spatial exploration and locations choice while using a given urban space. It could be concluded that the visual

properties of the environment are the major determinant of the pattern of activities and of people's behavior (Marcus, Francis, 1997).

II.2 SPACE USE: Concepts from environmental psychology and sociology

II.2.1 Urban space use: people's preferences

Urban designers and architects' main concern is to design places that work and meet people's needs. Thus some of the key questions that may be asked consist of what kind environment people would prefer? What properties the environment must possess to enhance people's well-being? According to Kaplan (1973), the preferred environments are those 'in which human abilities are more likely to be effective and needs are more likely to be met. The effectiveness as defined by William Jame's observation is when 'the best attention is effortless' (Thiel, 1970). Christopher stresses upon the importance of assessing people's actual needs and preferences in design and affirmed that "Choosing good spots for outdoor seats is more important than building fancy benches. Indeed, if the spot is right, the most simple kind of seat is perfect" (Alexander, Ishikawa, Silverstein 1977, p. 125). People use space according to their preferences, and the impact will be on the space use; being a used or an useless space; people tend to accept less favorable locations until a prime location becomes available, or they choose not to sit at all (Zacharias, Stathopoulos and Wu 2004; Whyte 1988).

In environmental aesthetics, there are two approaches that deal with the individuals' preference of some environments to others. The First approach, led by Berlyne, Russel and Mehrabian, is concerned with the affective quality. It studies the evaluation of the person's emotional response to the environment. The degree of arousal of the perceiver is investigated through environmental variables (e.g., light, temperature) by the physical and visual pattern of the environment. In this approach, it is believed that appraisals of quality, beauty and pleasant feelings overlap. And it asserted also that emotion, feelings in a given place, influence people's behavior; to use or to avoid a place.

The second approach is concerned with the cognitive aspect, focusing on the perceiver's understanding of the environment. This approach is led by Kaplan and Kaplan that set some predictors of preference.

According to them, an environment, to be 'involving', it must have some complexity or diversity. Furthermore, in order to 'make sense' an environment requires coherence, the parts need to hang together and in some sense 'belong' there; legibility, the environment is comprehendible and manageable so people can easily identify all its components (pathways, places, landmarks) and group them into an overall pattern (memorized). they also consider mystery; as a possibility of exploring, would make the environment 'involving' by giving people possibilities of discovering its parts and features bit by bit while experiencing it. This is similar to Cullen's (1961) concept of deflected vistas and serial vision (fig: II.2).

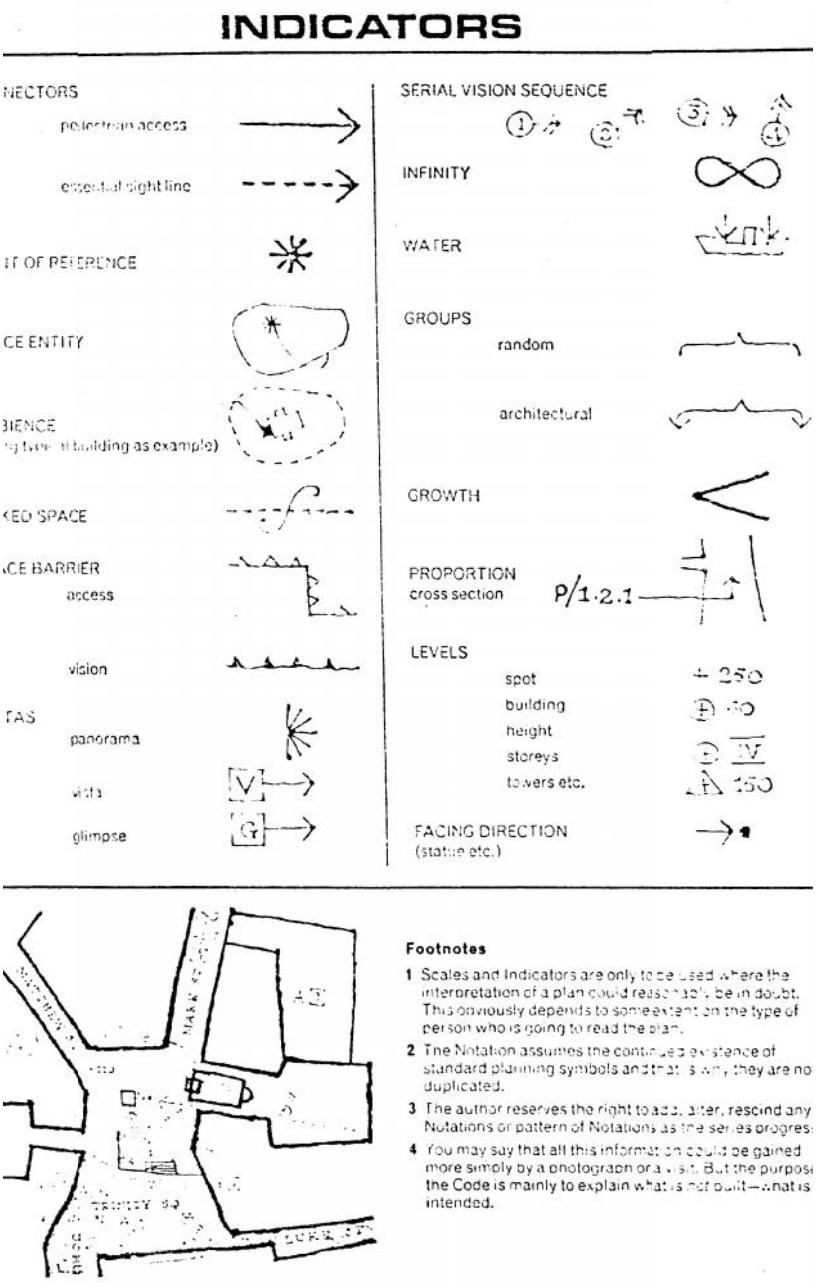


Figure II.2: Gordon Cullen Visual survey (Gosling, 1984)

For Nasar (1997) response to place may arise from two variables: formal and symbolic. Formal variables consist of the structure of form such as shape proportion, complexity, incongruity, novelty and order. Symbolic variables consist of meanings related to form. He argues that Complexity and novelty increase arousal, interest and excitement. However,

Kaplan asserts that there the basic information needs linked the preference framework are making sense and involvement. He also believes that the issue of the role of space in people's preferences is tied to spatial experience. He considered that a scene or landscape is not only things to perceive but things to enter into and move around it. Thus aspect of preference goes beyond the 'picture plane' to the inferred three-dimensional qualities of the scene. These latter are related to main properties, coherence, complexity, mystery, and content. Coherence is referred to as to the degree of easiness for the observer to organize and structure the features of the scene. Complexity is referred to as how much the scene's components keep the observer occupied, involved and interested. For him mystery differs from 'surprise', he argues that in "surprise" the new information is not present and it is sudden' and that in 'mystery, the new information is not present; it is only suggested and implied. Rather than being sudden, there is a strong element of continuity'. He also claimed that Preferences increase with openness even though, but people also like spatial definition.

Kaplan's primary concern was functional value for the perceiver of understanding the organization or layout of the environment. So he indentified some of the structural environmental variables as predictors of preference: *coherence, legibility, complexity and mystery.*

Nasar (1988) asserts the importance of the appearance, the aesthetics of the environment and people attachment to it. He states that "Human have feelings, both negative and positive, about their surroundings" and that "perceived visual quality has been described as the product of two fundamental human needs; the need to be involved and the need to have the scene make sense"; the environment has to be involving to attract people and has to make sense for people to operate in it; to use it.

II.2.2 Affordances

Man's use of space is the center of anthropological, sociological and psychological researches. They have been a source of guidelines to architecture and urban design and clarification about the person-environment interface and the environment design.

The term 'affordance' was coined by James J. Gibson (1979). Gibson argues that the users do not see shape and forms when they use a space but rather they perceive affordances- what that place can do for them. For him the environment is composed of substances (materials) and surfaces (architecture elements) and that their arrangement (layout) provides affordances (evident functions). So he defines affordance as "the perception of anything in the environment that automatically involves the perception of what it offers and affords with one's own action and purposes" (In Gifford, 1997, p. 26). He distinguishes two types of affordances: direct affordance that consists of or implies activities, and indirect affordance that consists of or implying meaning.

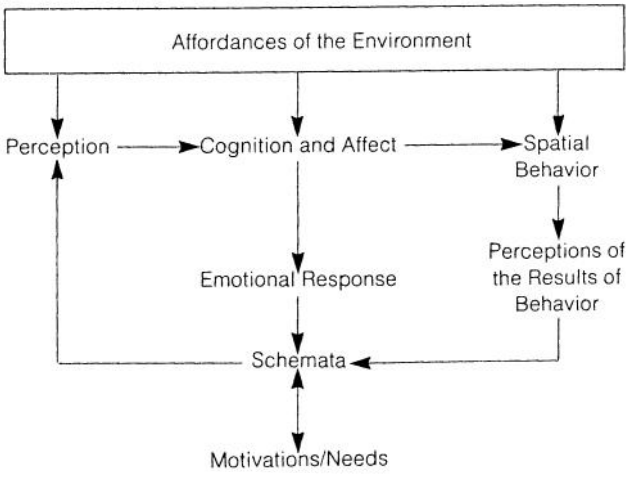


Figure II.3: The fundamental process of human behavior (Lang, 1987)

The affordance is also correlated to the preference aspect linked to the involved user's perception. Gibson states that the affordance deals much more with the image of the scene than of a single object, he stresses the importance of the field that he considers not merely a collection of objects yet a matter of larger spatial context. This larger spatial context is composed of gradients, textures, and surfaces that influence the user perception, behavior and preference. He argues that people's preferences are usually for the environment that enable them to meet their needs, that he sees different from preference. Preferences do not require immediate urgency so Gibson stated that "to fail to obtain one's preferences may be regretful, but it does not itself undermine one's functioning" (in Gifford, 1997, p 27). Preferences are

considered as prompt reaction to the physical environment; it is an extension of the perceptual process.

Essentially, the environment presents a series of affordances for human experiences, behaviors and use. So the diversity of affordances is bond to the pattern of the built environment and the sensorial stimulation (principally visual) as put by Lang "different patterns of the built environment afford different behaviors and aesthetic experiences…, and variety of visual stimulation" to the potential user (Lang, 1994, p 81(fig: II.3)) Yet actions are dependant of affordances of the natural, the built environment, the cultural environment, and the intrapsychic of people.

In another point of view on how people use a given environment either natural or built, Appleton (1977) provided two concepts inherent to people's experience of outdoor spaces and their assessments of these spaces: *shelter* and *prospect*. Both of them deal with visual matter. He defines shelter as place to hide in and where you can see without being seen, similar to the Gibson concealment. However, prospect permits the unobstructed seeing. He asserts that to be preferred an environment should provide such possibilities for people. Where one can find a refuge (space) and at the meantime can seek and look into distance; to be able to get information about the surrounding ant at the same time prevent from getting information about oneself.

Appleton's concept of shelter and prospect has been confirmed by some research studies of people behavior in space. Stilitz (1969) observed people waiting in London Underground stations and theatre foyers. He found that people tented to wait out of the line of the traffic flow near the pillars. In Japan, Kamino carried out similar observations in railway stations, and found that people also locate themselves near pillars but out of the flow of traffic (In Canter, 1977). So both researchers came to the conclusion that people were trying to position themselves in a place from which they could see but in which they were not too observable or too much in the way of people moving. In the same way, Canter showed that people tend to sit at the tables around the periphery of the restaurant rather than those of the middle.

The composition of the built environment affords not only visual stimulation but also many other things to the potential user such as sonic and olfactory stimulations. Yet it seems that visual stimulation affect the most people' space use.

II.2.3 Behavior setting

Two concepts have been developed inherent to spatial behavior, activity system and behavior setting. The former is concerned with the organization of the sequences of activities taking place in a given space (Chapin, 1965) and the latter is concerned with the relationship between the built environment and pattern of behavior that takes place within it (Baker, 1968) (fig: II.4). Behavior setting is developed by "ecological psychologists" who believe that the physical environment, constituted of several overlapped affordances, has a great influence on the behavior of individuals.

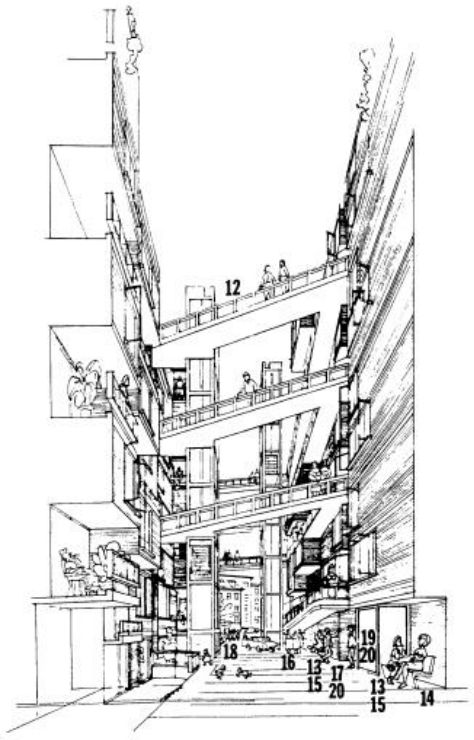


Figure II.4: A behavior setting (source, Lang, 1987)

Baker (1968), ecological psychologist, directed his research on observing patterns of behavior in relationship to their physical settings, named behavior setting that was coined first by David Havilland (1967) as "action-space" and then "behavior-environment" in architectural design. He defines behavior setting as a structured set of surfaces of various qualities designed to afford some activities (activity systems). For Baker, behavior setting is a combination of

activity and place; a regular activity (a pattern of behavior), a particular layout of the environment, (the milieu), a harmonious relationship between the two (a synomorphy), and a specific time period. It may have invitational quality, conducive to use or have low quality, repulsive to use, in Humphery Osmond terms, 'sociopetal' or 'sociofugal' settings; to bring people together or to force them apart. A behavior setting could present polyvalent and flexible. It may be occupied by different groups or individuals depending on their role (function). Furthermore, a behavior setting permits a person to achieve a 'multiplicity of satisfactions'.

Other similar concepts, besides affordance and behavior setting, such as the concept of fit, 'synomorphy' and congruence have been used to describe the relationship between the pattern of behavior and the physical environment. Whyte (1975) concluded that the liveliness of places depends on what behavior setting affords (comfortable sitting, good light, people watching and so on) and in contrast those without such affordances are dead places. This shows the importance and the impact of space and its components (buildings and objects) layout in creating behavior settings that consequently affect the individuals' behavior; the use of space.

The environment is considered as an ensemble of behavior settings linked together. Each behavior setting presents somehow a boundary (Robert Bechtel, 1977) yet wider than bounded space; "a side walk is a behavior setting; a room is not one until it is inhabited by people exhibiting behavior" (Perrin, 1970 p 104). Nevertheless, it could also be subdivided into a number of sub-settings. The whole network of behavior settings the activity system (Kantowitz, Zorkin 1983). For example a behavior setting such as a city square can be subdivided into a number of sub-settings. Lang asserts that 'the liveliness of such places [plazas] depends on what each sub-setting affords and the predispositions of the population. Popular gathering places are those that afford comfortable sitting, good light and people-watching' (Lang, 1987, p 118).

'Seeing' or 'watching' seems to be a very determining factor in people' choosing places or locations to achieve their goals or purposes; doing activities. It seems that 'choosing' a location that fits people's needs is part the process of behavior; using space. Concept of choice and freedom of choice, introduced by Harold Prohansky and William Ittelson, concern

the behavior and experience of the person in relation to the nature of organization of the environment. According to them, in an established physical setting the individual will position himself so he can both accurately cognize and move freely in order to achieve goal satisfactions (Prohansky, Ittelson, 1970, p 173). Therefore the individual has to get to know, obviously through vision, his environment in order to search in it and use it appropriately in the particular goal or objective. So the individual interaction or use of space is progressive. He proceeds first by achieving subsidiary goals to finally achieve primary ones. For instance, in order to achieve solitude, a person "may first have to find the right place, then find a place to sit, and then position himself so he can read effectively" (Prohansky, Ittelson, 1970, p 174).

Therefore the freedom of choice in a given physical setting depends not only on that setting and its layout, but much more occurs in it from moment to the other, new visual field that provides more alternatives for movement and activities. Rhode (1973) linked desirable human spaces to continuity as one of the important issues (to intimacy vitality and diversity). He defines continuity as a spatial and visual references succession though movement. In addition to 'seeing' or visibility aspect of the environment, Ittelson argues that the freedom choice is linked also to changing effects caused for instance by ambience factors such as light/shadow, temperature, and sound in that physical setting.

Freedom of choice is more likely bond to the built environment layout; space layout buildings and features arrangement- space configuration (space syntax). This would obviously imply visibility matter according to movement. So Freedom of choice has become an important issue since spatial behavior, how and why people use the space in a given manner as they go about their activities is a central concern to environment design theory. This is well stated by Doxiadis "we must learn how to plan and build our cities in such a way as to give all of us the maximum of choice" (Doxiadis, 1968, p 21).

The work of Christopher Alexander, Ishikawa and Silverstein (1977) stated in *a pattern language: towns, buildings, construction* (Alexander, Silverstein, Ishikawa, 1977) seems to be the first attempt of an architect to systematically link units of behavior to architectural elements. The goal was to include social and behavioral matter in design process. They replaced the term 'needs' by 'tendencies' that define an observable pattern of behavior. They argued that conflicts may emerge from these tendencies. And that these conflicts' resolution is

the purpose of design. Christopher believes, similar to behavior setting concept, that the solution of these tendencies or the success of design is in the way the environment elements are arranged (layout); the geometric relationship between the elements of the environment is the key success to design that fit people's tendencies.

II.2.4 Territoriality Behavior: 'defensible space', 'personal space', and proxemics

According to Watson (1974) the concept of territoriality is a concept developed in ethnology, which is the study of animal's behavior in their natural environment. Human territorial has been described as the study of man's behavior vis-à-vis other persons and his appropriation of space. Individuals build up spaces (permanently or temporarily), they consider their personal property and they are willing to defend them (Altman, 1975). Furthermore, territoriality implies the seating preferences of individuals within a group and in space (Sommer, 1969, hall, 1966).

Four types of human territories were distinguished by Lyman and Scott (1967): public, home, interactional and body territories. Public territories encompass all spaces open to everybody with free access such as plazas, streets and parks. Home territories are spaces confined to specific users with some behavioral rules; for instance public buildings. Interactional territories are space for occasional social gathering. Body territories refer to the space occupied by the human body.

Territoriality concept has been of great contribution to environmental design. Concepts such personal space, defensible space, and proxemics brought a lot of light and understanding to the man/space interaction within the built environment. This was translated into some design principles and guidelines to how create more human and functional urban space; comfortable and safe.

II.2.4.1 Defensible space

Oscar Newman and his team conducted investigations of many housing districts in New York City to look into the relationships between user demographics (income and other socio-economic factors), the physical variables, and the incidence of crime. Combining all the data of these variables, they found a great connection between crime and poor design. He ultimately proposed the concept of 'defensible space' that he defines as "a model for residential environment which inhibits by creating the physical expression of social fabric that defends itself" by using "real and symbolic barriers, strongly defined areas of influence, and improved opportunities for surveillance that combine to bring an environment under the control of its residents" (Groat, Wang, 2002, p. 213) (fig: II.5).

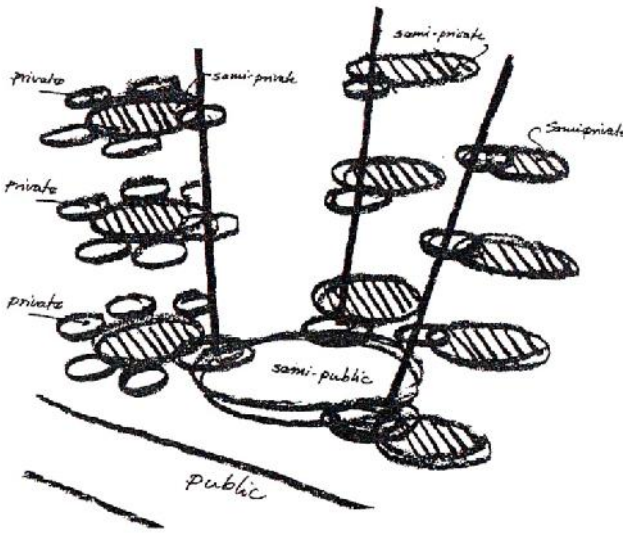


Figure II.5: Newman's defensible space, spatial hierarchy (source: Lang, 1987)

In other words he considers space as a principle allocation of responsibility for and supervision of territory. Moreover he emphasized on space configuration and building arrangement that generate traffic in order to reinforce natural surveillance- avoiding secluded space (Fig II.5). He also mentioned the importance of building design (the envelope) such as the positioning of windows to allow residents survey the exterior. He emphasized on this fundamental character of city space.

II.2.4.2 Personal space

Robert Sommer (1969) defines personal space as "an area with invisible boundaries surrounding a parson's body into which intruders may not come" (fig: II.6). It is similar to hall's distances; person's spacing from other individuals. The personal space is an intimate space that is related to the person's background (social, culture, education, gender and so on) and the type of relation the person has with the other person and persons. Therefore it is in term of area (spacing) is changing from person to another and from situation to another. Sommer argued that personal space is portable territory; wherever you stand it surrounds you. Therefore it has great impact on person's behavior; how he interacts with other people and consequently how he interacts with space, uses space. Because during socialization, interaction involves orientation and interpersonal distance that, in their turn, involve elements of territoriality and spacing. This means that choice and preference of space or locations are achieved according to relational considerations (that may be subjective), relations (social, psychological) to other people and their position (location) in space. As the use of space is governed by interpersonal relations, personal space is one of the important concepts to be considered in environmental design. Many studies on personal space and seating arrangements in public spaces showed the effect of seating arrangement in social interaction. Since arrangements of seating may either foster or hinder social interaction; as coined by Osmond, to be a 'sociopetal setting' that facilitate social interaction or 'sociofugal setting' that discourage social interaction. Many recommendations have been provided about seating arrangements (orientation and location) in public space such as variety and flexibility so people can find comfortable space and use space.

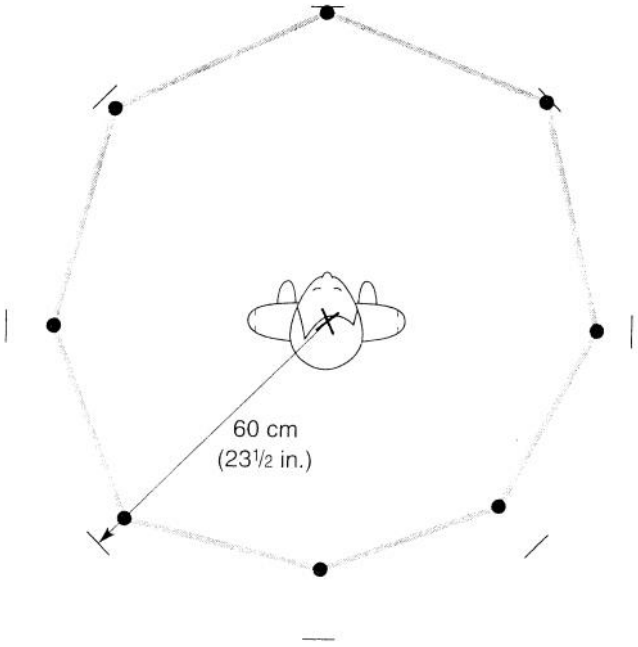


Figure II 1: Personal space (Gifford, 1997)

II.2.4.3 Proxemics

The second aspect of the interpersonal spatial relation is the meaning that everyone attaches to the position of his own body in its relation to others. Edward T Hall developed this subject under the name of proxemics that he coined from the Latin root *prox* (as in proximity) and the suffix *–emic* (as in phonemic, systemic) (Watson, 1974). Hall (1959) used the term *Proxemics* to designate "the interrelated observations and theories of man's use of space as a specialized elaboration of culture". His studies that focused on observation of cultural differences in the utilization of space are the content of his books, *the silent language* (1959) and *the hidden dimension* (1966). He sought the human aspect of man's behavior and focused on "the study of man's transactions as he perceives and uses intimate, personal, social, and public space in various settings while following out-of-awareness dictates of cultural paradigms" (Hall, 1974). He proposed three categories of proxemic description, distance, space and modes of behavior and perception. From this latter he developed a system of proxemic notation. He distinguishes four categories of interpersonal distance, intimate distance, personal distance, social distance and public distance.

He defined the personal space as being a small circle at its center the individual and culturally–determined radius; the *territorial cluster* and *territorial complex.* This personal space has no visible boundaries, yet is defined by distances that differ from culture to culture.

In term of space use, he discerns three categories of space according the way cultures organize space, *fixed*, *semi-fixed* space and *variable*. *Fixed* space is formed by walls and territorial boundaries. *Semi-fixed* space is formed by mobile elements such as furniture arrangement, movable partitions, and screens. *Variable* space is when a person varies the spatial features of his surroundings or the interpersonal distances.

II.2.4.4 Space configuration and space use: space syntax

Hillier, with his colleagues at University College London's Space Syntax Laboratory, has explored and theorized, in his book *space is the machine,* the relationship between (mainly pedestrian) movement and the configuration of urban space and also between pedestrian densities and land uses. He found that the configuration of space, particularly its effect on visual permeability, is important in determining movement densities and encounter rates (Hillier, 1996)

He believes that The functioning and the use of these spaces is related to their isovist properties and that human space is no limited to the properties of individual spaces, but relates to the interrelation and interconnection between the many spaces that make up the whole spatial layout; that is called configuration of space. So people's experience of space is associated to its geometry in a way that "the language of city space is written in this geometric language reflecting human behaviour and experience" (Hillier, 2000, p 97). In space syntax theory, Space is neither static nor independent, its properties depend to its relationship to its surrounding, and this influence the perception of this space that man experiences in motion. Space has two properties 'local' and global', local properties are intrinsic and confined to space itself (part); global properties are inherent to space and it its relation to its surrounding (whole); the structure in which it is embedded. Consequently the use of space is not related only the 'local' properties but also to 'global' ones. Hillier claims that the use of open spaces such as squares, in term of static activities, is bond to 'visibility field' or 'isovist' properties of

space and the highest levels of use normally adjacent to the most strategic spaces. It seems that the 'visual field' generated by space and configuration has a great impact on its use, according to him that 'exposed spaces often perform better than spaces with good enclosure' and that space must not to be too enclosed for its size. He sees that "the visibility field must be scaled up in proportion to the scale of the space" (Hillier, 1996 p165).

Montello showed the importance of the 'visual access' concept relevant to the physical characteristics of environments to the space use. He defines it as "the degree to which different places and features in environment can be seen' (Montello, 2007). This depends on the shape and the configuration of space. The greater is the degree of visual access of a space the more opportunity for people has to use it; more appealing. But he remarked that greater visual access will decrease mystery and uncertainty that consequently tend to boredom.

Hillier considers that space structure is composed of "convex" spaces and "lines" that link between these spaces; these 'lines' can pass through these 'convex' spaces. These 'lines' encompass people's movement; one may need to pass to pass through many lines (pattern of lines) to get to a given destination. Each line has its characteristics according to its connectivity to the others, in term of depth and shallowness – 'integration value: 'the less depth to all other lines, the more movement; the more depth the less'.

In his part, Alexander (2003), in his concept of the proper path, showed how the shape and configuration of space influence the user movement-by using a series of intermediate goals to arrange the path towards the destination; it consist of bending the path and the sight line by buildings. He also considers, in *the city is not a tree (1965),* the physical living as groups of sets, which are collections of material elements such as people, cars, and bricks, that run in them'. He defines the set of elements a system, when the set of elements belong together or work together somehow. He explains that the system has two parts: the unchanging part and the changing part. The unchanging or the fixed part (buildings and objects) is the receptacle for the changing part of the system (people, goods, light). So he defines the fixed part as the unit of the city. This latter with the changing part forms the dynamic coherence of the larger living system.

CONCLUSION

As being places for public life – space for gathering, human exchange, movement and entertainment, urban spaces have been of great interest of many scholars from many fields. Their functioning and use by people constitutes the central issue. This goes through the understanding of how people use urban space in term of interacting with it. This is covered by 'man-space', 'person-environment' or "space-action' interaction studies. Therefore the goal of these interaction studies is to tackle the issue of the use of space (occupying a space and achieving an activity) in its broader sense, by including affective, cultural and psychological, physical related to man and space interact.

The key question of this issue, asked by different research works, is what attracts or repulses people in using a space. So the attempting answer requires going over the understanding of how people occupy space and select location to achieve a specific activity.

Some researches linked the use of urban spaces such as public plazas to the comfort aspect. They stressed the importance of the impact of the ambientic characteristics such as thermal and acoustic comfort on the use of public spaces. Others emphasized on the importance of some architectural properties (normative) aspect such as the degree of enclosure, the size and the quality of the plaza. However the major trend, which is backed by environmental design and environmental psychology, is oriented more towards the ma-environment interaction that deals on one side with man's process of perception and behavior and on the other with the physical properties of space and its affect on man. Visual perception is the chief medium of this interaction.

Many in situ researches investigated the use, the pattern of occupancy of public spaces. Alexander (1979), investigating plazas use and people behavior, pointed that the occupancy proceeds around their borders and edges; coined by Gehl as the edge effect'. This was later confirmed by Compos (2005) research findings on plazas use that people avoid very exposed spaces and prefer areas that provide good views but keeping some kind of privacy. Though Whyte plazas investigation's results showed that people select to occupy the dense places (locations); where others are. Whyte argues that what attracts people most is other people.

Many theories and concepts related to the use of space and man –environment interaction have been introduced

Kaplan and Kaplan introduced the term 'involving' to define an environment that is inviting to be used. They argued that this kind of environment must have complexity or diversity that implies 'mystery' which consequently may induce people to its exploration. In the same standpoint Nasar stressed importance of the complexity and novelty in increasing arousal of people's interest and excitement. He also emphasized this not only on the spatial configuration but also on the appearance of the environment. He asserted that the aesthetics of the environment influences the use of space and that the environment must be involving (in term of aesthetics) to attract people.

Some psychologists such as Berlyn and Russel investigated and evaluated the person's affective response to the environment. They stated that emotion, feeling in a given space, influences people's behavior; such using or avoiding a place or a location. Gibson (1979) introduced the term *affordance* that he defines as what the place can do for people. He argued that what the users do not see shapes and forms when they us a space but rather they perceive affordances. Affordances that he classified into two categories: affordances that imply activity and affordances that imply meaning of the place. However Baker (1968), an ecological psychologist, introduced the term *Behavior Setting* that he defines as a combination of activity and place; a regular activity (a pattern of behavior), a particular layout of the environment, (the milieu), a harmonious relationship between the two (a synomorphy), and a specific time period. He believes that a behavior setting may have several affordances.

Harold Prohansky and Willian Ittelson (1973) introduced the concept of choice and freedom of choice inherent to the person's behavior in space. They argued that the person position himself in space in a way that he can both accurately cognize and move freely in order to achieve goal satisfactions. Consequently he proceeds first by achieving subsidiary goals to finally achieve primary one; a progressive use of space.

Territorial behavior, which is the study of man's behavior vis-à-vis other persons and his appropriation and use of space, as layered out in this chapter, focused on three concepts: 'personal space', 'proxemics' and 'defensible space'.

'Personal space' is defined by Sommert (1969) as an intimate space that is related to the person's background (social, cultural, education, gender and so on). The 'personal space' would influence the person's use of space. Since the person's behavior and use of space is principally governed by interpersonal relations; the selection of location for use is achieved according to relations (socially and psychologically) to other people and their location in space. In the same framework, Hall (1974) focused on the observation of cultural differences in the use of space. He used the term *Proxemics* to designate "the interrelated observations and theories of man's use of space as a specialized elaboration of culture". So he distinguished four categories of interpersonal distances: intimate, personal, social, and pubic. Newman, concerned with the crime problem in housing compounds, developed the 'defensible space'. He considers space is the principal responsible for the supervision of territory. He pursues that the layout and the configuration of space are the primary means for natural surveillance; because they influence on the use of space, either by providing 'affordance' for activities or for movement (presence of people).

Two approaches considered configuration of space as the key to understanding man-space interaction: the syntax theory initiated by Hilier (1984) and Alexander's patter language theory. Nevertheless these two theories are developed different arguments and core of knowledge.

Space syntax considers human space not only limited to the properties of the individual space but also to the properties of its interrelation and interconnection with other spaces that make the whole spatial layout, it is coined by configuration of space. Therefore this theory considers the functioning and use of a space is primarily is bond to 'configurational' properties. Hillier argued that the spatial configuration generate a 'visual field' that has a great impact on its use. In other words 'isovist' properties of a space are in great correlation with its the pattern of use. In another way of defining space, Alexander considers the physical living as groups of sets. He defines the set of elements a system when the elements belong and work together; all together create a certain spatial configuration that allows specific patterns of behavior.

It seems that most theories consider that the affordances of a particular pattern of the built environment are a property of its layout; its configuration and its components layout.

CHAPTER III

PERCEPTION AND SPATIAL EXPERIENCE

INTRODUCTION

This chapter examines some human basic psychological processes related to the man-space interaction. It will cover the different concepts of perception and aesthetic appraisal associated to the individual spatial and environment experience. However, for the goal of this work emphasis will be put on visual perception and also on the main topic that is inherent to, which is man-environment interaction.

III.1 DEFINITION OF PERCEPTION

Perception is the process of obtaining information from and about one's surroundings; it is a very active and purposeful. It is where cognition and reality meet (Neisser, 1977). Perceiving is considered as a process. The perceptive process is accomplished by person's vision, hearing, smell and touch. It happens through four phases, cognitive, affective, interpretive and evaluative (Ittelson 1973). In other words, it is the process of becoming aware of a space by the acquisition of information through the sensation of sight, hearing, smell, touch and taste (Porteous, 1977). Perception is essentially visual when it comes to aesthetics evaluation or behavior related to space or environment stimuli. Vision allows a person to gather, to detect, and to categorize the information collected from a particular environment; for the purpose of understating (discovering) or behavior, using the space either static (activities) or dynamic (movement, navigation). Yet perception depends not only the space or the environment being perceived but is also influenced by personal factors due to education, cultural background, and previous experience (Gifford, 1997).

William Ittelson distinguishes two types of perceptions *object perception* where the attention is more on the propriety of the object such as color and brightness, an *environment perception* where the attention is on large scenes where the perceivers are one component of them.

III.2 ENVIRONMENTAL PERCEPTION

III.2.1 Environmental psychology

Environmental perception is one of the substances of environment psychology which is the study of the interaction between human behavior and natural or built surroundings**.** In these transactions individuals change the environment and their behavior and experiences are changed by the environment. Egon Brunswick and Kurt Lewin are the pioneers of this field. The term environment may imply the natural environment (parks, wilderness areas) or the built-environment that embraces buildings and urban spaces (streets, squares...). Thus understanding these transactions implies an investigation of both the individual and the environment. Hence, on one hand this would require the study perception, cognition and behavior, and the other hand the properties of the environment *(Gifford, 1997*). There are two approaches the one that relies on quantitative data called 'objectivistic' and the other that relies on phenomenological entities qualitatively (Miller, 1998).

In sum, environmental psychology looks into how the environments affect person's perception, emotion and behavior (Brunswick, 1943). Kurt Lewin's tried to represent, mathematically, the person and the environment in the graphic term of topology: (P) the person, (E) the environment and (E) and (P) together comprise the life space, from this he set his formula B= f (p, E) (Kaplan and Kaplan, 1978) (fig: III.1).

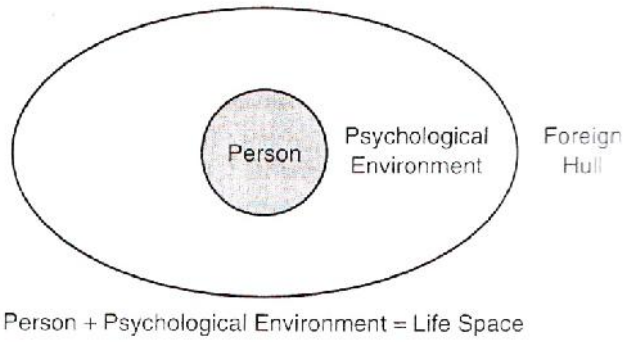


Figure III. 1: A simplified depiction of Kurt Lewin's of persons-in-environment (Kaplan, 1987)

Environmental perception is the gathering of information in order to construct an internal representation of the environment (Gifford 1997). As cited earlier environment perception is an important ingredient in man-environment integration. Rapoport (1977) stated that there is a communication between the world and the individual who perceives it, that consists of environmental process, environmental cognition and environment evaluation. In other words, environmental perception is the interaction of the physical context and the cognitive, affective 'emotional', interpretive, and evaluative aspects of the environment (Lang, 1987). Cognitive aspect involves the use of man senses that according to T Hall (1960) man's sensory apparatus falls into two categories; the distance receptors (eyes, ears, nose) and the immediate (touch through the skin). Hence, Perception is in fact a multi-sensory process in which vision plays a major role. Affective aspect engages emotional at reaction of man to the surroundings that have been experienced, resulting in attitudes; likes and dislikes toward that environment; degree of attachment to it. Evaluative aspect deals with man's aesthetic appraisal of the environment; defining and evaluating in term of preferences.

However, in another point of view Hilgard stressed that perception is not a passive, but an active process of interaction between organism and the environment. He argues that the perceiver seeks a perceptual stable environment as he seeks an internally stable environment and that there is "an environmental homeostasis parallel to the physiological homeostasis" (Kaplan, 1987, p.36). So he considers perception as an achievement of two objectives environment stability (stability of objects and stability of the world containing these objects) and definiteness (fig: III.2).

In the midst of environment perceptions there are various currents. The concept of 'landscape', which corresponds at the relation between a subject (man) and an object (landscape), is developed, according to Baily (1977), by two currents of thought: the theory of 'stimuli –answer' that focuses on the direct relationship between the stimuli of the environment and behavior, and a theory that integrates more subjective attributes (cultural, social, psychological). In his point of view, John Lang classified theories of perception into two basic sets, one is sensation based and related to the sensory experience and the other focuses on the senses as active and interrelated system. The first set that comprises, among others, *gestalt* and information-*based* theories, attempts to look into how sense data is related to the brain. Both believe that environmental stimuli arouse the senses that consequently

create sensation that are some part of the perception. However, information-*based* theory focuses on how we process phenomenal information and the relationship that comes to exist within it.

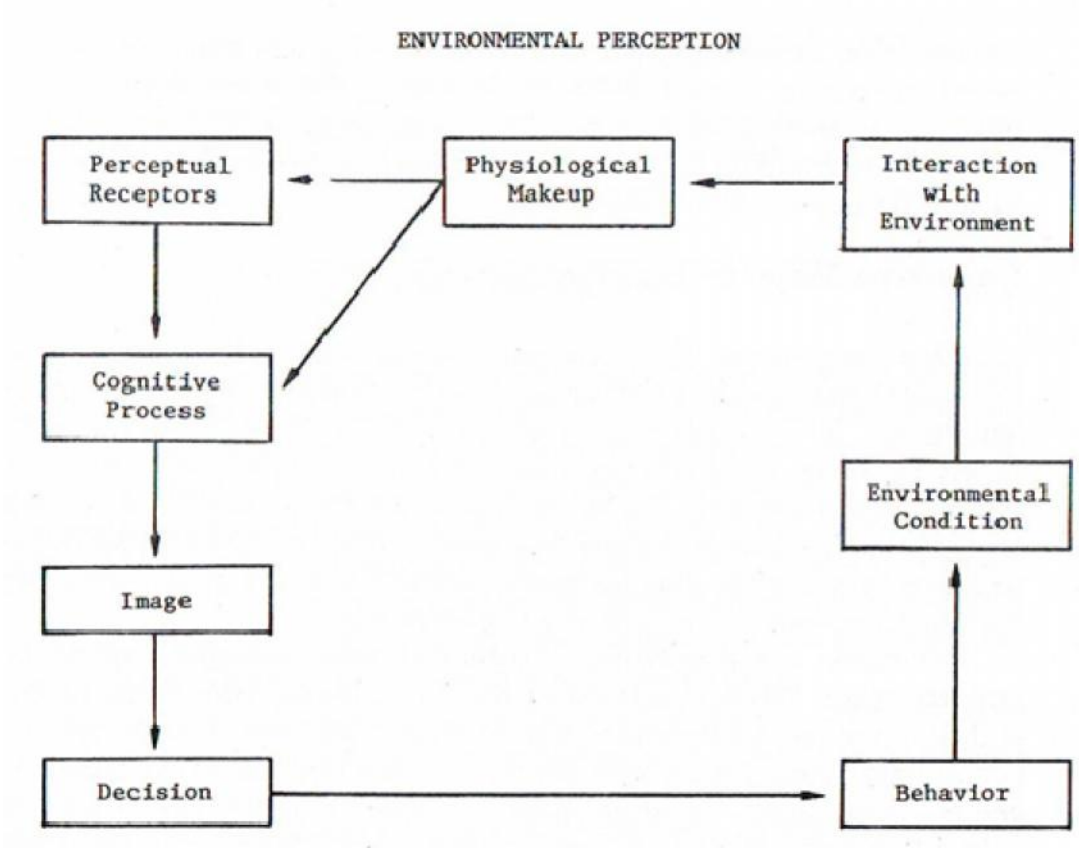


Figure III. 2: Environmental perception: man-environment interaction (Kaplan and Kaplan, 1982).

III.2.2 Gestalt theory

Gestalt psychology is attributed to Max Wertheimer (1912) who argued that perception is not only an assemblage of scattered point sensations but also an involvement of the whole shaped region; the pattern. This was largely explained by Kohler "instead of reacting to local stimuli and independent events, the organism responds to the pattern of stimuli to which it exposed" Kohler, 1975). Gestalt psychology repose on three concepts of form isomorphism ; a mirror-like aspect between the form in terms of neurophysical process in the brain and the form of the perceptual experience, and field forces; forces in the visual field have an area of application, a direction and a magnitude. Thus, it emerged of a set of rules that govern the

appearance of shapes and forms consisting of laws related to environment perception and form disposition have been set: *proximity, similarity, closure, good continuance, and symmetr* (fig: III.3)

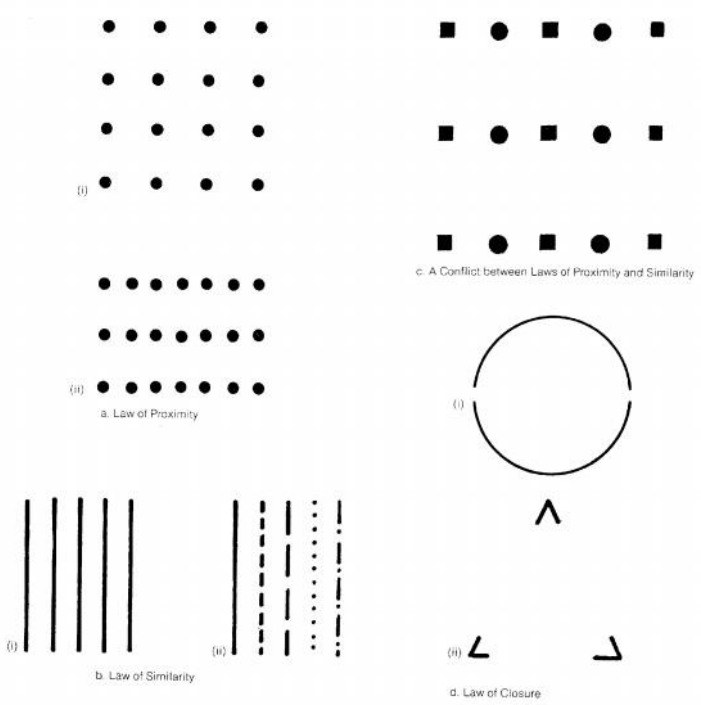


Figure III. 3: Gestalt principles (Lang 1987)

III.2.3 Information-based theory

In environmental psychology literature, the environment is considered as a set of messages that act as visual stimuli. Thus, either natural or built environment encompass a bunch of elements, where each elements emits messages. These messages are stimuli to affective responses that are related to perception and information processing (Gifford, 1997). Information theory considers that the information processing in the brain goes simultaneously with the emotional evaluation, independent of the actual content (Franz). So the environment properties affect the individual emotional experience (Berlyne 1970, Nasar, 1988). Berlyne defined *complexity* as a variety of elements in display, *novelty as* newness to the perceiver, *diversity*, *legibility* as the easiness to read and to recognize and *coherence* as orderly relationship between the elements (Mauron, 1975). He defines them as the "essential

ingredients of art and whatever else is aesthetically appealing". So collative properties have been defined as structural properties of a stimulus array that cause the perceiver to pay attention to investigate, compare and evaluate a given environment. He claims that these properties influence the perceiver's aesthetic judgments and desire to explore. Thus these environmental properties are interpreted and related to the aesthetics, responsible for richness or the poorness of the livability of the environment. Therefore, sensory values constitute one of components of aesthetic experience, this is mainly achieved by vision which is the main channel of information to the individual. Many interpretations of these properties are made by scholars. For Moles the intelligibility of pleasantness of the message is bond to its orderliness. Arheim (1971) sees that aesthetics depend on complexity and order; the more complex is the order the greater is the pleasure. Nasar (1988) rearranged them into two main factors first complexity including diversity, entropy, and richness and second order including legibility, clarity and coherence. However Kaplan added 'mystery' property that is defined as when environment assure new information for the individual when moving further.

Rappoport (1969) stated that "repeated exposure to complexity and ambiguity tends to improve the optimal perceptual rate". However the opposite will cause "a detrimental affect on the mind". Besides the lack of diversity, by repetition of elements in an extreme way, the environment would lessen the arousal of interest.

III.2.3.1 Preference

Later, research has identified five types of environmental attributes inherent to preference classified into two categories: formal variables consisting of order complexity, and openness; and content or symbolic variables consisting of naturalness, upkeep, and historical signification (Walsh, Price, and Craik, 2000). Openness is related to the degree of enclosure of the space and its open views. Openness presents wider views to the user to observe the scenery and enable him to prospect for movement to other spaces. In studying a cognitive mapping of urban space to find what is the most noticed by pedestrians, Lynch and Malcolm Rivkin (1959) found out that 'spaciousness' or constriction of the streets was the main observation for the pedestrians' experience. However some research studies showed that people's preference is for some spatial definition; reasonable defined openness with views on

the surrounding. This was confirmed by Lynch's value 'visual scope' that is "vistas and panoramas which increase the vision depth" and defined space as 'a strong physical form', both constitute a great value to people's preference and thus memorability of the space (Lynch, 1960). Rapoport (1990) found out, in a study of several streets and plazas around the world that the well preferred and liked are linked to the enclosed depth and the width of view aspects. In another approach Kaplan's attribute of mystery deals much more with the arrangement of space in order to keep a serial of sequences of deflected vistas as a generator of the user's interest for more exploration (fig: III.4). Therefore vision seems to have great importance in people use of space on both static activities and dynamic ones.

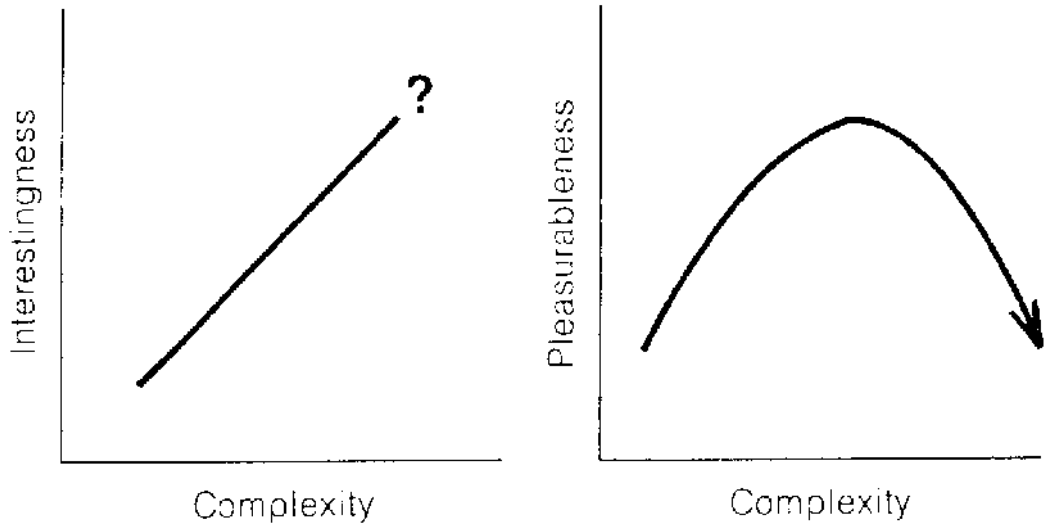


Figure III. 4: Complexity and pleasure (Lang, 1987)

III.3 ECOLOGICAL THEORY OF PERCEPTION

James J. Gibson (1966, 69) introduced a new analysis of the environment that consequently led to a new person-environment relations. This analysis is based on real and tangible experience of a person perceiving a particular environment. He started from the basic that man in his daily activity experiences the environment by movement; walking from place to another. Thus motion is the medium by which man perceives his environment in a series of visual changes produced by his interaction with the environment. First he considers the environment as a composition of three elements: *medium, substances and surfaces.* Medium

is *the* air which permits light to pass and movement through it. *Substances* are all the components of the environment, *and surfaces* are the interface between the medium and the substances. *Surfaces* and their reflecting properties constitute the base of his approach. He stated that any environment diffuses light either emanated or reflected from the environment's components such objects, surfaces and textures; this light is called *ambient light.* This latter, which is reflected with different intensities and directions, arrives at a station point- the eye- is called the *optic array* of that point, which is rich in patterned information about the environment; the environment and objects in it. So a slight movement would create changes in the optic *array*, consequently changes in the information received from the environment. Gibson defines movement as any motion of the body that causes changes in the field of vision. So he argued that throughout movement certain information about properties of the environment contained in the light rays remains invariant.

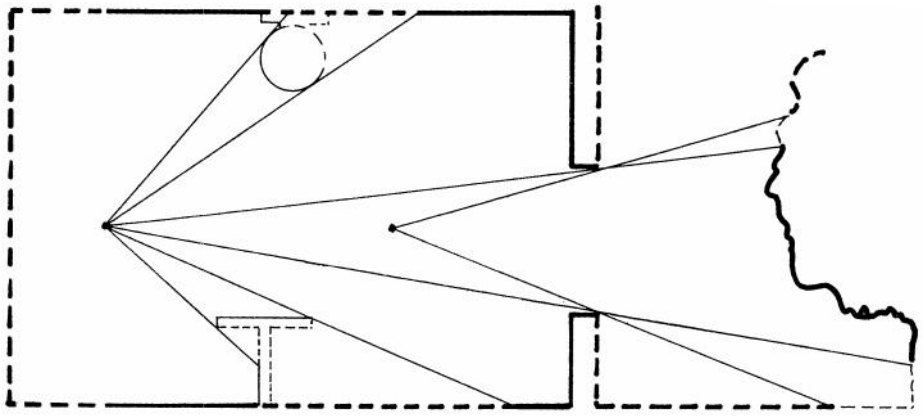


Figure III. 5: The occlusion and the disocclusion interplay, Gibson (Lang, 1987)

This theory emphasizes on movement as a vehicle enhances the process of perceiving the environment. Gibson suggested during movement the perceiver either walking or travelling within the environment, the visual field goes through continuous dynamic changes; *optical flow: as* outflow of features from a center of expansion of the field of view accompanying forward movement*, motion parallax:* differential rates of movement of stationary objects as a function of their relative distances from the perceiver*, and optical occlusion and disocclusion:* interplay of covering and uncovering of objects (Gibson, 1979)(fig: III.5).

The main contribution of Gibson's ecological theory is that perception is a consequence of optical flux stimulation generated by the environment (with all its components) and activated by movement of the perceiver rather than by means of constructed mental representation (fig: III.6). This is confirmed by Lang's arguments that thinking about design (architecture and urban design) must emphasize on layouts design instead of 'forms' design (Lang, 1987).

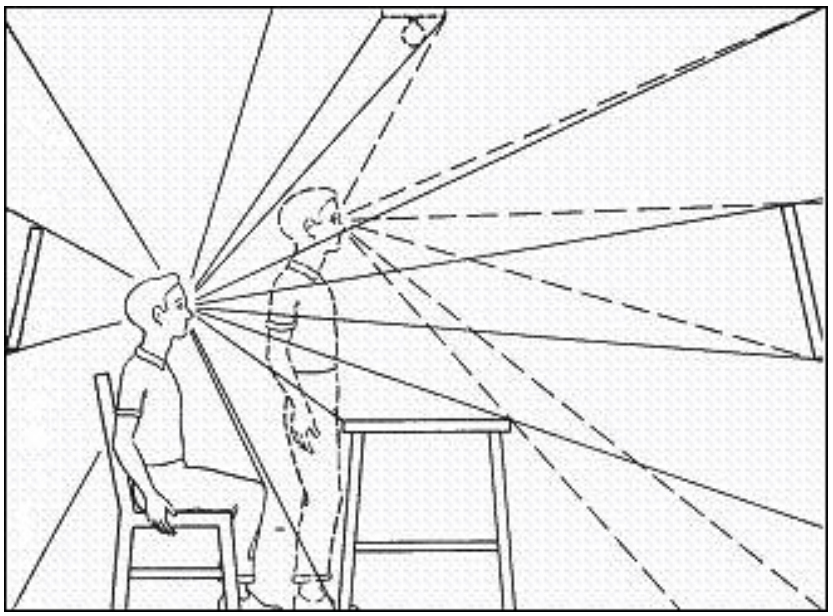


Figure III. 6: Gibson's Ambient Optic Array (Gibson, 1966).

III.4 VISUAL PERCEPTION AND MAN-ENVIRONMENT INTERACTION

According to (Kaplan, 1987), For the psychology view, we experience the environment not as series of snapshots of what is going on immediately in front of us, but rather as a construction. This construction is made up of a good deal of prior knowledge and only a sampling of current information. He argues that man reaction in an environment is not only due of stimuli of that environment but to prior experience. As (Ittelson, 1962) explained that in such situation the 'organism' is making a 'best guess', which is not from a random, because it influenced by the features of the environment and prior experience. Montello (2007**)** identifies, in an attempt to see how physical elements influence human experience, a variety of psychological mechanisms: *sensory access* (what can be seen, heard and so on), *attention*

(what is looked at), *memorability* (what remembered), *behavioral affordance* (spatial potential for activities), *affect* (mood, comfort, etc), *sociality* (social contact). He sees that these mechanisms depend on the physical characteristics of environments mostly on the appearance ones- that he called 'visual accesses. It is the degree to which different places and features in an environment can be seen. The higher degree of visual access the easier is the legibility and comprehension of the environment, but less mystery in unfamiliar environment. Consequently, it may result in less stress (for way-finding) yet more boringness.

So perception is not a passive process of registration, but an active process of interaction between organism and environment.

III.5 ENVIRONMENTAL COGNITION

Environmental cognition concerns the way we acquire, store, organize and recall information about spaces, locations, distances, and arrangements in buildings, streets, and the great outdoors. so all this amount of information taken through a person' eyes will serve to effective use, he must both condense and relate it to the rest of his experience, past, present, and future. So this information is useful and activated to the person need, look for something, behavior, and navigation within the environment (Carr, 1970). Moreover, Environmental cognition is concerned with the way people understand the environment. Many researchers have been looking for fundamental elements that organisms use to abstract a breakdown the environment (Montello, 2003). However, the psychologist meaning relates that cognition deals with the individual's Knowledge of the environment while anthropologist considers cognitive process is concerned with making the world meaningful (Rapoport, 1977). Meaningful implies a continuous 'cognizing' as argued by Prohansky (1970) that the individual behavior may be guided by his cognitive process by how he reads and interpret the environment; not always by the goal he's seeking, "man, is almost all instances and situations is a cognizing and goal-directed organism".

In sum up Cognition is the mental processing of sensory information that involves the activities of thinking about, remembering and evaluating the information in a given environment; a process of perceiving, cognizing and recalling.

III.5.1 Cognition map

Cognitive, 'mental' map, conceptual spaces "schemata" "image" is a sketchy drawing people make of what they hold of information about an environment. As stated by Wohlwill "the environment is not in the head" but what is in the head is a representation of it, selective, sketchy, it may constitute an 'image' of the environment (Wohlwill and Weisman, 1981). This would imply the process of perception and memorization of events and objects encountered. Therefore the information is schematic or an abstraction of the real world. For Kaplan (cognition and the environment) a cognitive map is a sort of accumulation or a summary of an experience that one had in a particular setting, a structure that holds information a person had about the environment (This map associated to the terms 'cognitive' or 'mental' refers not to the physical things in the world but to a pattern of stored information). He argues that the cognitive map, in opposite to the real map based on continuous space, is based on familiar objects and events, connected by disconnected paths. He stated that Cognition map could serve as an efficient tool for storing predictive information. Because what one needs is not only where one is but mainly where one is going.

Terrence R. Lee introduced the term 'schemata' consisting of an abstraction of the real world. According to him people construct schemata of the environment distinguishing between value (whatness) and location (whereness) of the objects in the environment "*whatness"*. 'Whereness' involves space that can be experienced as interval between objects. He argued spatial schemata are composed of multitude of layer of information about the environment such as the house, the neighborhood, the city, the country and so on. All these put together constitute the space we inhabit. Schemata are mainly useful for navigations within the environment. Meanwhile Manley talks about schema, which is the knowledge structure about an object, a building or an environment that he developed through past experience that he used it to test or to discover new situation (Kaplan and Kaplan, 1987).

III.5.2 Cognition and urban environment

III.5.2.1 Image, imageability and intelligibility

Initially the term 'cognitive map' was introduced by Tolman, in 1948, in an article entitled 'cognitive maps in animals and men'. Since then, it spread out through many fields such as sociology, psychology, and urban planning and design. In urban design, it was introduced by Kevin Lynch in his research and book, *the image of the city*. Lynch studied what people knew of their physical/spatial environment in three American cities-Boston, Jersey City and Los Angeles. Lynch's research aimed to see what forms of city make strong images. He started from the assumption that people know and use a city that is easy to read or legible. So the main goal of his research is to know how people understand the structure of their cities and how they use them. His investigation was carried out in two ways: a systematic field reconnaissance by a trained observer and interview with thirty or fifteen residents in each city. The research methodology was based on interviewing participants and asking them to draw a quick map of central part of the city.

The findings of this are that environment image is composed of three parts: identity, structure, and meaning. This is related to the process by which people apprehend their environment. First the *identity* level where People indentify features of the environment, second the *structure* level, they define and recognize a pattern of relationships between the features composing the environment, and third the *meaning* level, they express and evaluate emotionally the environment and its features (Lynch, 1960, p.15-90, p.140-159). Analyzing the maps and the descriptions provided by people, Lynch identified five elements of city images related to legibility; that people could recall of their city. He refers to *paths, edges, districts, nodes*, and *landmarks*: Path, the routes along which people travel (typically, roads, walkways; Edges, non travelled lines, such as cliffs, escarpments or shores of rivers, lakes, or oceans; districts, moderate-sized areas that city residents identify as having a particular character, Nodes, well-known points that people travel to and from often at the junctions of important paths, such as key intersections, transit terminals, and popular plazas or squares; Landmarks, easily viewed elements , either on a grand scale (e.g., the tallest building in town) or on a smaller scale (e.g., a statue or unique store front). In a related topic, Appleyard (1969) studied the inhabitants' maps of their local areas and the whole city of Ciudad Guyana, in

eastern Venezuela. The goal was to see how people structure their city. From people's maps interpretation he suggested that three types of relating parts of the city to each other (structuring), *association*, related to functional, people's attachment to physical features, *topological*, related to continuity and juncture of movement; and *positional* related to spatial placement, direction and distance.

So the elements identified by Lynch are the components of city legibility and imageability. They are which help people to apprehend and to build an image of their environment. He argued that legibility, which is 'the ease with which parts can be recognized and can be organized into a coherent pattern' (the image of the environment) is an important characteristics of the quality of the city. This quality is linked to people's life encompassing easiness of use of space, way-finding, and emotional and physical well-being both individually and socially. For him imageability of an environment is strongly linked to its legibility; imageability is "that quality in a physical object which gives it a high probability of evoking a strong image in any given observer it might be called legibility". Therefore the 'image' is the product both of immediate sensation and of the memory of past experience, and it is used to interpret information and to guide action. This image has wide practical and emotional importance to the individual (Kaplan, 1982).

III.5.2.2 Intelligibility in space syntax

For space syntax, a configured space is intelligible when its properties allow an immersed observer to comprehend it and make him able to find his way around it. Space syntax defines intelligibility as predictability of the global structure of an environment from a reading of its local properties; one property the most used is connectivity: the number of convex spaces directly accessible from a given convex space or the number of axial line.

How the space is comprehended and navigated by human being is requisite quality parameters of the environment, which is defined by "intelligibility. In The *Space is The Machine* (Hillier, 1996) Hillier argued "the property of 'intelligibility" means the degree of visual relationship between a space to the whole spaces making up the system; this is the integration of space to whole system. He considers that "An intelligible system is one in which well connected

spaces also tend to be well-integrated spaces" (Hillier, 1996 p. 129). This connectivity is 'axial' - sight lines- that are important for people's orientation because people move in lines. Therefore the intelligibility of space structure is intelligible only through movement. Hillier ads that due to the fact that urban space is never experienced all at once but piece by piece through movement, intelligibility is then related to the "picture of the whole system can be built up from its parts". Consequently intelligibility is linked to both the local properties of space and the global properties of space within a system. The degree of correlation between connectivity and integration values is an indicator of the predictability built into the entire environment through movement and therefore of its intelligibility.

III.6 SPATIAL EXPERIENCE

In his daily activity man experiences the environment by movement; walking from place to place. Experience involves perceptive, evaluative, and sensorial and orientation aspects related to man-environment interaction. Environment could be defined as buildings, trees, nature, urban features and so on; all physical elements.

Therefore, this experience is subject of a perceiving process and getting information from the surroundings. This involves an emotional and evaluative relationship to space. The perceptive process relies on one's senses, vision, hearing, smell and touch as a medium to experience and evaluate space. It is active and composed of four phases, cognitive, affective, interpretive and evaluative (Ittelson, 1973**)** (fig: III.7). Experience is an important issue in architecture and urban design because it is the basis to interpret, evaluate, or foresee any spatial design; it constitutes the feedback to a human oriented design.

Experience of environment is chiefly based on the sense of vision. It is not only useful to apprehend the environment but evoke people's memories and experience, and affect emotion (Cullen, 1966). Camillo Sitte (1945) emphasized on the quality of medieval cites' places (streets and squares) due to their geometry and configuration that offer an interesting visual experience and perception of spaces and buildings. Accordingly, he advocates that urban aesthetics is matter of a varied topological space, not geometrical, that is the font of a rich visual experience, spatial variations, a building and monument display (fig: III.8).

The Senses Considered as Perceptual Systems

Name	Mode of Attention	Receptive Units	Anatomy of the Organ	Activity of the Organ	Stimuli Available	External Information Obtained
Basic orienting system	General orientation	Mechanoreceptors	Vestibular organs	Body equilibrium	Forces of gravity and acceleration	Direction of gravity, being pushed
Auditory system	Listening	Mechanoreceptors	Cochlear organs with middle ear and auricle	Orienting to sounds	Vibration in the air	Nature and location of vibratory events
Haptic system	Touching	Mechanoreceptors and possibly thermoreceptors	Skin (including attachments and openings), joints (including ligaments), muscles (including tendons)	Exploration of many kinds	Deformations of tissues, configuration of joints, stretching of muscle fibers	Contact with the earth, mechanical encounters, object shapes, material states—solidity or viscosity
Taste-smell system	Smelling	Chemoreceptors	Nasal cavity (nose)	Sniffing	Composition of the medium	Nature of volatile sources
	Tasting	Chemo- and mechanoreceptors	Oral cavity (mouth)	Savoring	Composition of ingested objects	Nutritive and biochemical values
Visual system	Looking	Photoreceptors	Ocular mechanism (eyes, with intrinsic and extrinsic eye muscles, as related to the vestibular organs, the head, and the whole body)	Accommodation, pupillary adjustment, fixation, convergence, exploration	Variables of structure in ambient light	Everything that can be specified by the variables of optical structure (information about objects, animals, motions, events, and places)

Figure III. 7: Perceptual Systems, (Lang, 1987)

On the other hand Cordon Cullen in his book (the concise townscape) introduced the concept of ‘serial vision’. For him the scenery of town is revealed, by movement (walking), in ‘a series of jerks and revelations’ (fig: III, 9). He claimed that the quality of scenery is tied to how much hiding and unhiding scenes present in the environment contrary to “straight road has little impact because the initial view is soon digested and becomes monotonous” (Cullen, 1968, p 8).

Alexander (1979) argued that what the individual perceives to be ‘things’ (buildings, walls, streets, fences) during his daily experience of the environment are in fact a ‘patterns’ intersecting with other patterns. The ensemble and the layout of ‘things’ constitute a pattern that it is embedded in the patterns that surround it. Consequently the individual’s experience of a given environment is affected by the relationships and the arrangement of these ‘things’.

He also related the quality of the experience to the degree of contrast within the environment: difference between features would be alive through the 'drama of juxtaposition'. In the other side, he defined the experience to one's body in its environment as being 'inside/outside', 'in the middle of it', and so on. So he asserts that the experience is impacted by the degree of enclosure and exposure to the point 'the whole city becomes a plastic experience, a journey through pressures of vacuums, a sequence of exposures and enclosures, of constraints and relief'.

Experience could be defined by the psycho-sensory and physical transactions between man (user of the space) and the environment. Thus, these transactions encompass both perceptual and behavioral modes in interrelated way. When experiencing an environment man reacts emotionally and physically, these two reactions are inter-dependant. Experience is the outcome of environmental stimuli and personal experiences and values. Besides its nature itself, related to a particular environment, the experience is also influenced by personal characteristics inherent to aspects such as socio-cultural, cognitive, the previous experience, the age of the person (Amedeo, 2009). The perceived environment is therefore a biological and a socio-cultural product (Carmona et al 2003).

To explore people's experience of the urban environment, environmental psychology considered two approaches, phenomenology and semiotics. The former considers experience as 'active' where man chooses, organizes, interprets and acts in the environment. The latter as being 'passive' considers that man receives and 'reads' information sent by the environment. That is why The Phenomenologists, Husserl, Heidegger, Merlau-Ponty, focused on the concept 'intention' (consciousness) dealing with man's experience of the environment to understand how consciousness seizes the environment according to its own structure. However, semiotics centered their attention on how man decodes the messages which have b The mainstream of studies in many fields has a common ground base consisting first of understanding the impact of the environment(built or natural) on man's feeling, associated to its wellbeing, and its behavior in space(space selecting, moving, wayfinding and so on). This impact affects man on his psychological existence, affective and emotional aspect (Cullen, 1966) orientation in space (Schulz, 1971). Second how people perceive the environment and its feature, the process of perception. Any environment contains a myriad of physical and social stimuli that affect man's emotional state that consequently affects his behavior. So

these affects are experienced by man's five senses of touch, taste, smell, hearing and vision. The large literature considers that vision is the dominant sense and that the organization of human space is uniquely dependent on sight. Other senses expand and enrich visual space (Kaplan, 1987). They also reinforce each other to provide the intricately ordered and emotion-charged world in which we live (Tuan, 1977). Schulz (1971) argued that Seeing is not only a simple recording of light stimuli but also is a selection and creative process in which the environment stimuli are organized into flowing structures that provide signs and meaningful to the purposive user. Therefore, vision plays the dominant role and thus requires a particular attention related to experience.

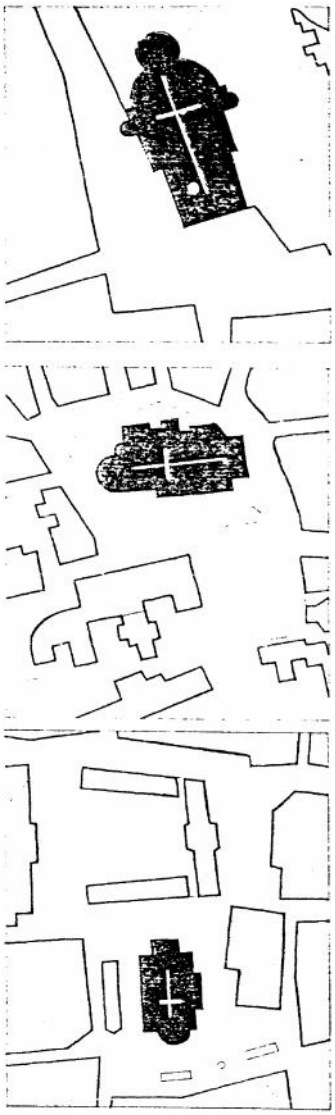


Figure III. 8: Sitte's monuments and buildings display, urban space visual experience (Gosling, 1984).

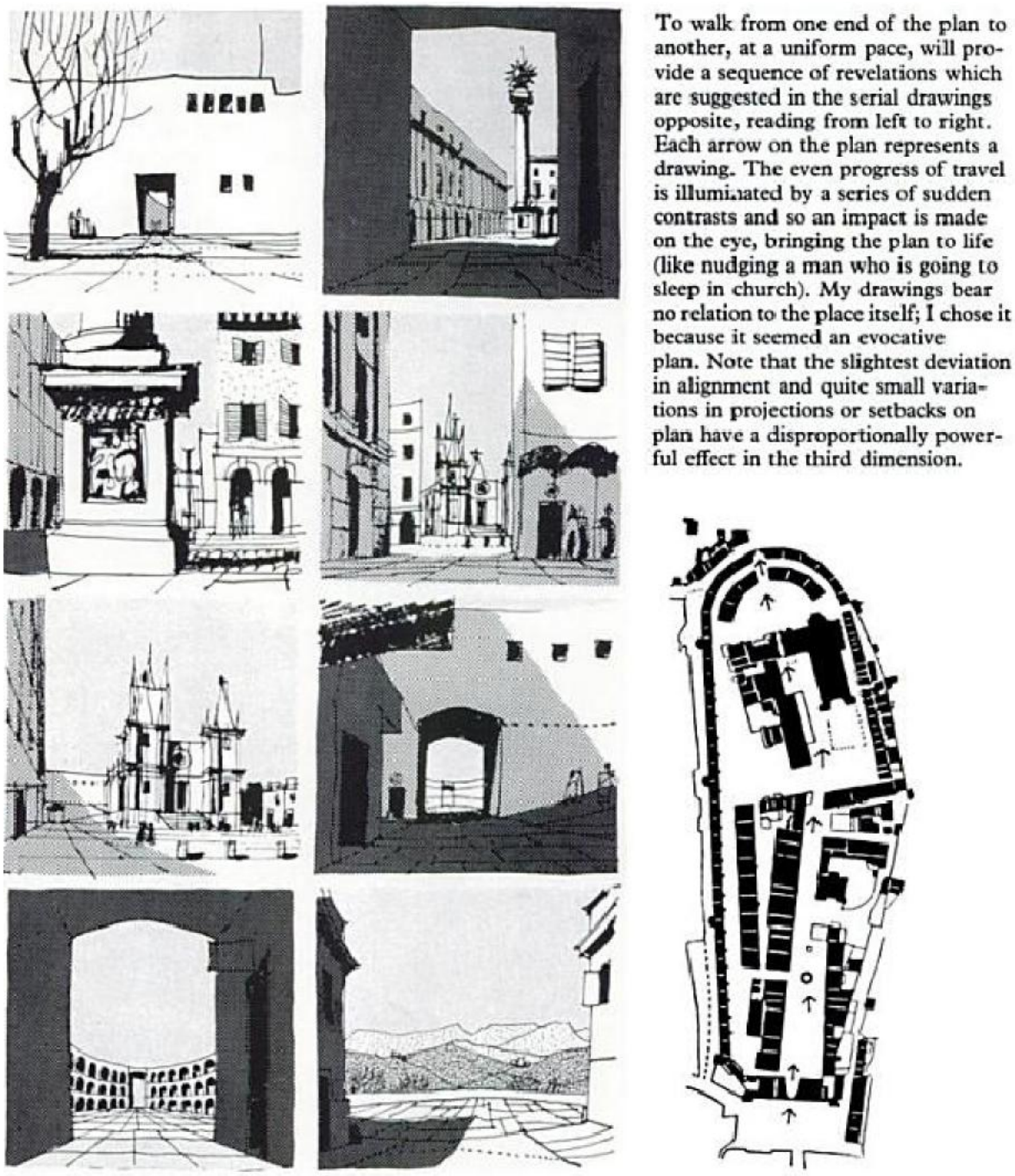


Figure III. 9: Gordon Cullen's serial vision (Cullen, 1961)

Experience of an environment implies movement from place to another. According to Dagobart (cited in Schulz, 1971) man's experience is bond to a space structured by means of goal and path; implying movement through space. In the same time Schulz defines man's existence to major elements 'goal' and 'path' that structure space, implying movement.

Therefore man's experience is tied to these two elements. He defines goals or foci places where man experiences the meaningful experience of his life. Paths are the means by which we experience the environment. for him a path could not be geometrically directed toward a goal but just preferred path, as termed by Kurt Lewin 'hodological' that might provide many characteristics such as ' maximum experience". Besides he adds that the quality of the experience of the path depends on the sequences of experiences and the value of the goal as he put it 'what happens along the way 'path' is added to the tension created by the goal'.

Therefore movement as a major means of experience implies the ability to learn from what one has undergone. This does not consider only the important things and places but on how they relate to each other (Tuan, 1977), called by Terrence Lee correspondingly as 'whatness' and 'whereness'; connectedness. This pattern of connections reveals the experience that one has had.

Thiel tried to scrutinize in details the person's experience of a built environment This was, in fact in a research on sequence notation of a physical environment throughout a spatial experience; a sequential experience of the physical environment. His investigation considered only vision as the chief sense despite the fact that experiences involving sensory perceptions other than the visual are well appreciated. He considers all components of the environment (objects and people) as parameters of experienceable physical environment; (P) the person experiencing the space, (EN) the physical environment, (S) space, (F) furnishing of space, (H) people. He argues that P's mode of experience in (S) is in motion (M) and for this motion to e purposeful, (P) must be able to orient himself in (S). As movement or motion (M) is important condition for spatial experience, it is referred to as change of position in space over time and, given an initial spatial location (as in latitude, longitude, and elevation), can be described in terms of time, distance, and direction. Therefore, through motion, a person could experience many simultaneous spaces (human occupiable space). Thiel identified three types of spaces: the primary space**,** The smallest space that is more explicitly established; subspaces, Smaller, less explicit spaces, are called; secondary spaces larger than the primary spaces. He remarked that a secondary space must not be confused with a view. Secondary spaces, like subspaces and primary spaces are by definition occupied by (P) (an in space), the implication here is that in these cases (P) is able to see all the elements which establish all these spaces. A view at the other hand (as an out-space) implies a partial visual relationship with a space. (Fig III.10).

Besides he introduced the concept of 'event' that he defines as the point at which any uniform, or uniformly varying, attribute such as rate, direction, slope, curvature, or distances changes. An event occurs when motion departs from, or returns to, movement in a straight and/or level path, or to any change in these changes.

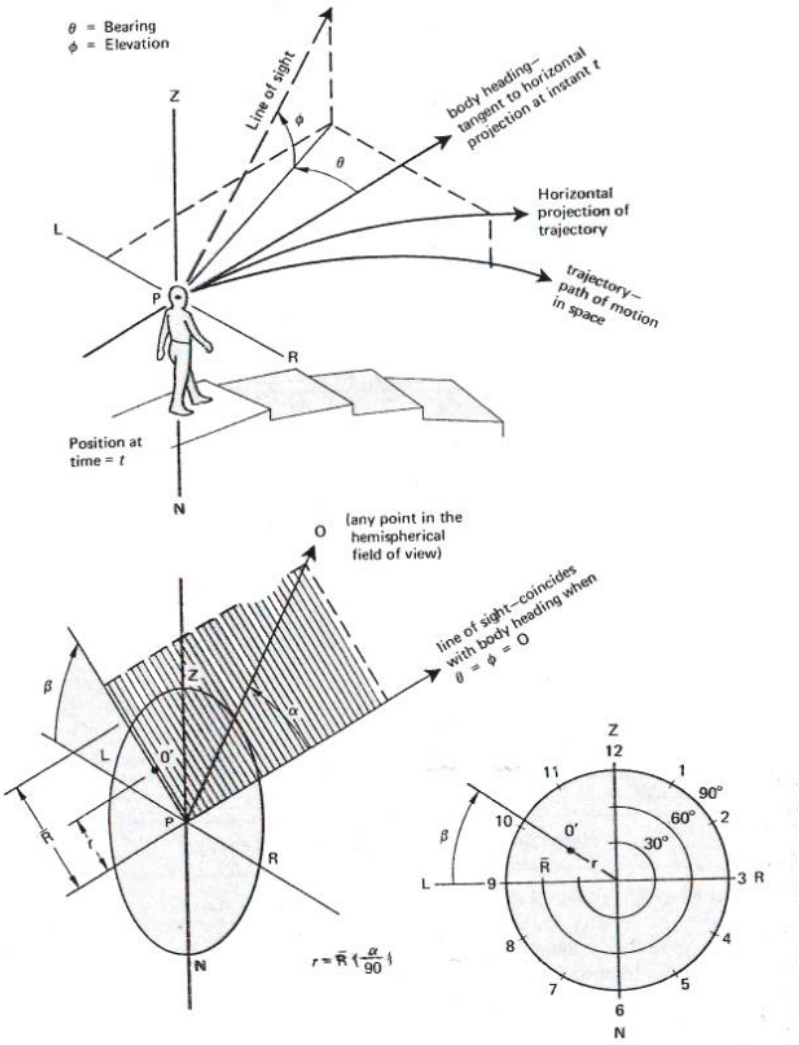


Figure III. 10: Thiel's representation of man's visual perception (experience) of space (Prohansky, 1970).

Gibson (1947) tried also to look into how a space or an environment is experienced (visually) by a person. Hence he divided the range of everyday space experience into two groups: *aerial space* and *local space***.** He defined *aerial space as* the visual surroundings extending away

from the observer and bounded in any direction by the horizon, the surface of the earth and the sky, and *local space as* a space enclosed by walls and restricted in range by them.

These spaces are connected by three categories of spaces the *end*, the *port* and the *merge.* a *merge* exists when two (or more)areas, runs, in a such a manner that there is no definite point of juncture, and one space merges or flows into the other. A *port* exists when a contradiction occurs when passing from one space into another. *An end* exists when the juncture of one space with another is neither a merge nor a port. A connection between two ports may be both a port and an end, depending on the direction the moving person (in Thiel, 1970). He stated that we perceive the world us in three dimensions, and that our perceived visual field encompasses approximately half this visual world. For him this field of view constitutes the 'environmental display' 'or 'scene' (fig: III.11).

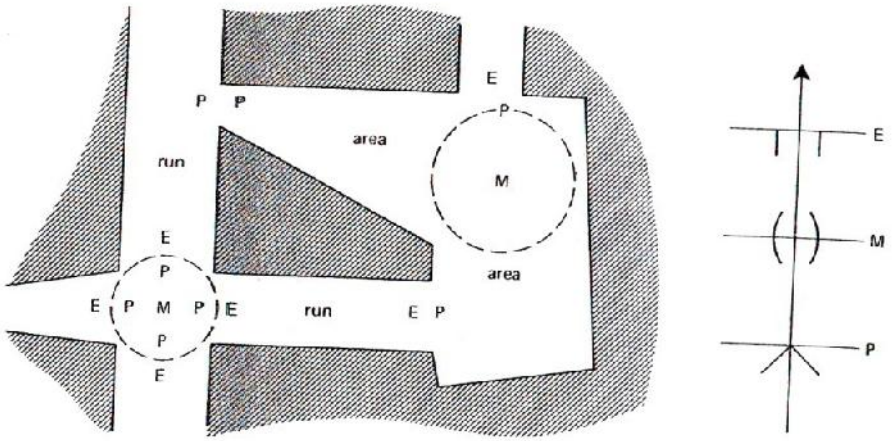


Figure III. 11: Gibson's depiction of man's experience of space; categories of spaces. (E) end space; (P) port space; (M) merge space. (Prohansky, 1970)

III.6.1 Space syntax and spatial experience

Space syntax believes that space has a great affect on people behavior, use of space and movement. Moreover, it defines space as a unit or a part dependant of the whole (other spaces) and that its properties depend of its 'linkability' or connectivity to the whole called configuration: "A set of relationship among things along things all which interdependent in an

overall structure" (Hillier, 1996). Hillier argues that the functioning and the use of o these spaces is related their isovist (visual) properties and that human space is no limited to the properties of individual spaces, but relates to the interrelation and interconnection between the many spaces that make up the Whole spatial layout (Hillier, 1996, 2000). Thus space syntax analysis consists of two basic conceptions. Convex space, or convex polygon, is a polygon that no line drawn between any pair of points within that polygon goes outside the polygon. Axial space or axial lines, is the longest line which links convex polygons, it's a straight line associated to the notion of visibility and movement. Hillier resumed man's interaction with space as "People move in lines, and tend to approximate lines in complex routes. Then if an individual stops to talk to a group of people, the group will collectively define a space in which all the people the first person can see can see each other and this in mathematical definition of convexity in space" (Hillier, 1986*).* This last space, despite its irregular shape, provides the possibility for people to see each from any point – this is called a convex space or a 'convex isovist'. Hillier argues that these shapes changes according the individual movement, and therefore define a key aspect of the individual experience of them (fig: III.12).For him movement, from origin to destination, is the potential for other (optional) activities that he termed as by-product effect. Hillier (1996) argues that this movement is affected by the space layout (urban grid) and its visual properties that itself represents a 'mechanism for generating by-product effect'; optional activities.

In studying the impact of the configuration of urban space on pedestrian movement, independently from other attraction theory parameters, Hillier suggests the concept of natural movement; 'natural movement' – the proportion of movement determined by the structure of the urban grid itself rather than by, for example, magnet land uses. The application of space syntax method has been used to cover a myriad and various issues that deal with the impact of spatial on human activities and behaviors in urban environments; pedestrian navigation, criminality space attractiveness and space use.

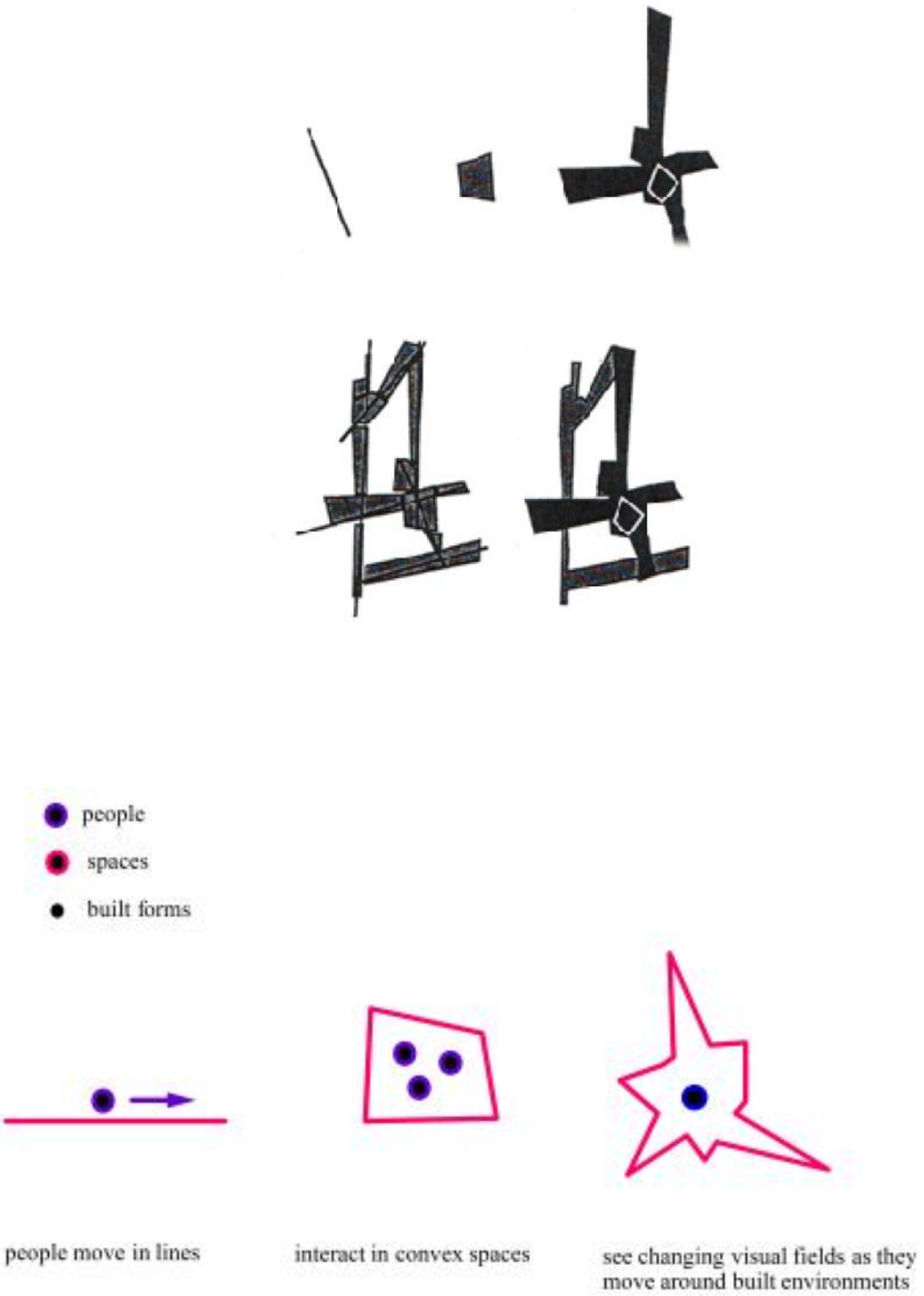


Figure III. 12: Hillier's representation of man's interaction with space; moves in lines, interacts in convex space, and sees the changing visual fields through movement.(Hillier, 1996)

Benedikt, looking for a precise way to represent space as experienced by the perceiver Benedikt introduced isovists. An isovist is ``the set of all points visible from a given vantage point in space and with respect to an environment" (Benedikt, 1979, page 47). He suggested that in order to grasp the actual human's experience many isovists might be needed; linear or field isovists. From this a set of measurements of the isovists properties could be extracted to quantify the spatial environment such as area, perimeter, and circularity that might, according to Benedikt could be of use in the study of behavior and perception. He argues that motion of the perceiver through space implies a number of changing isovists, creating an isovist field. And the different values extracted indicate some spatial properties of the space that induct a certain behavior of the perceiver. In their Research work, Wiener and Franz (2005) explored the role of isovists as predictors of spatial behaviors, suggesting the existence of strong correlations between some isovist measures and the way in which space is experienced. Dalton (2003) ,in studying people's navigation in space, found, using visibility graph analysis (VGA), found that people pauses during movement are pauses do not occur in a random manner but coincide with junction that offer more visual information; where the isovists are and where the observer take spatial decisions. So concerned with how to quantify space and what perception of space might be, Turner suggests that more than one isovists is needed, arguing that the way an individual experiences a space and how uses it is related to an interplay of isovists. From this, Turner developed a software package (Depthmap) capable of performing *Visibility Graph Analysis* (VGA). VGA entails a grid onto a space, and uses it to measure the relative mutual visibility among all the cells of the grid and consequently provides all spatial properties through 2D analyses. Numerous measures could be calculated either syntactic or isovist; integration, connectivity, perimeter, area and so on.

III.6.2 Isovists and perception

The various measurements extracted from isovists polygons such as the area, the perimeter, circularity and so on could be, according to Benedikt, used for the study of behavior and perception and for the identification of architectural archetype. These values vary through the space creating an 'isovist field'. In fact the perceptual quality of isovist fields was found in the seminal work of Gibson (1979) relevant to *optic flow*, which may guide an individual through

the landscape; he emphasizes the importance of movement in the perception of the environment. Hence Benedikt sees that the variance of the isovist field may be used in studying perception and behavior; When contour lines are closely crammed means a situation of changing view in which the user may either take the shortest path (estimated) or proceed slowly in order to take new vista; the user's behavior is dependant to its visual perception of the environment. Benedikt and Burham (1985) work on correlation between isovists properties and perception showed that perceived value of 'spaciousness' related to complexity of the isovist; the richness of vistas (sight lines) towards the surrounding rather than to the area of isovist, a panoramic view.

CONCLUSION

Many attempts have been launched to define and to explain perception. All these attempts stressed the importance of perception in man-environment interaction; using or experiencing an environment either natural or built. According to Lang (1987) these attempts could be set into two trends: one emphasizes on the reception of sensory experience and the other on the senses as active and interrelated systems. The former is concerned about how the sense information is put together in the brain; however the latter, the ecological approach (Gibson), is concerned with the information generated by the environment as experienced by the individual, it is an information based theory. Though, Gibson stressed the importance of the sensory experience that he considered as a by-product rather than 'building a blocks of perception'.

The environmental perception is a process that implies the interaction of physical context, the cognitive, the affective and the evaluative aspect of the environment. Movement (motion) plays a great role in environmental perception; to discover and experience the environment- as explained by Gibson's theory.

So experiencing an environment involves a cognitive aspect. First, cognition focuses on the acquisitions, organization and storage of knowledge (images), for eventual use 'schemata' (Neisser, 1977); the city's, imageability and legibility concept developed by Lynch (1960). Second, it focuses on the *affect* that deals with emotion and concerned with an evaluative

aspect of like and dislike made by the individual in term aesthetics of environment (natural and built) that may involve the choices he makes in the use of the environment.

The environmental perception is extremely linked to human behavior study, because the individual's behavior is, principally, a function of his direct perception of the environment. Many concepts inherent to perception and the people's behavior or use of space have been developed such behavioral, setting, environmental affordances, and preferences.

Various researchers attempted to understand and to explain the spatial experience as lived by man in his daily activity. All of them agree that it is a perceiving process and getting information from the surrounding and that perception process relies on the individual's senses. Nevertheless vision plays the major role to apprehend and to evoke memories and experiences. Spatial experience involves movement or motion (movement of parts of the body or to travel from place to place) as a requisite condition. Furthermore it engages an emotional and evaluative relationship to space.

Gordon Cullen introduced the concept of 'serial vision) and the effect of hiding and unhiding generated by the configuration of the built environment. He argued that the; environment is apprehended bit by bit; in series of sequences. Alexander put forward the concept of pattern, explaining that what the individual perceives during his daily experience is things (buildings, walls, streets, fences). The layout of 'things' constitute a pattern. Consequently the individual's experience of a given environment is affected by the relationships and the arrangement of these 'things'- a pattern that may be intersecting with other patterns. Schulz defines the individual's spatial experience to 'goal' and 'path' that structure the space. He defines goals or foci places where man experiences the meaningful experience of his life. Paths are the means by which we experience the environment. In a pragmatic way, Thiel's researches on sequence notations of a physical environment aimed to scrutinize in details the person experience of a built environment. He introduced the concept of *primary* and *secondary* space, and the *event*. He emphasized on the sequential experience of the physical environment. In the same standpoint, Gibson divided the range of everyday space experience into group: the *aerial* and the *local* space which are connected by three categories of space: the *end*, the *port*, and the *merge*.

Lynch and Appleyard, concerned with the legibility and imageability of the city; studied how people understand the structure of their cities and how they use them. He found that the environment image is composed of three parts: *identity, structure*, and *meaning*. He argued that these parts are related to the process by which people apprehend and experience their cities. He also identified five elements inherent to the city image and to people's city experience: paths, edges districts, nodes and landmarks.

Space syntax theory states that people's behavior and spatial experience is greatly affected by the spatial layouts. It defines space as a unit or 'part' dependant on the whole (other spaces). Hillier argues that the functioning and the use of o these spaces is related their isovist (visual) properties and that human space as experienced is no limited to the properties of individual spaces, but relates to the interrelation and interconnection between the many spaces that make up the Whole spatial layout (Hillier, 1996, 2000). So people experience the environment (while moving) as changing 'visual fields' generated by the space configuration. This is represents the isovist concept introduced by Benedict to quantify how people experience actually a given space.

CHAPTER IV

URBAN SPACE EVALUATION: Methods and Analytical Tools

INTRODUCTION

Environment either landscape, architecture, or urban environment have been the subject of evaluation from different fields; urban design, psychology and sociology. For instance in architecture and urban environment, investigations goals cover an innumerable ranges of topics such ambiences (acoustic, light), space perception (spaciousness, spatial orientation), spatial cognition and aesthetic evaluations. All these investigations called for a variety of evaluation instruments. It is important to mention that despite the diversity of topics of investigations and their goals, the same investigations' tools may be used by different methods and theories of research fields. Furthermore a research study may combine or overlap many tools and techniques. So in the thesis the definition of tools will be set respectively to the development of this chapter.

IV.1 URBAN SPACE EVALUATION METHODS

IV.1.1 Behavior, spatial use evaluation and analytical tools

People behavior in space has been the center of interest of many fields such as, among others, psychology, sociology, architecture and urban design. So the aim is to understand on one hand human behaviors, perception of the environment and on the other hand the affect of this latter on his behaviors. So to have deep knowledge of this interaction between man and his environment many research and analytical methods have been developed. Behaviors could range from man's attitudes **(**Baker in Gifford, 1997, p 6-15) to how he uses space to achieve his purposes. The main matter in architecture and urban design as well as the topic of this dissertation is people's space use; does space work as intended and believed by designers? The understanding of this key question constitutes the chief way to improve people's wellbeing. Because space is one of the major things that define man's existence as put by Sherwood L. Washburn 'man is remarkable among the primates in that he requires homesite, a location where he can go back and a place that he will be there every night' (Washburn in Kaplan, 1987, p14). Understanding human space use has become a requisite analytical step in design process to be developed.

IV.1.1.1 Observation: direct observation (in situ)

Observation is to get information about people's behavior within a given environment. Observation could be experimental in laboratory simulating the real world or direct or in-situ observation (in the real-world). This is used in many correlatioanal research methods that aim to clarify the relationship between multitudes of the real-world variables. Variables mean the variety of characteristics inherent either to physical features, people, activities or meaning (Groat, 2002). These variables change according to the circumstances of the setting being studied and consequently affect the socio-physical interaction.

The observation could be extended to categorical measurements, the variable of interest is sorted into distinct categories of activities or behavior such as sitting, standing, walking. Other measurements could be sought, by such as ratio, primarily to understand and predict relationships among several variables.

Direct Observation (in-situ observation) is the best way to get information about people behavior. It consists of observing people rather than asking them about their activities. So this observation technique requires suitable tools suitable in order to collect and record the information related to the research's goal. Tools could be either from naked-eye observation coupled with mapping to record people interaction with the setting or using cameras or video cameras to track people's behavior (Moser and Weiss, 2003) .The information and the data acquired from observations permits the extraction of many measures such as, number of people counting, people distribution, specific behaviors and so on. This technique suggests that the exact distance (or interval) between one measurement (observation) and another must be specified. This method has been used in many research studies aiming to understand the interaction between people and their physical setting. The following cases studies give a hint about the applicability and the results that would be useful to the present dissertation. This method has been first applied to urban space by Whyte who wanted to understand why and suggest guidelines for the design of successful plazas. And he also wanted to understand the behavioral dynamics of plaza use, and in particular to find what physical features would encourage their use.

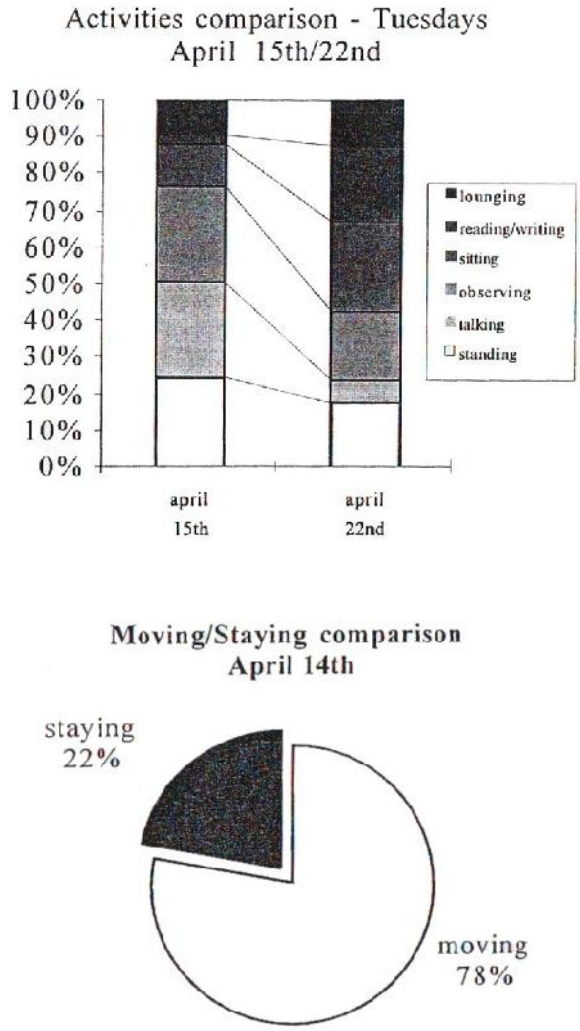


Figure IV. 1: Whyte's research results of activity patterns (Prohansky, 1970)

So he and his team conducted a six-month study involving intensive observation of 18 representative plazas, counting the people using the space at specified time intervals with the aid of a video camera. By charting plazas use as a function of certain physical variables, they were able to identify several key design elements. Chief among them was the availability of sitting places. To support his analysis, Whyte presented charts that compared plaza use (number of people at the lunch hour) with the amount of open space available in each of the 18 plazas; there is no obvious relationship. However, a similar chart comparing plaza use with the amount of sittible space demonstrated that these two variables were more closely related (fig: IV.1). The collected data documented how people were using a given plaza at lunch

hour. And one he indentified ‘sittable space’ as a key physical features, he could measure such attributes as the total lineal feet of sitting space and its various dimensions.

The second case study was carried out by Groat and her students in what she qualified as a non-random assignment in Quasi-Experimental Research. So goal of the research is to look into the problem of a small gallery added to an existing building that is supposed to function as an exhibit space and a lounge space for both faculty and students. It was observed that this space was underused. So how to make this space more used as a gathering space was the key question. The proposition was fist to improve a visibility matter by putting small screening element to block the view through the glass wall along the door way side of the space (to create more visual privacy); and second was to change the layout of furniture to be less formal and introducing some plants in order to create an ‘inviting’ ambience. The investigation was based on two types of observations of the space use: the first consisted of recording people’s use of space in its existing conditions; and the second recording its use under the experimental treatment. The observation was made one weekday of two successive weeks. The observation duration is of 15mintes, staring at the half-hour and ending at 45 minutes after the hour; from 8:30 am to 7:30 pm. The observations were recorded on one-page observation sheet that included the following information: number of people using the space, a plan of the gallery in which people’s movement and activities were mapped; and a coding system by which people’s specific activities could be described (i.e. speaking, writing/reading, sleeping). It was found that the number of people using the space did not change substantially but the average amount time each person spent in the gallery.

In space syntax method, the direct observation is a basic tool in space –behavior analysis. Since understanding people and their interaction with space is the foundation space syntax theory, people observations is an important step in the analysis process. There are two important techniques of observation: Gate count and snapshot. For both of them, people observation may be coupled with some other factors, the observation period, the observations interval, time, weather, categorical observation (what activity or behavior?).

.

IV.1.1.2 Gatecount

Gate Count is used to record observations of moving people or vehicles at specific locations within a city or within interior spaces of building. A gate is a conceptual line (fictive) across a street or a space; the observer stands on that line to count the number of people crossing the gate in either direction (see appendices). The observer is appointed to the space to be observed and given a prepared table pad tailored to the nature of the study being undertaken; encompassing number of people, activity categories. Then he just record on that table each person passed by putting down one stroke. This method is well explained on a document released by space syntax in June 2005.

IV.1.1.3 Snapshot

The term snapshot originally means a photograph that is taken quickly and casually (on line dictionary: thesaurus). Its meaning is different from discipline to another. But, in general, snapshot is an operation that allows information to be collected from different periods of time and also to give a concise idea of place or situation is like. In all fields that interested in people and space interaction, snapshot method is a recording and representation of people either in stationary or moving activities according to their locations in space. So it gives an understanding on how people use a particular space.

Space syntax researches use this method to understand how a space either interior or exterior space works; the kinds of activities, people movement, people distribution throughout space and so on. Generally, the snapshot is a series of short-period observation over one single or over many days. The observer is given a prepared plan of the space to be observed. He proceeds by just counting people or also the precise location in space or the type of the going on activity. This is linked to the nature of the study being undertaken.

IV.1.1.4 Behavior Mapping

It is a technique that is concerned with collecting of information in the field in which data of people's behavior are recorded on a prepared map by the observer (s). It is used in many fields and research areas, to see the person-space transactions. It consists or recording type of activities, the number of people and their exact locations within the studied space (Moser and Weiss, 2003). So it consists of identifying the spaces where occur certain behaviors. This localization enables to look for any correlation between the characteristics of spatial environment and the behavior patterns (Fig: IV.2). In term of space function, investigations are always centered on what makes some spaces very used by people and others underused. So Analysis of the space from the point of using the place by people indicates which places in the examined area are among those attractive for people and frequented by them, and, on the contrary, which of them stay empty.

The investigation could be done on one site (intra-site) or on a number of sites (inter-sites).On one site (intra-site) the observation permits to see how a behavior pattern is spread over the different regions composing space. Comparison of these regions enables to understand the dependence of a certain behavior with specific spatial characteristics.

The inter-site comparison is effective when the aim is to show the similitude between different sites and the stability of the relation between behavior patterns and particular characteristics in different contexts. More than one mapping might be required for an analytical study. This is linked to the research objectives e.g. Beatriz analysis of 12 public spaces in the city of London focused on static people and non-static; concerned with the subject choice in selecting a specific space for a stationary activity or a specific itinerary for moving stationary: activity mapping and movement mapping have been set up (Example cited earlier).

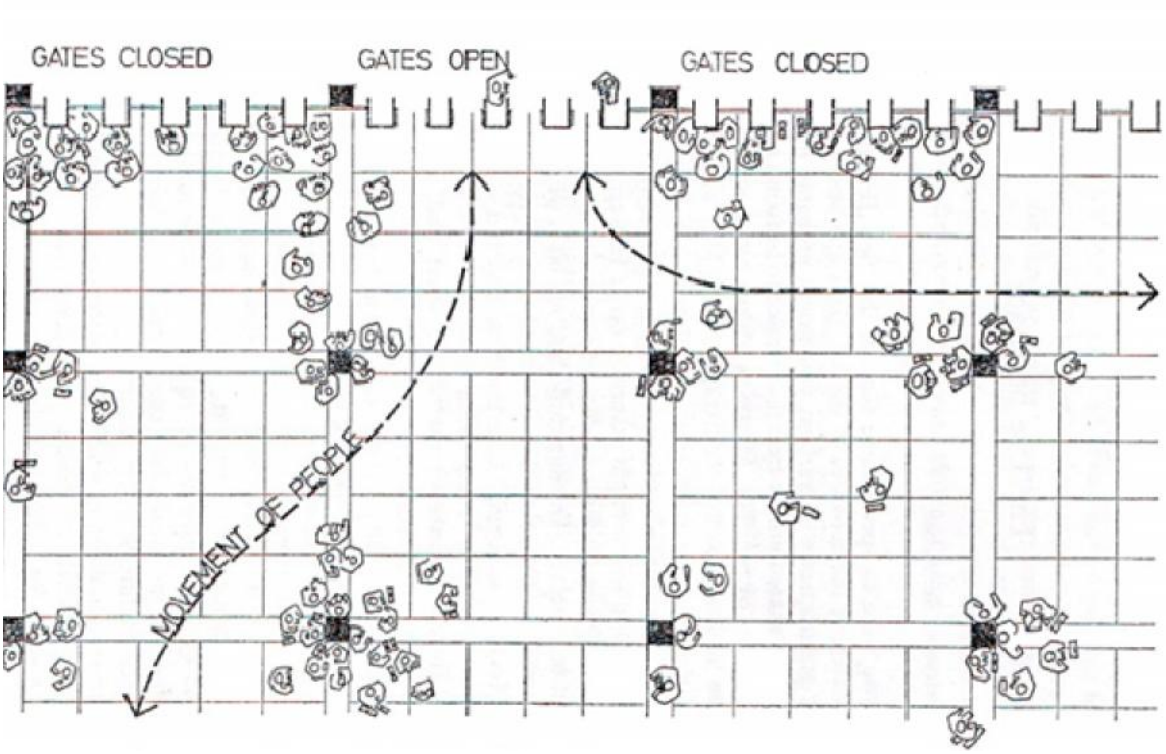


Figure IV. 2: Behavior mapping, people's location -waiting in railway station, (Canter, 1977)

IV.1.2 Sensory: ambiences, Preferences and aesthetics appraisal: analytic tools

IV.1.2.1 The commented walk and 'sensory path'

It is a technique centered on the individual perception of a certain environment. It allows having affective evaluation which will be associated sequentially to different spaces. The subject is asked to concentrate more consciously only on one sense and record his impressions while walking through a given environment. It is an in-situ experience where the subject is asked to walk either randomly or along a specific itinerary selected in the environment to be studied. The procedure may be repeated for each sense. Immediately after each walk the subject is asked to give his impression and feeling acquired from the sense being 'used'. The collected information is gathered and associated to spatial sequences. (Moser and Weiss, 2003)

The commented walk was first used by Kevin Lynch and Malcom Rivkin in a research at MIT linked to urban perception called 'a walk around the block'. They tried to understand what the ordinary individual perceive in his landscape and what makes the strongest impression on

him. Twenty seven participants took part in this research. Each one is asked to walk according to a specific itinerary (along the interviewer), from the corner of Berkley on and Bosylton streets in Boston, and at each time must to respond to the interviewer about things he sees, hears, or smells; everything he notices. All the responses are recorded by means of a tiny microphone attached to the participant's lapel. After each walk the participant was tested for their memories of the events, both verbally and through photographic recognition. This method uncovered many things about spatial perception; the fundamental impressions for all the participants came from individual buildings, open spaces and vegetation. However, few participants talked about the weather, sounds and smells. This method did not focus on one sense as defined earlier but was 'open' to all senses; perception.

However Jean-Paul Thibaud, a researcher at Cresson, developed on a similar method 'Le parcours commenté' with more focus on urban ambiences. It is an in-situ approach for ambiences appraisal. So he developed the concept of 'intersensorialité' that he defines as 'the crossing of all senses'; how the individual perceives the real world. So the method consists defining a path in a given environment to study. A place of departure, an itinerary and a place of arrival are to be determined. The participant is asked to walk along this path for a 20 minute-duration. He's requested to describe what he perceives using all senses about ambiences (light, temperature, odors...) along his walk. He is also allowed to stop anywhere at any time during the walk to describe what he perceives yet has to describe his location by giving some spatial cues. All his impressions are recorded using a tape recorder. At the end of the walk all data would give indications on what he perceived and how he perceived in-situ (Adolphe, 1998).

Moreover this method has been used also to see how blind (sightless) people perceive space (Thomas, 1996). The research center Cresson in Grenoble explored various topics related to perception of interior public spaces (e.g. M. Saraiva, l'environnement sensorial dans l'aménagement museographique) and urban spaces using the method of 'le parcours commenté'.

IV.1.2.2 Sorting

Sorting is method investigate people perception and aesthetics of urban environment through vision. This investigation could be achieved through two ways: representation or simulation. Representation means a fixed image such as photos architectural drawings, video film that stand for a real object or environment. However simulation is an imitation of the real-world or just a fictive environment by implying a manipulation of factors that imply changes, a dynamic interaction (Fig:IV.3).

Nasar's researches (1988) in environmental perception and aesthetics used static representations of the environment either in the form of photographs or slides. Stamps (1990) (in Millon et al, 2003, p. 432) has found, in measuring perception of real versus photographed environments, that responses to color photographs and slides are alike to those obtained from perceiver in real environment from which the image was captured. Despite the accuracy (vis-à-vis the real) this method of environment evaluating is criticized by its 'static' aspect (from a fixed location) that does not represent the way the individual's experience as moving perceivers through the environment. However in another study of environmental scenes evaluation, Nasar (2000) used, in comparative way, dynamic displays consisting of videotaped segments taken along a route presenting transition events, and static displays as 'freeze' frames of each segment. He found that participants responded differently to static and dynamic displays of the landscape. It showed that the dynamic displays were rated significantly higher than static displays on the epistemic variables; mainly the ones related to exploration and curiosity.

IV.1.2.3 Check-list/ Multi-scaling

The individual stimuli that determine an environmental evaluation may be presented in a number of different methods: these instruments encompass the use of; *adjectives checklist* (where participants are asked to check, from a given checklist, appropriate adjectives to the environment under examination (Bechtel 1987), *multiple sort tasks* where participants are asked to make discrete categorization of a set of elements based upon considerations of the perceived similarities among the elements (Groat, 1982*), bipolar scales* participants are asked

to evaluate an environment and then place a check in the space indicative of how close that environment is to either adjective *(Bechtel, 1987) and unipolar scales,* participants are asked to evaluate the environment according to the adjectives provided , and then responding using 05 point-rating scale. (Fig: IV.4)

Besides these instruments, other techniques are used such static perceptual simulation that reproduces specific environment through drawings, sketches, and photographs, while dynamic perceptual simulation involves film tours of scale models of places and videotape simulation (Nasar, 1982).

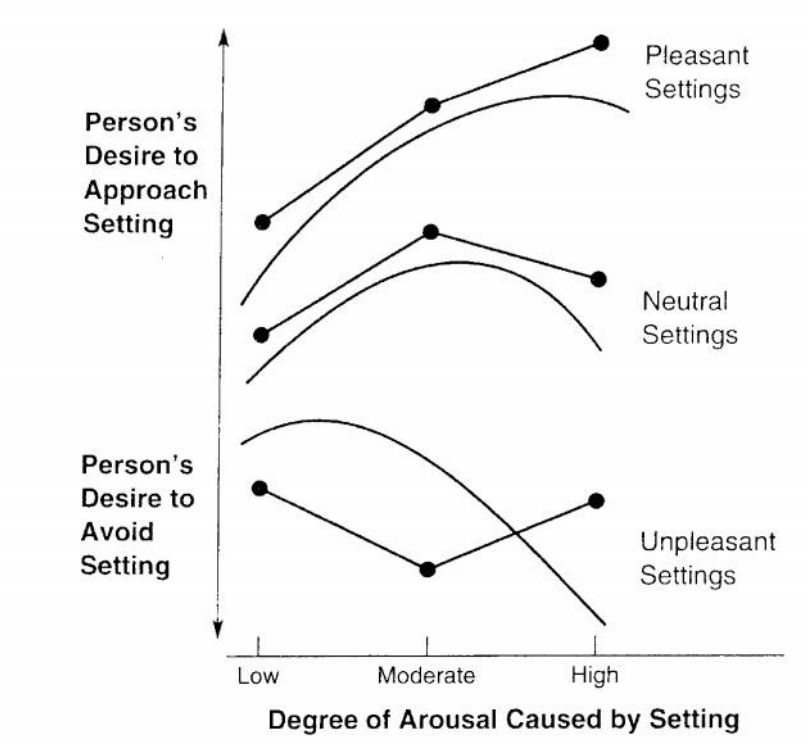


Figure IV. 3: Setting use in correlation to the degree of arousal (Gifford, 1997)

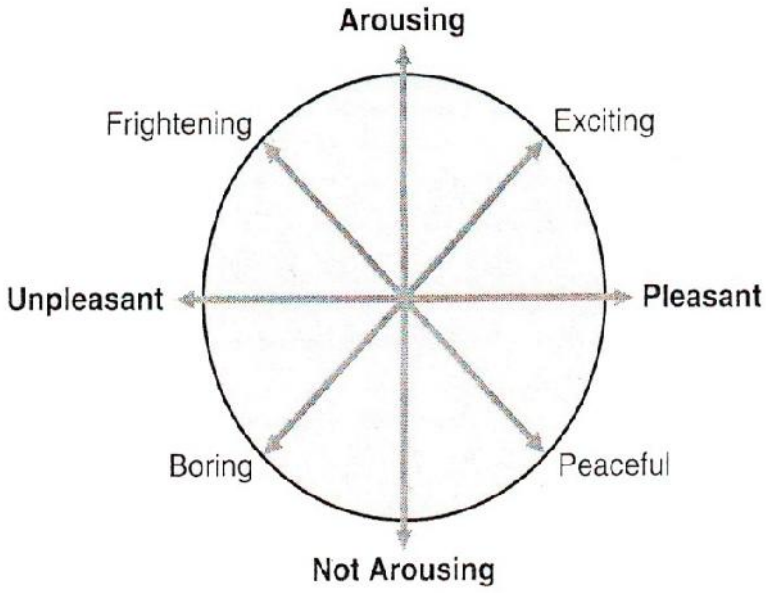


Figure IV.4: J. Russels and A. Mehrabian : emotional response to an environment; Basis for environment evaluation through man's perception (Kaplan, 1987)

IV.1.2.4 Preferences and aesthetics appraisals: photos, sketches, and film videos

In another type of study, related to could be related to path evaluation and people preferences, Anne Lusk wanted to find out the frequency of and distance between 'destination' and places along the greenway path. She selected six known greenways according to their aesthetic qualities. At each site, she asked greenway users to apply a sticker representing a different quality of physical features to the greenway map that she provided. So the user's maps enabled her to determine and measure the distances between collectively established destination points. Then distances for each greenway were established and then general patterns for each greenway type were identified (Fig: IV.5). She found that destination in a place where multiple features of interest converge, shady place, pictorial view of the mountain and so on (Groat, 2002).

Other techniques are used to measure people's aesthetic appraisal of a given building or environment. It consists, for instance, of static perceptual simulation that reproduces specific environment through drawings, sketches, and photographs, or dynamic perceptual simulation involves film tours of scale models of places and videotape simulation (Nasar, 1982).

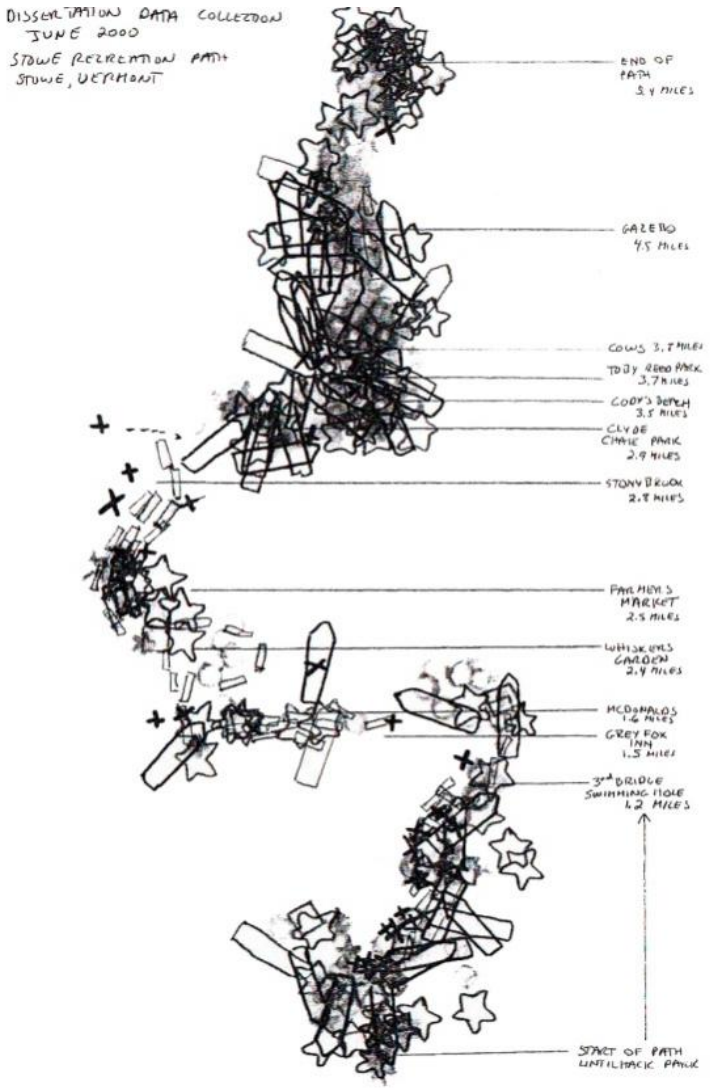
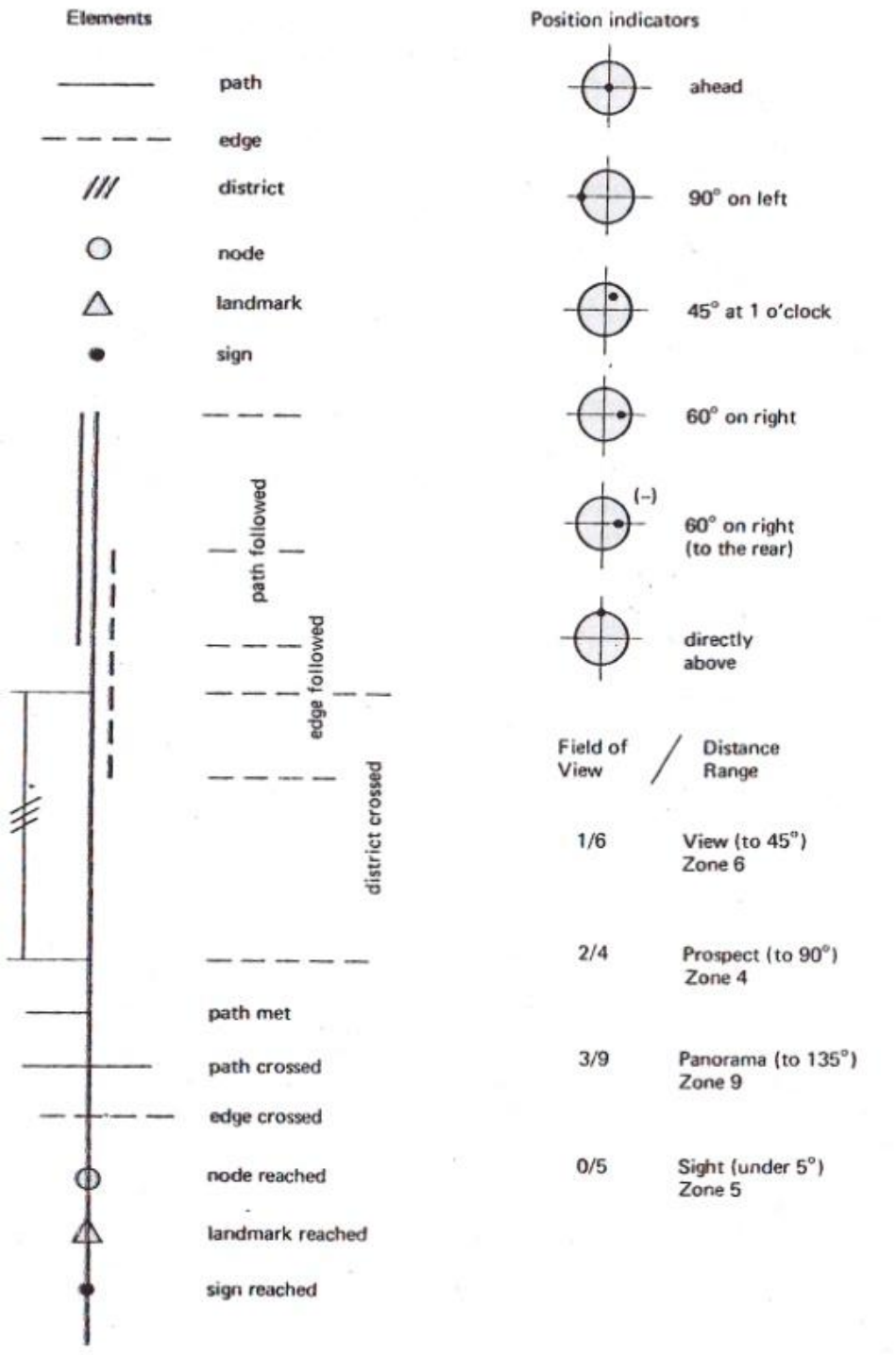


Figure IV.5: Anne Lusk, site aesthetic evaluation; map with stickers representing different qualities elaborated by site appraisal a participant (Groat, 2002).

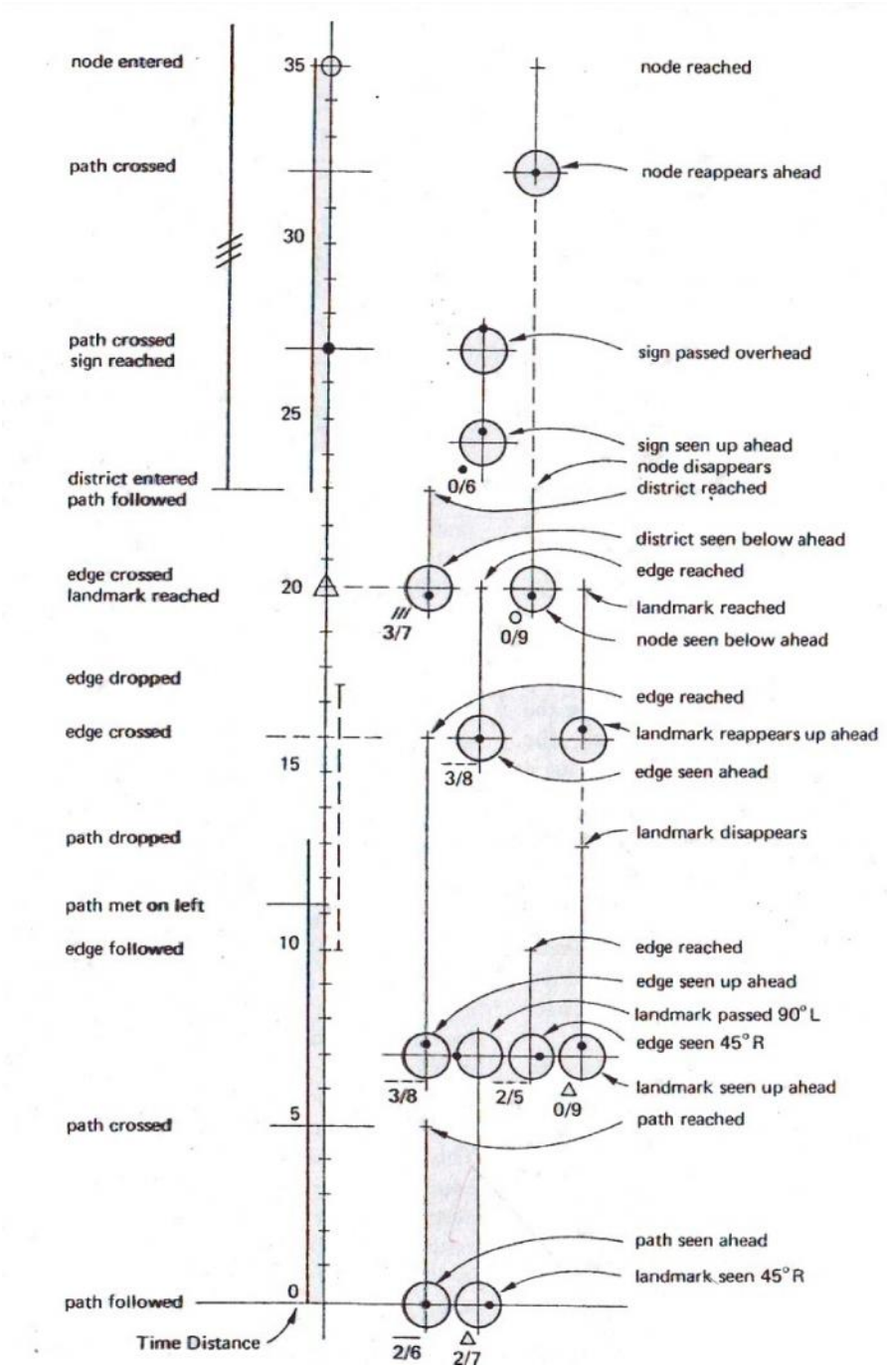
IV.1.3 Space, cognition and perception: cognition map and urban environment

Since cognition theory has been developed in the chapter perception of this thesis, emphasis will be, in this section, on cognition and the urban environment. In psychology spatial cognition involves the information-processing perception of the visual perception (Kaplan, 1982). It implies memory; that of recalling or recollecting information from an environment experience (objects, events, places). Gibson (1979) linked this to the individual's visual perception in picking up the sort of information one might need to function in the physical environment; sort of landmarks. Thus every individual holds in his mind a 'partial' representation of a larger real-world environment; 'for a given space many maps are possible' (Kaplan, 1977). Among terms used to describe this representation are 'schema', 'spatial schemata', 'generic map' 'mental map', 'cognitive map'. However, Thiel's research was oriented towards space notation as experienced by the individual (Fig: IV.6). In general, space cognition is inherent way-finding and navigation in built-environment and environment legibility (Lynch).

For the sake of this dissertation focus will be on the cognitive map that has been used in a variety of disciplines such an anthropology, psychology, sociology and so on. Its use in design was initiated by Lynch's work. So he introduced this technique to study the image of the city; as hold by people (Fig: IV.7). The goal is to assess the way the physical characteristics of the cities of Boston, Jersey City and Los Angeles cities were experienced and understood by inhabitants. He simply interviewed and asked residents to sketch maps of their city. Then he drew a composite map derived from the residents' sketch maps and another one derived from the interviews. He found that there is a very high correlation between the two sets of maps for all three cities. From these maps lynch derived the important five categories of urban features; path, edge, node, landmark, and district.


Elements
path
edge
district
node
landmark
sign
path followed
edge followed
district crossed
path met
path crossed
edge crossed
node reached
landmark reached
sign reached
Position indicators
ahead
90° on left
45° at 1 o'clock
60° on right
(–)
60° on right
(to the rear)
directly
above
Field of View / Distance Range
1/6
View (to 45°)
Zone 6
2/4
Prospect (to 90°)
Zone 4
3/9
Panorama (to 135°)
Zone 9
0/5
Sight (under 5°)
Zone 5

a)



b)

Figure IV.6: a and b, Thiel's 'space notation' (Prohansky, 1970)

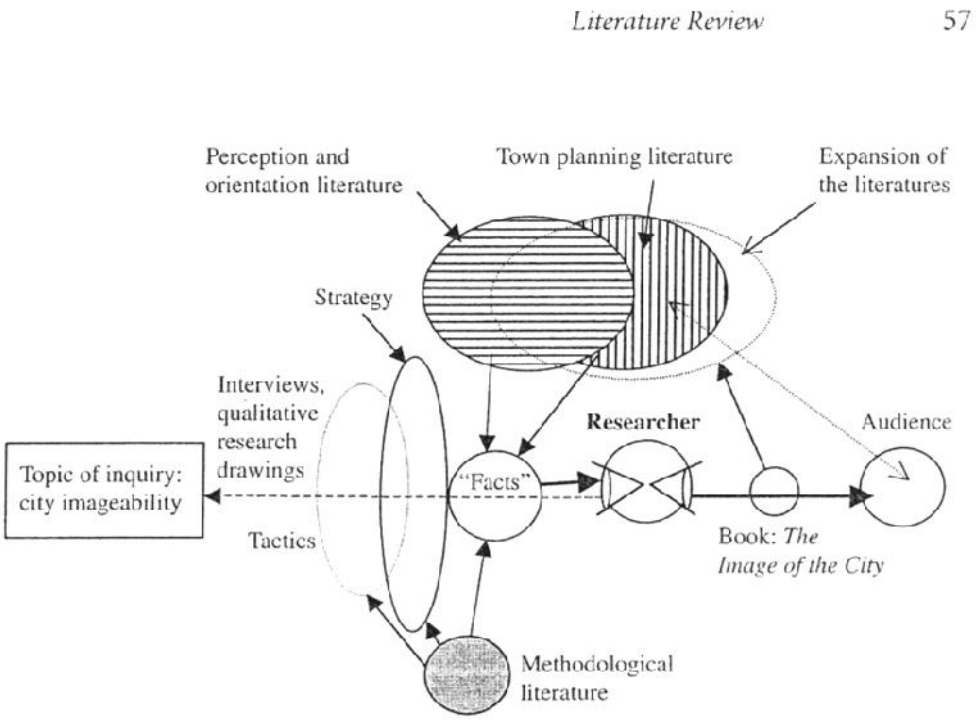
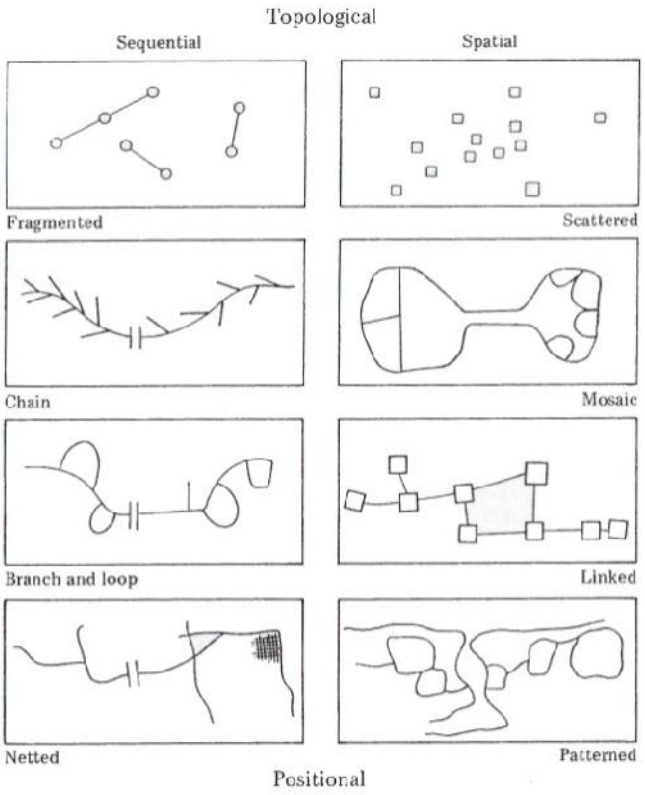


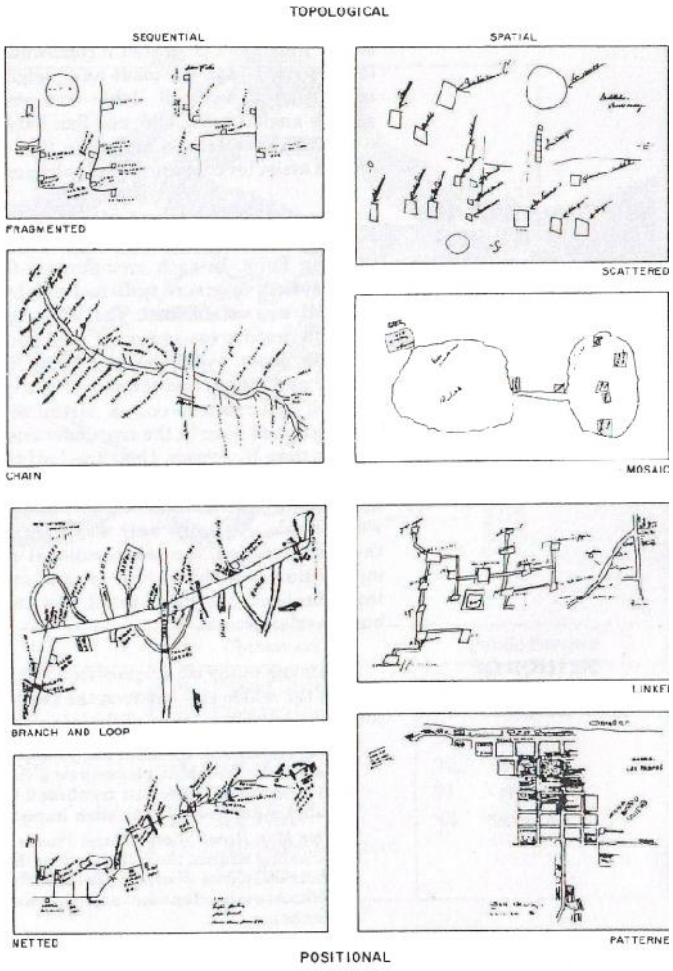
Figure IV.7: Diagrammatic of Kevin Lynch's research in image of the city (Groat, 2002)

In a similar study, Donald Appleyard (1976) carried out a study of the inhabitants' map of their local areas and the whole city of Ciudad Guayana in Venezuela. The method of investigation consisted, among many other questions, of asking respondents to draw a map of the whole city and a map of their local area. Then he classified the maps into two categories according to the type of element predominantly used and the level of accuracy. He found that the maps predominately used sequential elements (roads) and spatial elements (individual buildings, landmarks or districts). He also identifies four subtypes from each of these two map types: *fragment, chain, branch and loop*, network; and *scatter and cluster, mosaic, link, pattern* (see figure. The results confirmed Lynch's results that cities could be understood and structured by different elements, either sequential or spatial. Besides this;, he extracted from the map interpretations and the field surveys three methods of relating parts of the city: the *associational* (association and patterning of functional, social and physical character), the *topological* (junction and continuity of movement), and the *positional* (spatial placement, direction and distance). He concludes that people structure the city in varyingly schematic ways due more to cognitive differences, travel mode, and familiarity with the place. He found

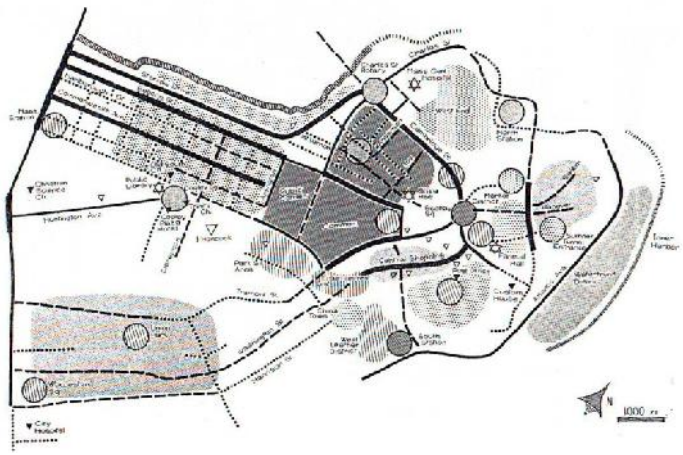
the mental map is a rich source of information about urban perception, mainly when it is coupled with field surveys of the visible, functional, and social character of the city. Nevertheless he stated that mental maps do no indicate visual imagery and he recommended to find other devices to find how people structure visually their cities such as 'photo-sorting, film recognition travel through the city as part of the interview, together with questions on route planning, route choice, and route imaging'.



a)



b)



c)

Figure IV.8: Cognitive map, a), b) Appleyard's maps classification, c) Lynch's mental map (Marion, 2001)

IV.2 SPACE SYNTAX AND ISOVISTS THEORIES

IV.2.1 Space syntax theory: measurements, analytic tools and urban environment

As mentioned earlier the aim of space syntax was to find out the problem in social housing in the 1960s and 70s in the United Kingdom relevant to the non-development of the sense of community. Hillier tried to find tools to analyze the interaction between housing layouts and people behavior.

Space syntax started with describing and spatial configuration and forms by means of simple relational graphs consisting of paths and nodes. This representation has been achieved manually or semi-automatically to quantitative data about connectivity, centrality etc.

Space syntax is best described as a research program that investigates the relationship between human societies and place from the perspective of general theory of the structure of inhabited space in all its diverse forms: buildings settlements, cities, or even landscapes (Bafna, 2003). It sees the inhabited space as a configured space. Configuration is a key term that considered as a tool to subdivide the continuous space into a multitude of set of subspaces.

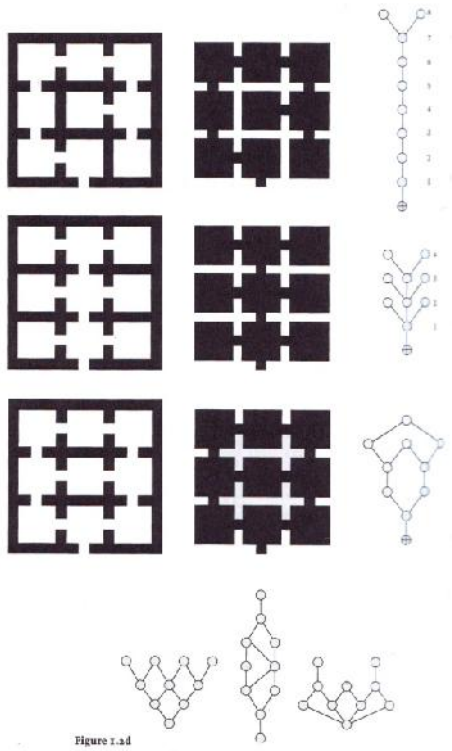
Hillier describes how space is ‘decomposed’ or subdivided according to man’s interaction (moving, interacting with other people or just seeing the ambient space) with space as “People move in lines, and tend to approximate lines in complex routes. Then if an individual stops to talk to a group of people, the group will collectively define a space in which all the people the first person can see can see each other and this in mathematical definition of convexity in space” (Bill Hillier, 1996, p.166). Hence all ‘spaces’ (subspaces) have a geometrical aspect. These geometries give ideas on how people use and experience space and also how related to the city components and organization : linear could be associated to streets , boulevards and so on , and convex spaces to plazas and other open spaces (Hillier and Vaughan, 2007) . Consequently these geometries or spaces interrelated to each other constitute the lived or the experienced space. So this spatial experience is not affected by and related to the properties of the individual space but to properties of the interrelation between all the spaces. This is called configuration in space syntax; “meaning the *simultaneously existing* relations amongst the parts which make up the whole”.

Space syntax theory believes that spatial configuration of any spatial or building layout may be seen differently depending on points of view in the layout; since we are dealing with moving users. This is due primarily to the demarcation of boundaries of each space that allows particular relationship of access of visibility to exist among the other spaces- defines the type of configuration. This would create a particular pattern of movement and encounter with population inhabiting the space. Therefore the effect is on both the human aspect and spatial configuration (Bafna, 2003).

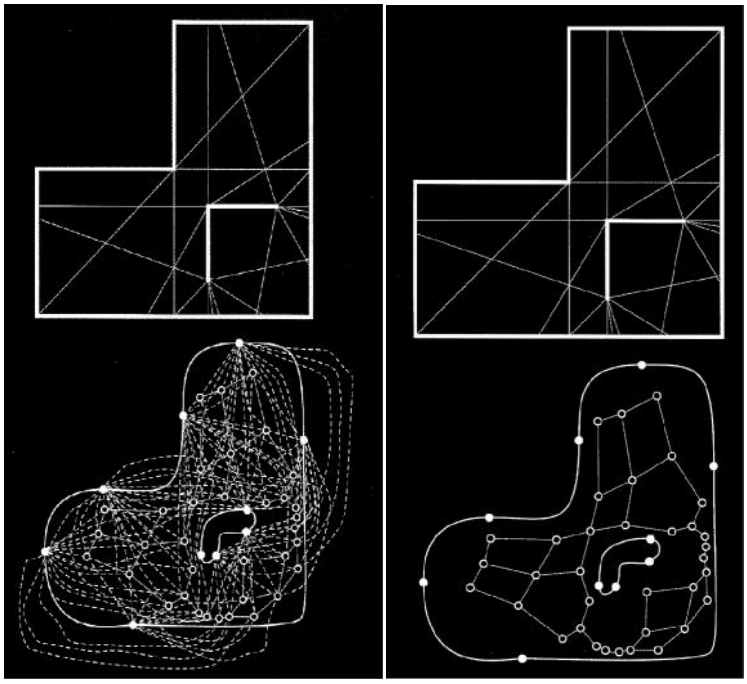
In analytical study the configured space is taken on its abstract format focusing on its topology through two basic conceptions: Convex space, or convex polygon and axial space or axial lines. Convex space, or convex polygon, is a polygon that no line drawn between any pair of points within that polygon goes outside the polygon. Axial space or axial lines, is the longest line which links convex polygons, it's a straight line associated to the notion of visibility and movement.

In term of measurements, space syntax started with describing spatial configuration and forms by means of simple relational graphs consisting of paths and nodes- called *justified graph* or *j-graph;* is to consider a location in a given space (two or more 'spaces') – called the *root* or *base* of the graph represented by a circle with cross marked and all other spaces as circles. And then representing the relations of access by lines (the space connected directly to the root) that we align above the root – these represent the spaces 'depth one', and we continue orderly (according to the depth) till all the pattern of spaces is represented. (fig. IV.9 a) *j-graph* method shows how spaces in a pattern are related to each other (configuration) from a particular point in it; *root* or *base*. Hillier also stressed the fact that this method shows how a pattern of space is different when justified from the point of view (root) of its different constituents spaces (Hillier, 1996 p30).

In studying the configuration of space according to visibility matter, Peponis introduced *e-partition* (endpoint partition) that generates a series of e-spaces that have the property of while we remain inside the same space and look around us, we can see the same set of discontinuities and the same set of wall surfaces, whether completely visible, or occluding.' (Peponis, 1997) (fig. IV.9 b).



a/



b/

Figure IV.9: a/ J-graph method in representing a space with depths indicated (Hillier, 1996), b/ A shape with its e-partition and a graph showing the relationship of incidence between interior wall surfaces (filled circles) and the relationships between e-spaces (unfilled circles) (Peponis, 1997)

Later on, the spatial properties of analyzed space are quantified through a series of measures that could be computed space syntax software programs (depthmap) developed by Alasdair Turner. Two major measures are considered important and constitute the basis of the space syntax theory, integration and connectivity: Integration or RRA (real relative Asymmetry): It indicates the degree to which a line is more integrated or in which each small-scale space is over linked to all other small-scale. This is called *global* major. It is calculated for each space (or each axial map), it is a ratio. It is computed by calculating the average depth for each node from all the nodes in the graph. Integration is valued from 0 to 1; high integration value of nodes indicates that the node is less deep on an average from all other nodes; the number of connection needed to reach that line of space is low, or in other words, that is more integrated into the spatial system. Connectivit**y**, which is a local measure, indicates the relationship of space to the surrounding space; to how many is connected; in other words the number of depths that are directly connected to a space. The higher connectivity value is the more accessible is the line or the space.(Bafna,2003) The connectivity formula is defined as the number of nodes directly linked to each individual node in the connectivity: $Ci = k$.

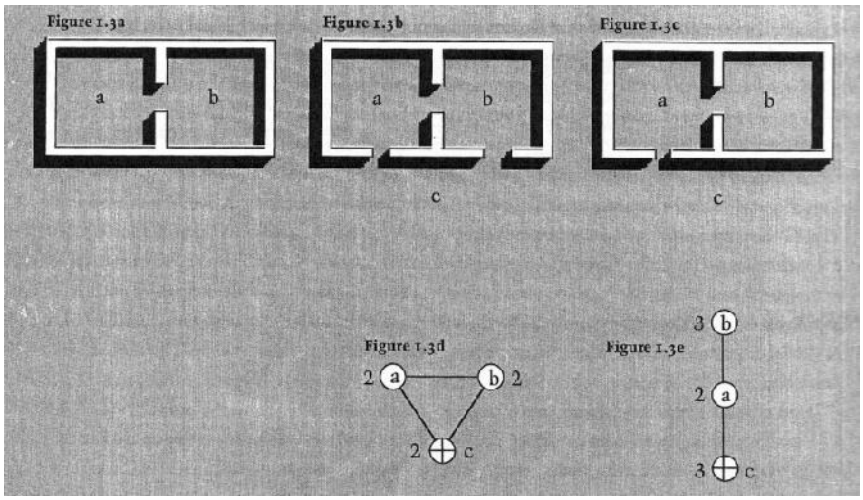


Figure IV.10: The pattern of space vary according to point of view, with depths indicated (root) (Hillier, 1996)

IV.2.2 Isovist Theory: measurements, analytic tools and urban environment.

The concept of isovist initiated by Tandy (1967), was developed by (Benedikt, 1979) in describing the space from the point of view of the individual experiencing it; as he perceives,

interacts with it, interacts with it , and move around it. In fact, Benedikt concern had been the matter of many scholars' attempts, Thiel, Gibson, Lynch, and others, to understand and quantify the human experience of a given spatial layout. Thiel was more concerned with the description, scaling and notation of some of the perceptual and cognitive attributes of the parameters of experienceable physical environments. So the goal was to development of a simple graphic sign system, analogous to musical notation, as a means

He stressed the importance of the environmental intervention on the basis of the continuous real time experience for designer, or as he coined envirotect, to enrich the quality of this experience and to promote people. And that his task is not just to design buildings but design experiences. He evoked the strong relationship between the spatial experience and the role played by vision. He also relied on Lynch's five physical and visual-form elements "imageable" (districts, nodes, paths, edges, boundaries.) to codify the sequences of the spatial experience along a path through urban environment, that he found them to be relevant to environment orientation.

Inspired from Gibson's division of everyday space experience, aerial space where the visual surrounding extends to the horizon and local spaces enclosed and restricted by a series of wall, Thiel suggests that the spatial experience implies three types of spaces; primary spaces, subspaces and secondary spaces, and each space is established by the relationship between surfaces, screens and objects- as the space-Establishing elements. So his concept of space experience is tied up to the movement and the visual field provided by the physical environment.

So his work is somehow linked to Gibson's thinking about the ecological relationship between human and environment , and the consideration of semantic consideration quality of the environment as important to man's experience and perception of the environment. And the main goal is to find tools for the analysis and design of physical environments on the basis of sequential experience in real time. whereby the details of the experience can be recorded for paths as they progress through buildings or an urban environment and then codified with symbols inspired from Lynch's 'imageable' elements.

Therefore Thiel was the first who attempted to understand how man experiences the environment. He proposed a sequence notation where the details of the experience are

recorded by the individual while progressing through an urban environment and then codified with symbols. Yet Benedikt who finds Thiel's analysis lacking tools that can describe architectural and space as visually presented came with a precise way to think of space by introducing isovists to architectural analysis an isovist is "the set of all points visible from a given vantage point in space and with respect to an environment "(Thiel, 1979, page47).

Benedikt's isovist method aim to quantify space as experienced and visually perceived by humans. Conroy and Bafna define Isovist as "the field of view , available from a specific vantage point; a horizontal slice through this field of view is then calculated , usually taken at the eye height and parallel to the ground plane. It is the resulting polygonal representation of this two-dimensional, visual 'slice' that is referred to as an istovist." This visual 'slice' is similar to people's vision with a rotation of 360 degrees. Therefore it provides an internal description of space as is perceived and experienced by an individual.

Benedikt introduced a bunch of measures that could be derived from the polygonal representation 'isovists' such as polygon area, circularity perimeter length, compactness, occlusivity (the proportion of the perimeter lying on the solid boundary of the environment) and number of vertices. These measures, According to Benedikt, may be of use in the study of people's behavior and perception. He suggests that the rate of change of the isovist field may be used in investigating perception and behavior. He argues that when contour lines jammed they propose a rapidly changing view, and in this location where the individual takes decision about his spatial orientation. The behavior of the occupant might be either to take a shallow path around the rapid change, or to slow on approaching it in order to take in the new vista.

Area value is the area of the isovist polygon generated, explicitly the sum total of all visible points (seen on a horizontal plane). *Perimeter* is distinguished by Benedikt into two measures: the real-surface perimeter which represents the sum of the projected radial lines defining the contour of the isovist polygon, and *occlusivity* that it is the occluding radial boundary of the isovist. The occluding radial separates the isovist area from the non-visible area, the area of perceptual vagueness. It measures "the length of nonvisible radial components separating the visible space from the space one cannot see from the original locations X" (Benedikt, 1979); the sum of the length of all occluding radials. *Circularity* is a measure from Benedikt's paper. Circularity is not a measure on how well a space approximates a circle, but it is also a

measure of the viewpoint's position within the space. For this reason circularity is not only a measure of the shape of as pace but also of the centrality of the viewpoint within the space. *Robustness* value illustrates the change of the shape and size of isovists**.** Values are as area/perimeter ratio. *Variance* and *skewness* describe the degree of dispersion of the perimeter relative to the vantage point and to asymmetry of such dispersion respectively.(Davies , Mora, and Peeble, 2006)

Other measures have been introduced by researchers. *Drift* is a measure, set up by Dalton, which quantifies how eccentric the informational center of the isovist is in comparison to its actual center of gravity (Benidikt, 1979; Dalton, 2001; Turner, Doxa, O'Sullivan, and Penn, 2002). *Jaggedness* measure, introduced by Wiener and Franz, is inversely related to the convexity of the isovist. It is defined by the ratio between the isovist' square perimeter and its area. A jagged isovist is one that has 'spikes' (not convex space) with long perimeter comparatively to its area. However less jagged isovist would tend to circular shape.

These diverse measurements deduced from isovists polygons would enable, according to Benedikt, to the study of behavior and perception of people's spatial experience. Yet Benedikt advocates that in order to get the whole configuration of a spatial layout as it is experienced more than a single isovist is required; because, in fact the real experience is an interplay of a multitude of isovists. So in order to quantify an experience (many single isovists) he presented the 'isovist field' that records single isovist property for all locations (many isovists) in a configuration by using contours to show the way those features vary through space. As the individual experience space by moving from place to place, the isovist could be ' single' for a stationary activity (one vantage point), 'linear' according to a specific path of movement, or 'field' that gives all the visual potentiality of the whole space (that may not be completely experienced by the individual). This latter is very useful to represent the experience in an open space such as the urban environment by following the varying and changing isovists and consequently the variant isovist parameters. It is important in studying people's spatial use and behavior related to visibility.

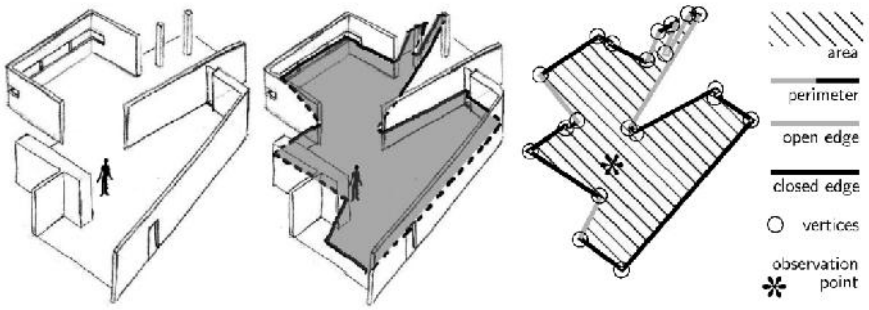


Figure IV.11: Generating isovists : Left: an indoor environment; middle: the gray area is visible from the person's observation point within the environment; right: the resulting isovist ant its basic measurements, Franz Gerald (Franz, 2004).

These values vary through space creating an 'isovist field'. In fact the perceptual quality of isovist fields was initiated by Gibson's work (1979) relevant to *optic flow*, which may conduct an individual through the environment; he emphasizes the importance of movement in the perception of the environment. Hence, Benedikt sees that the variance of the isovist field which may be very useful in studying perception and behavior; choosing paths, selecting spaces (locations) for achieving his purposes; for instance when contour lines are closely packed means a situation of changing view in which the user may either take the shortest path (estimated) or proceed slowly in order to take new vista; the user behavior is dependant to its perception of the environment. (Franz, 2005).

IV.2.3 Visibility graph analysis (VGA): Depthmap computer program

Turner found some limitation in Benedikt' isovist method in considering only local properties of space and omitting the visual relationship between current location and the whole spatial environment and internal visual relationships between locations with the isovists (Turner, 2001). So, concerned with how to quantify space and how to represent space as perceived, Turner suggests that more than one isovist is needed; arguing that the way an individual experiences a space and how he or she uses it is related to an interplay of isovists. From this, Turner developed a software package (Depthmap) capable of performing Visibility Graph

Analysis (VGA). VGA requires a grid onto a space, and uses it to measure the relative mutual visibility among all the cells of the grid and consequently provides all spatial properties through 2D analyses. In fact, it is an analysis of the visual relationships of all the points in a given space to each other; these points may be potential locations for people use. Visibility graph analysis, using Depthmap program, enables to extract many measures could be either syntactic or isovist, to perform many graphs and also to carry out simulation tests; using 'agent-based analysis' (Turner and Penn, 2002) where virtual 'people' (called agents or animates) are released into the environment. Besides Depthmap a myriad of computer programs have been developed from space syntax such as, among others, Spatialist program developed by Peponis et al in Georgia Tech (USA) , space syntax 2D developed by James Turner at the university of Michigan and OmniVista developed by Conroy Dalton at UCL, and Axman and Webmap both developed by Nick Sheep Dalton of UCL

The construction of an isovist graph, according to Alasdair (1999) is to create isovists throughout the spatial area to be analyzed. In this way, this area is subdivided into innumerable tiny sub-spaces to approximate the way experienced by people. Therefore it is necessary to set a grid over the area to study. The points of the grid are the locations of the generating of isovists (vantage points). The smaller the spacing intervals are the closer are to human visual perception; as experienced by walking.

Depthmap allows drawing graphs related to isovist (visibility or sight). Two graphs could be generated: the *all line axial map* that consists of the strategic lines that connect of any couple of mutually visible edges and the extension of these lines to eventual boundaries. *Axial lines* are the fewest and the longest lines of sight that pass through every space in the system; it is subset of the all line axial map (Conroy and Bafna, 2003). However Peponis et al. (1997, 1998) talked about *m-lines* and *e-lines* as a more detailed approach to produce axial lines objectively. They considered movement lines or m-lines as the minimum path that the moving observer needs to cover so that all the surfaces become visible from at least one point. The set of these lines produce *linear visibility map***.**

Depthmap program provides many measures of the spatial properties of any analyzed space. These measures, as seen in space syntax theory, are defined on two levels: local properties and global properties.

Local properties comprise, besides *connectivity defined earlier, visual control (VC), Global Choice, neighborhood size and clustering coefficient* (CC). *Visual control* is a measure that shows how controlling is the space; how much visibility or information is having over the surrounding spaces a location. Visual control_$Ctrl_i$ $d$irectly linked nodes of a considered node (i) is determined according the following formula:

$$Ctrl_i = \sum_{j=1}^{k} \frac{1}{C_j}$$

(k) = directly linked nodes of a considered node(i), and C_j is the connectivity of the jth linked node. (Jiang, Claramunt and Klarqvist, 2000)

Neighborhood size is the neighborhood of vertex which is the set of vertices immediately connected through an edge. If the set of generating locations covers the entire space at some uniform resolution then this set can be thought of as an equivalent to the isovist itself. It is important to mention that the neighborhood of a location does not include itself. *Clustering coefficient* gives a measure of the proportion of intervisible space within visibility neighborhood of a point. It is defined as the number of edges between all the vertices in the neighborhood of the generating vertex (that is the number of lines of sight between all the locations forming the isovist) divided by the total number of possible connections with the neighborhood size. If the isovist being considered is almost a convex polygon (almost all the point locations within the neighborhood will be able to see each other), and hence C*i* will tend to one. In the other hand, if the isovist is 'spiky' (not at all convex) means that many points within the isovists will not be visible from each other, and the C*i* tends to zero. It indicates how much of an observer's visual field will be retained or lost as he or she moves away from that point. This means that if the neighborhood of a point approximates a convex polygon, then the clustering coefficient is high and moving from that location in any direction will not cause any great loss of visual information. However, at a junction with multidirectional visual fields, C*i* will be low as moving from that location will involve loss of part of the currently visible area. (Depth map handbook). Clustering coefficient is a viable indicator of how visual information is changing within the system; a measure that can detect the junction points in an environment. In sum up**,** *clustering coefficient* is to show the changes in visual information are changing while the system is navigated. It can detect the junction points in an

environment. Low clustering coefficients occur where a new 'area' of the system may be discovered, for example, as suggested by Conroy (2001) for finding pause points or journeys.

Global properties comprise, besides *integration defined earlier, Global choice, isovist maximum radial (MR*), entropy and relativized entropy (RE). *Global choice* is a dynamic global measure of the "flow" through space. A specific space has a strong choice value when many of the shortest paths pass through it. *Entropy* and *Relativized Entropy* (RE) give an insight into how ordered the system is from a location. It is a good indicator of people occupation of a system, in that entropy shows how easy it is to traverse to a certain depth within the system. So point depth entropy concentrate much more on the visual accessibility of a point from all other points, by using this topological, which it remedies the problem that VGA integration related to open areas. Because in axial integration the system is dimensionless, large areas do not overly weight the values of the lines; that is, the large areas only weight the values by their increased connections, not through their area.

In sum up they indicate how ordered a system is from a location, i.e. they provide global information available from that location. Lower RE values (colored blue) which indicate that the system is rather ordered from these locations as there is more information; in other words the system is rather easy to traverse starting from these locations. The spaces that require higher number of turns to traverse the system have higher RE values (colored red) indicating that the global information from these locations is limited (Guney, 2007).

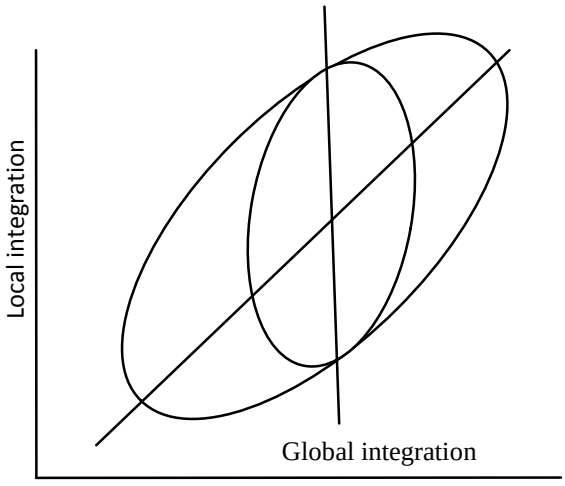


Figure IV.12: Global and Local Integration (Jiang et al,200)

In addition to the local and global measures, there are some measures, which are computed by Depthmap program, and which correlate the local and the global parameters such *Intelligibility* and *synergy*. *Intelligibility* describes the relationship between the part and the whole of a system. A local area is considered intelligible if its co-efficiency value is higher than the one of the global area. The global parameter is the global integration (n), while the local one is either the connectivity or local integration. *Synergy* is a measure that correlates between the radius-3 integration (to be defined later) and radius infinity (global) (n) integration. This measure indicates how the global structure of an entire entity such as a city is reflected in the local structure of space; how the internal structures of sub-areas relate to the larger in which there are embedded (Hillier, 1996).

Furthermore Depthmap program permits to perform agents or animates simulation; simulating people's behavior in space. This agent-based analysis consists of releasing agents into the environment to be studied. These agents make decisions on where to move within it. Their movement is guided by visibility potentiality of the environment. So they require a visibility graph in order for them to have a vision of the environment. This simulation would give results closer to where people actually move; in real environment. This analysis may be performed by using various parameters such as number of a agents, counting agents passing through gates, the number of steps they take and the starting location (Alasdair, 2007 in depthmap 7).

IV.2.4 Space syntax and the city: urban space

IV.2.4.1 Urban space in space syntax theory

Besides the overview of space concept in space syntax theory seen in previous chapters, it is important to shed some light on this theory vis-à-vis the city, specifically urban space that is the core topic of the present dissertation; consisting of plazas.

Hillier (1996) stated that the problem for today's urban design to create rich 'places' as inherited from traditional cities is due to the little understanding of 'how the physical and functional' of those cities work. So he sees that those places are not 'local things' but parts of

a ‘large-scale things’- called cities. He emphasizes on the interrelation and the interdependency between the ‘whole’ and the ‘part’, mainly the importance of the whole by stating that ‘places do not makes cities’ but ‘ cities that make places’.

He considers that cities’ functioning is bond to two aspects: first its multifunctionality related many features such as climate, economics, social, aesthetics; Second its part-whole problem (place-city problem). Both aspects are related to the forms of the city through two main functions: navigate and use as put by Hillier ‘how people find the city intelligible’ and how they move around it. Therefore space constitutes the basis of the relation between form and function; the structure of the urban grid is a shaping force for movement and use of urban space (e.g. plazas).

Hillier defined the individual experience and use of space (discussed earlier) according to movement and the varying isovists. He considers the space structure as composed of a series of convex spaces and lines to ensure the link between those spaces. Lines embed people’s itinerary movement and sight line (view). The city pattern determines people’s movement because to go from a place to a given destination, one has to pass through many lines. Each line has certain ‘depth’ (defined earlier), ‘the less depth to all other lines, the more movement, the more depth the less’ (Hillier, 1994)

He showed in Rome plan analysis how the convex spaces (public open spaces) form a global pattern linked visually (isovists) rather than seen locally- so such spatial structure or layout affect intelligibility and use of these spaces, either static activities or movement.

So the values of lines could be measured through the measure ‘integration’. The integration, value of a line reflects its mean depth from all the other lines of the system. All these integrations (from red to purple = the more to the less integrated) could be represented on a global integration map (covering the whole city). Another map could be produced ‘local integration’ or radius-3 integration in which integration is calculated only up to three lines away from each line in every direction.

Hillier defines natural movement when people movement is much influenced by the structure of the urban grid itself than by attractors or ‘magnets’ existing in that structure. As people move in line, movement depends mostly on the properties of that line within the whole

structure. As a result of movement; He introduced the concept of by-product the series of spaces that one pass through while moving from an origin to a destination. He stressed the importance of lines as being the fundamental land use elements rather than the block or the zone. So he argues that liveliness of space, with shops and people, is not due to those shops but much more the properties of the spatial configuration of that area. Therefore he believes that, even the shops' attractiveness of people, the major effect is from the integrating lines that encompass the shops- 'the shops were selectively locating these lines'. It could be concluded that the most integrated lines (or grid) provide more potential for movement and use than other lines because they generate more by-product – a used and lively space is a required quality for good space as put by Hillier a 'good space is used space' (Hillier, 1996, p 160) Besides the issue of land use, it has been found that many city life aspects relates to spatial configuration and thus correlated to the integration values spaces such as crime rate that are higher in less integrated locations (Hillier, study of Barnsbury area).

Hillier studied a number of open spaces in the city of London to investigate the pattern of use of these spaces in terms of informal use (stopping and taking pleasure). He found out that spaces having dense traffic are better used that the ones without traffic and open and exposed places are better than the enclosed ones. This observation correlates with the measure that he named 'the strategic value' of the isovist, it is the sum of the integration values of all the lines that pass through space. He discussed the results by asserting that people main activity is to watch other people so they locate themselves strategically near the lines of movement, so what matters for them is sight. This shows how important is the visibility field, provided by urban space, for it functionality.

Figure IV.13: Hillier's study of eight squares in London: isovists analysis. (Hillier, 1996)

IV.2.4.2 Methods and cases of application

Space syntax studies aim to describe the social life in space to not only to understand the distribution of population on a given setting but also to predict its mobility by grasping the structure of movement for eventual strategies of development of the setting (functioning and socially, economically aspect of a given setting). So the application of space syntax covered architecture (building's interior space) as well urban space (exterior space, settlements and complex buildings). So it was a tool to develop lots of knowledge and practical explanation concerning the effect of spatial configuration on a range of social and cultural aspects.

Typical applications, among others, include pedestrian modeling (Hillier *et al.* 1997, Jiang 1999), criminal mapping (Jones and Fanek 1997), and way-finding processes in complex built environments (Peponis *et al*. 1990). All these investigations tend to be based on the assumption that spatial patterns, or structures, have a great impact on human activities and behaviors in urban environments.

Weiner and Reichelt and Franz (2005) in a spatial navigation research asked 16 participants to find the place offering the best view in 16 indoor spaces. A desktop of virtual reality setup has been used to provide a simulated field of view of 90°x60°. The participants interacted with the simulation using a joypad, and during navigation all their itineraries and stops are recorded. The analysis is based on overlapping and comparing participants behavior trajectories with isovist measurements of the corresponding scene. Neighborhood size, number of vertices of the isovist polygon, jaggedness, visual stability (the sum of adjacent isovists/ isovist area) is the isovist measures considered in this investigation. The results showed strong correlation between participant's navigation performance and the isovist measures. Therefore, according to the researchers, the results showed that isovist and visibility graph analysis are formal description sets that provide spatial properties relevant to human behavior within space.

In a study related to navigation and way-finding**,** Davies, Mora and Peeble (2006) studied the impact of environment structure of people's static orientation and maps (being in place with no idea where one exactly is, as for example emerged from a subway and one is in an unfamiliar environment and need to locate and orient oneself using a map). Furthermore to investigate if impact of urban features that may be a visual barrier such as bus stop shelters, trees foliage and walls on the isovist and people behavior.

First, the research proceeded on using desktop-based experiments. Participants are asked to indicate the direction in which they are facing as they view an image of an outdoor scene, relative to the map on which their location is marked. So the experiment goal is to see how people rely on the overall spatial structure of scenes (e.g. continuous streets, dead ends, open spaces, large buildings) rather than any specific feature of them to guess their direction of this scene within the map. Participants are shown one of the simplified 3D scenes and its respective map with a dot. Assuming they are standing at the dot (so they have only to orient themselves), participants are asked to indicate in which direction the photograph was taken. The result showed that environment of irregular shape is easier to be identified on map than the highly regular and enclosed environment and the simplicity of the isovist; in other words easier for people to orient themselves. Second, the investigation aimed to see if the urban features that present a visual barrier have an impact on isovist and people behavior. By means of photographs of five scenes of a park (at its vicinity), they showed how the visual perception of the same scene changes by for instance tree foliage. Trees foliage obscures the perception

of the distant objects and buildings (depending on seasons and tree types). Therefore it has been deduced that the true isovist varies with season. The results showed that, despite the different patterns of correlations of the visibility graph analysis in both situations considering and not considering the visual barriers (urban features) the space use and people behavior seemed not affected.

Dalton used a similar VGA technique to test people's navigation in six virtual environments, recording their trajectories, pauses and time spent. They were able to demonstrate from this that pauses do not occur in a random manner but in those places where more visual information is available, usually junctions. In those places the isovists tend to be larger and often spread in different directions, permitting the observer to evaluate the information and to take spatial decisions based on it.

Trova and Peponis (1999) studied how visual fields, linear paths and sociospatial boundaries interact to structure open public space. The case study consists of three housing estates in Athens. First part of the investigation consisted of observing people both static and moving in all space of the three estates. Then 20 isovists of each estate were generated (omitting visual obstacle; urban features) with selected roots locations in order to cover at least 10 well used space and 10 less well use ones. This was by using the software 'Spatialist" .The overlapping of each set of 20 isovists with the corresponding dot map enabled to extract the density of moving and static people per isovist. The correlation between the area of the isovists and the number of people gave significant values.

In attempt to answer to the question asked 'whether isovits that reach more people are also rooted in more densely occupied positions and whether isovist with greater areas are more densely occupied around their roots' the researchers proceeded at measuring the root density by drawing a 20-meter radius circle (arbitrary) around the root. It is found that the isovists which cover more people beyond the 20 meter radius are also occupied by more people inside that radius. So these findings indicate that people converge towards the areas of greater potential visual field. Second part, they studied the correlation between integration and the densities of people per 100meters of axial line, considering three main syntactic variables, Integration, Integration-radius three and Connectivity. These were computed on the basis of a large axial map comprising all the estates of the study. The results showed that the correlation

between densities of standing people and syntactic variables are very low. However correlation between densities of moving people and syntactic variables are higher; this gets higher when only the interior of the estate is considered without the surrounding streets.

Cases of application related that open public spaces use and inherent mostly to the topic of the present dissertation are deeply scrutinized. First, the methods and the findings of the studies of Arruda Compos (UCL) on squares in the city of London are presented. Then a comparative study of two public open spaces, a park in Athena and a park in London is reviewed. Both analytical studies have used syntactical and isovist tools for investigation.

Maria Beatriz de Arruda Campos (1997) has investigated, in a comparative study of twelve public squares in London, if well designed elements , providing places to sit and enclosure of a public square are determinant factors for its performance (to be used by people). The key question of this study is "are there morphological characteristics that can be established for public squares to enable predictions to be made when new or existing public spaces are being developed?" So she considered the space use according to the variation on the number of people making informal use of the public space during the day. The criterion of squares selection was to have traditional squares and the new office development spaces. The method is based on three levels: first, the square assessment about the level of enclosure (and openness; visual connection with the surrounding) by *high, medium* and *low* values, the quality of street furniture (available places to sit) by *good, medium* and *poor* value and the presence of catering establishments. Second, syntax measurements (integration); the global integration map of the city of London, the axial lines of each public square. Third, static people counting, considering number of people according to categories: *people all*, *people less occasional,* people *less occasional +bars.* People counting has been done on two distinct days (July and October), to include the climate parameter, and also different times; one from 8am to8pm and the other from 12am-2pm (lunch time). Static people were recorded according to gender, activities and respective locations every ten minutes.

The results show that the analysis of the axial configuration of the City of London (containing the squares) demonstrates a good correlation between local (radius-3) and global (radius-n) integration values with a correlation coefficient of 0.64 which indicates a good 'legibility'. Concerning the configuration of squares and the patterns of space use, she found that in two

squares that perform best a correlation between the total number of static people and the total number of axial lines (coefficient= 0.82 and 0.75 when occasional and people using catering facilities exclude) .These two squares are enclosed spaces, provided plenty of place to sit and a catering services. However, the third most successful square is completely exposed to its surroundings, encircled by a heavy encircling vehicular traffic, having no catering services, and having a good number of seats (people sit on steps during lunch time). A group of squares that are very enclosed spaces and providing catering services recorded the smallest number of static people (Campos, 1997).

In sum up, this study showed that the hypothesis claiming that performance of squares is tied to provisions of places to sit, well designed elements and enclosure is not much significant. Nevertheless, it shows that the degree that the public space is embedded in the urban fabric is the most important. Moreover the number of static people using the square is not only due to the number of axial lines that interface with the public space, but to the sum of its global and local integration values. This is a confirmation of Hillier's findings about the correlation between the strategic value and the levels of static occupation. Compos found good correlation with the number of axial lines intersecting and at an urban space implying a multidirectional visual field, that is, low Ci and the number of people making informal use of the squares.

The same author, in another work (public spaces revisited: a study of the relationship between patterns of stationary activity and visual fields) investigated the relationship between visual fields and patterns of stationary activities. This study concerned the analysis of static activity for six public places in London. These spaces are selected according to size, geometry, morphology, and surrounding land uses. Besides people counting and observation, three methods have been used and compared, overlapping point isovist (OPI), visibility graph analysis (VGA) and convex isovists.

Overlapping point isovist (OPI) method consists of the axial breakup of the urban grid in which public spaces are embedded. The intersection of two or more axial lines from which any part of the space can be seen constitutes the isovist vantage point (250 meters from the square). From each point isovist is generated (considering walls and unusable space such as columns, flowerbed and so on). And then the point isovists of each space are overlapped

resulting in convex spaces with different degrees of exposure, named the 'coverage density'. This was divided into a scale of six (from dark grey: highest degree of exposure to light grey: least degree of exposure). This method analyses the exposure vis-à-vis the surrounding of the public space (the observer being outside the public space).

Visibility graph analysis (VGA) method used to calculate the visual integration of each space; is limited only to the boundary of the public space (the observer being inside). The results were analyzed according to the position of people in stationary activity. The convex isovists method has been used to analyze the size of the visual field from 'hot spot' for stationary activity inside the square. Then the visual fields areas of public spaces (including surrounding spaces) have been quantified and compared individually in order to see if there is any correlation between the stationary's people location and the size of the visual field.

Stationary people observation and counting was done over one weekday during the summers 2003 and 2003. Two times were considered mid morning (off peak for static occupancy) and lunch time for (peak for static occupancy); people using facilities such as cafes and shops were not considered in the analysis.

Concerning the overlapping point isovists analysis, the results showed that in all the squares the pattern of static distribution in inversely related to coverage density level. In other words the areas with high coverage density are the ones with the lowest levels of stationary activity; only 10% of people sat in these exposed areas while 50/% used the least coverage areas (the less exposed) and 40% used medium coverage areas.

For the visibility graph analysis, the results showed that the pattern of static distribution is inversely related to the visual integration; four of the six analyzed squares presented higher number of people in areas of lower visibility. So statically talking the static people for area of low visibility levels is of 45%, medium levels with 35% and High level with 35%; however, when sitting areas considered the rates are respectively 50%, 30% and 24%.

For the convex isovists the results showed that people gather in areas of large visual fields. Yet there is no correlation between the size of the isovist and the number of stationary people and the location of 'hot spot' for stationary activities.

The discussion of the results of the study by the author indicates that people avoid very exposed areas and prefer spaces providing views. This study showed somehow how people proceed in selecting a location for a static activity. First they arrive to public space through the linear properties and then choose the location providing certain privacy. So when searching for location, for a static activity, the individual avoid the first area of public space seen for more secluded. So, the degree of seclusion looked for is bond to the characteristics of the person himself, but the need of the ability to see is present. This confirms the "edge effect" of Gehl that previously explained by Alexander that people prefer the borders and the edges of public spaces, and when they are full the gradual occupation will be inwards. So the preference for people to sit in areas facing the pedestrian flow responds to both the privacy and the ability to see needs.

In another study concerning space use, Papaegyropoulo (2006) studied, in a comparative way, Regent's park in central London and Pedion Areos in the center of Athens. The objectives were first to examine the relation of the parks with their environments and then to investigate the movement and occupations of the parks. The methodology consisted of direct observations and syntactic tools.

Direct observations consisted of gate method and the static snapshots to record people number and type of occupation (static and dynamic) and their locations. These observations were carried out the weekday (in June for Pedion Park and in July for Regent's park) on five time periods. The snapshots covered all the spaces in both parks by the means of a moving observer.

The syntactic analysis consisted of generating the axial map of each park where the lines considered as lines of sight and movement. The integration value was calculated to see the relation of each park and its surroundings. Moreover segment analysis was used to compare the spatial properties of the two parks.

In term of visual analysis two methods were used Isovist and Visibility graph analysis (VGA); Isovist analysis to highlight the visual properties of spaces and the visibility graph analysis overlapped with the data from snapshot observation. The syntactic analysis was carried out using Depthmap software (Alasdair Turner in 2001).

The results showed that the entrances (access) analysis consisted of counting people moving inside and outside (surrounding space close to entrances) the park to indentify the busiest ones Here the relation of the parks and their surroundings are explored trough their entrances. Pedion park presented quite low movement rates that illustrate the under-usage of the park and its disconnection from the surroundings (the city); however, Regent's park showed better usage: a higher average number of people crossing each entrance per hour than Pedion park. The reason is that most entrances of Regent's park overlapped with the most integrated areas. At the same time the ones that are underused are the ones that are not connected to the city.

In term of visual properties, the highly used entrances of Pedion Park have large visual fields and isovists penetrating to the inside of the park, giving more information to the passer-by. On the other hand the under-used entrances have large isovits but not penetrating inside the park- no visibility to the inner parts.

For Regent's park all entrances provide large and 'long' isovists but this does not match with the data collected from observation of some entrances that showed low rate of movement. The author argued that entrances' visual properties that offer a great deal of information of the park entrances are not determinant for the accessibility of the park but the relation of the park to the its surrounding.

The overlapping of observation data with the visibility graph (in one map) showed, for Pedion park, the low visibility of the park and the accordance between the observation data (number of people and location) with the visual properties of the park; people's presence (occupying or moving) is on spaces situated on the visibility integration core. In the case of Regent's park analysis illustrated a better correlation between the observation data and the visibility graph, mainly the north-south movement axis and its visibility variation of its parts (integrated in the north, segregated in the south). Concerning the correlation between space use and visual properties of space, the results showed that programmed activities (static and dynamic) occur in the most visual integrated spaces; nevertheless, activities of sitting and relaxing occur in places with low visibility but not visually exposed.

Hillier, Burdett, Peponis and Penn (1987) explored 75 towns and urban areas from many countries to avoid the cultural bias, using space syntax method. The goal was to try to search for consistencies, variations and co-variations among a family of spatial parameters

expressing different configurational properties of axial layouts. The results of the axial maps showed that the pattern of pedestrian movement in urban area is determined by the pattern of integration and the overall density of pedestrian movement by the overall integration of the area. They showed that the densities of movement in urban spaces are determined principally by the relation of spaces to the layout as a whole. However, the local properties of the space, or location of facilities or 'magnets' are secondary. In another side the study showed that the reduction of overall densities is strongly associated with the loss of 'integration', and the reduction in the predictability of the pattern of movement from the layout is strongly associated with the loss of 'intelligibility'. So the theoretical outcome of this study is that an urban system on one hand has both static and dynamic properties and on the other local and global properties. The global measure is *integration*, the local measure is connectivity, the local dynamic measure is *control* that means the degree of choice does each space represent for its immediate neighbors as a space to move to, and the global dynamic measure is *choice which* is the degree of each space represents on all shortest routes from all spaces to all other spaces in the system (how likely it is to be passed through).

Concerned by people's movement in space, many studies used Visibility Graph Analysis for investigation. These researches were carried out either in laboratory (virtual environment, or in si-tu). Some researches' findings have showed how visibility impacts much on people's movement, navigation in space trajectories; orientation, and pauses.

Dalton used a similar VGA technique to test people's navigation in six virtual environment, recording their trajectories, pauses and time spent. They were able to demonstrate from this that pauses do not occur in a random manner but those places where more visual information is available, usually junction. In those places the isovists tend to be larger and often spread in different directions, permitting the observer to evaluate the information and to take spatial decisions based on it. (Dalton, 2003)

In another research, Dalton and Bafna showed the relevance of isovists to orientation in comparing and criticizing Lynch's assumption that orientation at a given 'node' in a city is dependant solely on its having a distinctive local landmark. To them, isovist analysis may help to "differentiate between nodes that contribute to a sense of orientation and assist in way-finding, and nodes that may confuse or hinder it" (Dalton and Bafna, 2003, p. 59.1). They

concluded that Lynch's concept of imageability /legibility has been fundamental in the urban design, planning, architecture and environmental design fields. However it presents a drawback of ignoring the relational characteristics between physical elements of the urban Environment.

On the other hand; Franz Gerald (2005) tried, by using the isovists method, to quantify spaciousness as one of space description qualitative theories; spaciousness, openness, complexity and order. He also showed that visibility graphs are useful to predict spatial behavior in interior spaces.

CONCLUSION

Space evaluation is extremely linked to people's behavior and spatial experience either expressed in certain attitudes or certain use of space to fulfill some purposes. Almost all the methods and investigation tools to evaluate a given space or environment implicate man in the process, and aim to correlate between attitudes or behavior patterns and the spatial properties. Since the goal of spatial or environmental design is people's wellbeing.

The methods could be sorted into four categories: those which focus on people's behavior, those which focus on people's feelings (sensorial perception), those which focus on people's cognitive aspect and those that focus on the spatial properties (quantitative). In general, all these methods require an in situ investigation.

The first category which focus on people's behavior do not really implicate people in the investigation (as process), it implies only the direct observation of people within a given environment, such as the Whyte's study and Groat's students' research. All the acquired information about people's behavior goes through a corelational study with the spatial properties and variables of the environment. This would provide some indications on space or the environment's properties and its impact on people's behavior. Besides, this category relies on the observation of people density and distribution over within a given space through for example the gatecount, snapshot and people mapping methods.

The second category is more oriented towards the sensorial aspect. These methods implicate actively people into the investigation process. People are asked to give their impressions and express their feelings about a given space, ambience or environment. These impressions are either expressed freely by the participants, such as in 'the commented walk' or expressed according to a certain chart or scaling such as in sorting, checklist multiscaling and adjectives checklist methods. The aim of these methods is to measure people preferences about the experienced environment. The obtained results are subject of a corelational investigation to the spatial properties or ambience parameters to look for example what attract (pleasureness and aesthetics) or repulse people.

The third category tackle the 'knowing' or cognition and the urban environment. Its goal is to evaluate the intelligibility of the environment through the investigation of people's perception (mainly visual) and recalling of information from that environment for their daily use (schema), navigation. The investigations are based on people's mental maps (sketches) as seen in Lynch's and Appleyard's works. The mental maps coupled with questionnaires would give valuable indication about elements of the environment that make it intelligible or not for people. However this category presents some drawbacks since it is extremely linked to personal, social, cultural parameters.

The forth category put much emphasis on the properties of space and the environment in a quantitative approach. The spatial properties are quantified through many measures and graphs, as developed by space syntax (Hillier) . These measures are principally based on linkability and visibility of 'parts' of space (whole), in topological aspect. Therefore, this helped to avoid all the bias of the conventional description of space. Investigations and evaluation of space functioning by using syntactical measure coupled with the results of direct observation of people's behavior has given tremendous outcomes. Moreover, even the visual perception as experienced by the individual is quantified through the isovist (Benedikt). This has been of very important contribution on evaluating spatial configurations and their impact on people use of space.

All the methods are very instructive in space or environment evaluation. However, there are those that present some subjectivity by being linked, in their investigations, to personal, social, cultural and educative factors. The one is more objective, is space syntax and isovist

methods that really start from an interpretation of spatial quality or property by quantifiable measures that emphasized mostly on the topological aspect. This is the finest way to investigate the correlation between the spatial properties and people's behavior. The results would be, conclusively, constructive in space evaluation and consequently in space design.

Due to this, the thesis will adopt space syntax as a method to investigate into the issue related the plazas' use as stated in the research question.

CHAPTER V

CASE STUDY PRESENTATION

V.1 OVERVIEW ON THE CITY OF BISKRA

Biskra is an oasis city located in south eastern Algeria, at the edge of the Saharan Atlas that constitutes the limit between the north and the south of the country (fig.V.1). The city is called the 'gate of the Sahara' (La porte de desert) due to its situation.

It is known by its hot and arid weather; temperate during the winter, mild in fall and spring seasons, and harsh in summer (maximum average 44°C).

Throughout history it has been the crossroads of many civilizations as a place for exchange and trade between the north and the south. During the Roman era, it was the capital, Vescera, of the southern Numidia. The ancient city, that constituted the core of the city, was built during the Turkish period (1541), Ottoman Empire. It was built next to the military fort within the palm trees. This ancient core was abandoned for epidemic reasons and relocated within the palm trees gardens into seven villages according to the existing waterways of that epoch.

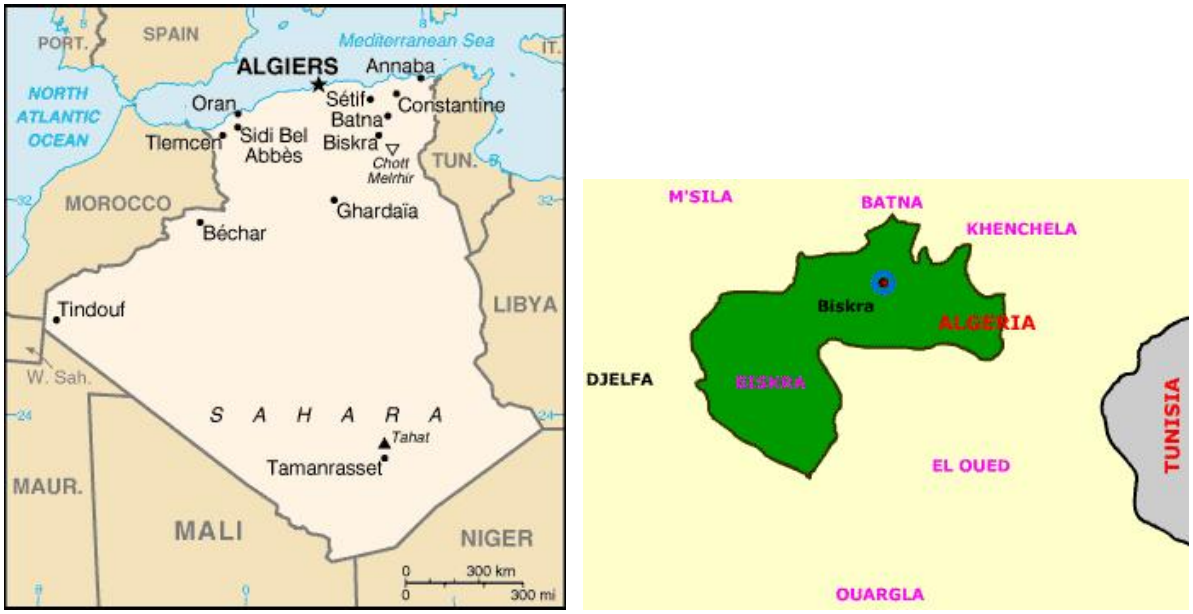
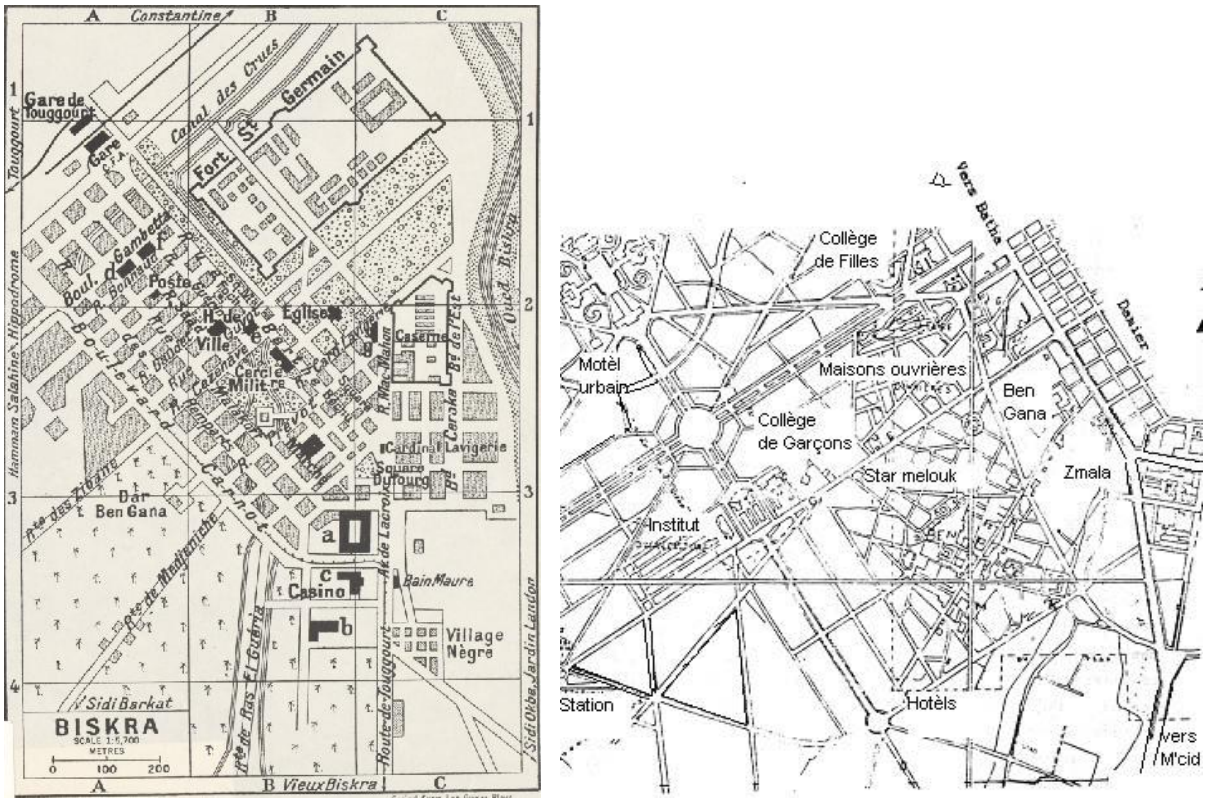


Figure V. 1: Geographic situation of the city of Biskra (mapzones)

V.2 URBAN SPACE LAYOUT: OPEN SPACES

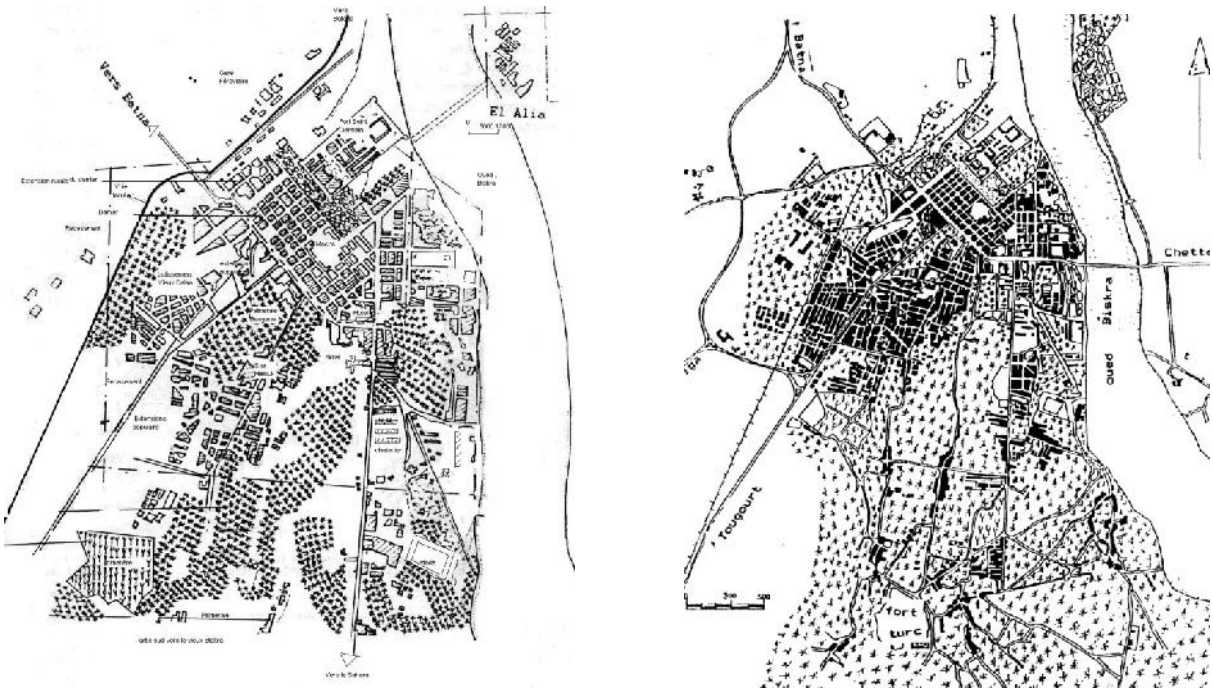
During the French colonial period, in 1936, the city knew its first planned urban layout named to president of French urban planners of Algeria, “Plan Dervaux”. The plan based on a modern concept in Urbanism aimed to transform the city into a tourist place (fig.V. 2). The goal was to maintain the oasis character, known by its greenery (palm trees gardens), to link the new city to the existing parts of the ancient city, and to reorganize the city favoring vehicular flow (Courtillot, 1979). So the layout was laid upon a regular and orthogonal grid, gridiron, generating open public spaces such as plazas and gardens. Besides that, the plan intended to build a series of accommodation and leisure facilities. The land use of this new district is of mix-use activities; public and state buildings, residential, trade, tourism and so on. However, the plan has not been built entirely because of drawback linked to land shortage (Agli, 1988).



a) b)

Figure V. 2: a) Plan of the colonial quarter, b) Dervaux’s Plan (1932), proposed layout of the city of Biskra.

The expansion and the growth of the city stated from both the colonial quarter and the old ancient tissues existing within the palm tree gardens (fig. V. 3); two different geometric fabrics: a regular and irregular one.



Biskra in 1959 **Biskra in 1972**

Figure V. 3: The urban growth of the city of Biskra (DUC, 1972)

Currently, the city's urban structure is a compilation of three principal urban fabrics, the old core (seven villages and their extension), the colonial fabric, and the post-independence districts. The old core and its extension present an irregular pattern of tiny streets with very high compactness. Parts of it constitute, to some extent, the city center as public spaces. The colonial district composes the center of the city. Its gridiron fabric defines clearly and orderly categories of streets according to circulation flow; main and secondary streets. The open spaces generated by this fabric consist of a series of plazas and a garden. The plazas are spatially very well structured and defined as public space. The garden called 'the public garden', along the main street (la rue de la République), is considered to be the major open space due to its dimension and situation within this urban fabric and the city

The third urban fabric represents all the development being made at the peripheries of the old core and the colonial district. These developments intended to absorb the extension and the growth of the city by either private or public buildings. However the residential represents the chief component in both the private 'self-built' individual housing and public housing of 'mass -construction'. Now this fabric is a patchwork of spatial organization with sometimes a 'look- like' gridiron fabric of the individual housing district and a 'loose' and amorphous urban space of the mass-construction housing district. Nevertheless this type of urban fabric is the one that actually characterizes the city.

The main open spaces (designed as such) for instance public plazas and gardens that encompass public life are situated within the city center. For instance, Landon Park built by the Comte Landon in Chatenier Quarter, inspiring from The British gardens, to house leisure activities for the occupants (Berlan-Darque, 2007). The city center of Biskra is laid down at the boundaries of the colonial district and the old core principally along El Emir Abdelkader Boulevard, expanding spatially, to some extent, into both districts (regular and irregular urban fabric).

Initially most of the plazas were as "left over" spaces of buildings or a result of the junction between two geometrically different urban fabrics redesigned to be public spaces. However, only the plazas and outdoor spaces of the gridiron fabric were part of an urban plan scheme.

V.3 THE CASE STUDY: SELECTION OF THE FOUR PLAZAS

The selection of plazas as a case study to carry out investigations for the purpose of this dissertation was guided by the following considerations: situation, Size, morphology of the space and the configuration of the plaza, in other words the type of how are linked to the surrounding. The plazas are El Houria Plaza, Zwaka Plaza, Dalaa Plaza and Larbi Ben Mhidi Plaza (fig.V.4). It is important to mention that these are the only plazas that really can be morphologically named as such. However, there are many urban spaces that are used as exterior public spaces such as irregular spaces at some crossing roads that can be considered much more as large sidewalks. This situation did not really necessitate proceeding at rigorous

selection. Despite this the four major plazas selected for the case study present some differences as stated earlier.

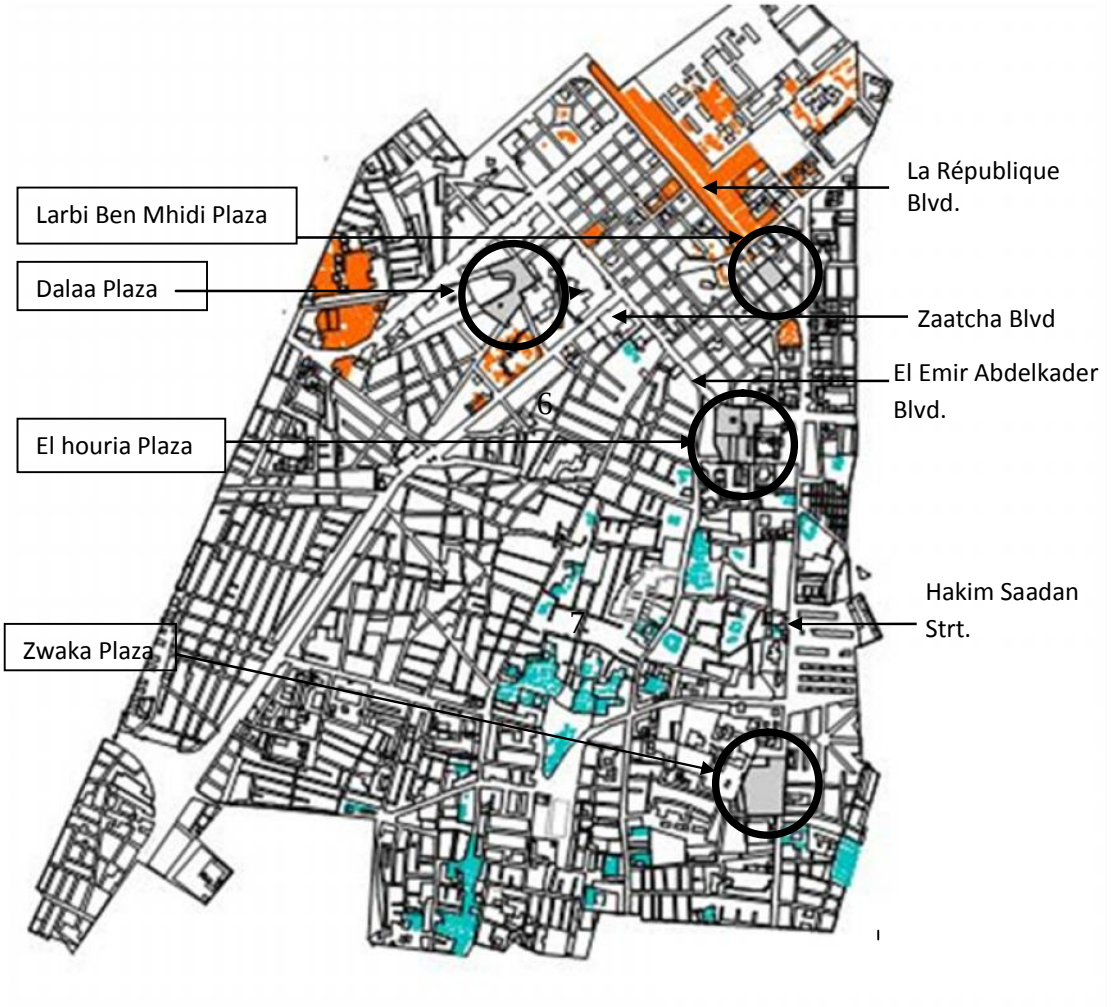
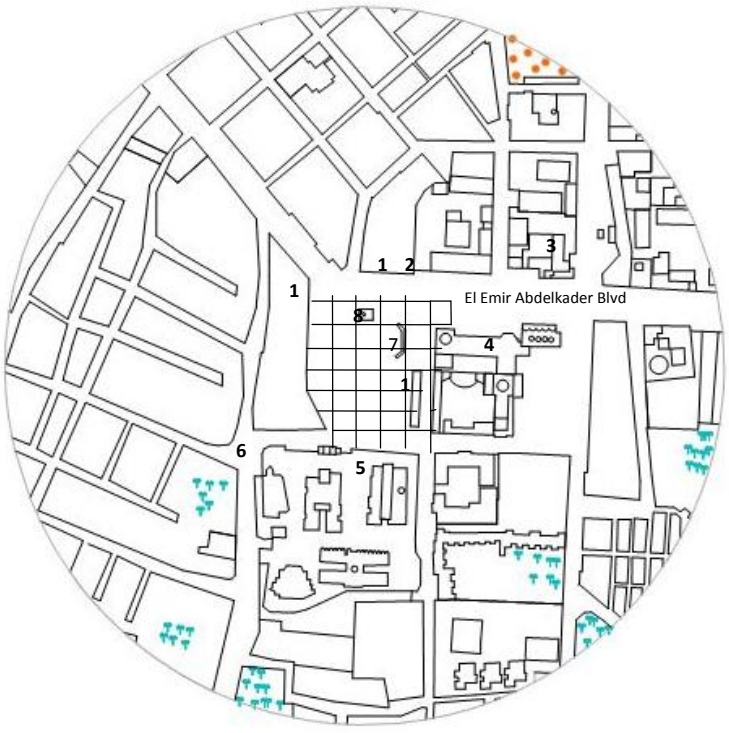


Figure V. 4: Plan of the city center district, embedding the four plazas

V.3.1 El Houria plaza

The first plaza, El Houria, was selected for its location which enables it to be used frequently and for the services available such as cafes and shops. On two opposite sides of the plaza, two main busy streets go parallel to each other (fig. V.5). The plaza layout is mainly characterized by its two-level space: the higher section limited by El Emir Abdelkader Boulevard, the most livable street of the city and the lower section limited by a busy street that links to a popular

market. The height difference between the two levels is about 1.20 meters, and the connection is assured by a series of stairs without causing any visual obstruction within the plaza. The space layout is characterized by a linear fountain along a central pathway, a memorial wall and well defined spaces by built-in sitting areas. Surrounding land uses include cafes, few shops and a state building. In the present study, all the features contained within this plaza do not obstruct eye-level views for pedestrians such as sitting areas, fountains and trees are not considered).



a) **1- café , 2-bank, 3-post office, 4-cultural facility, 5- *Wilaya* headquarter, 6- *souk* area, 7- fountain, 8-martyrs'memorial.**

b) Photos of the plaza, left: the upper part and the linear fountain in the lower part.

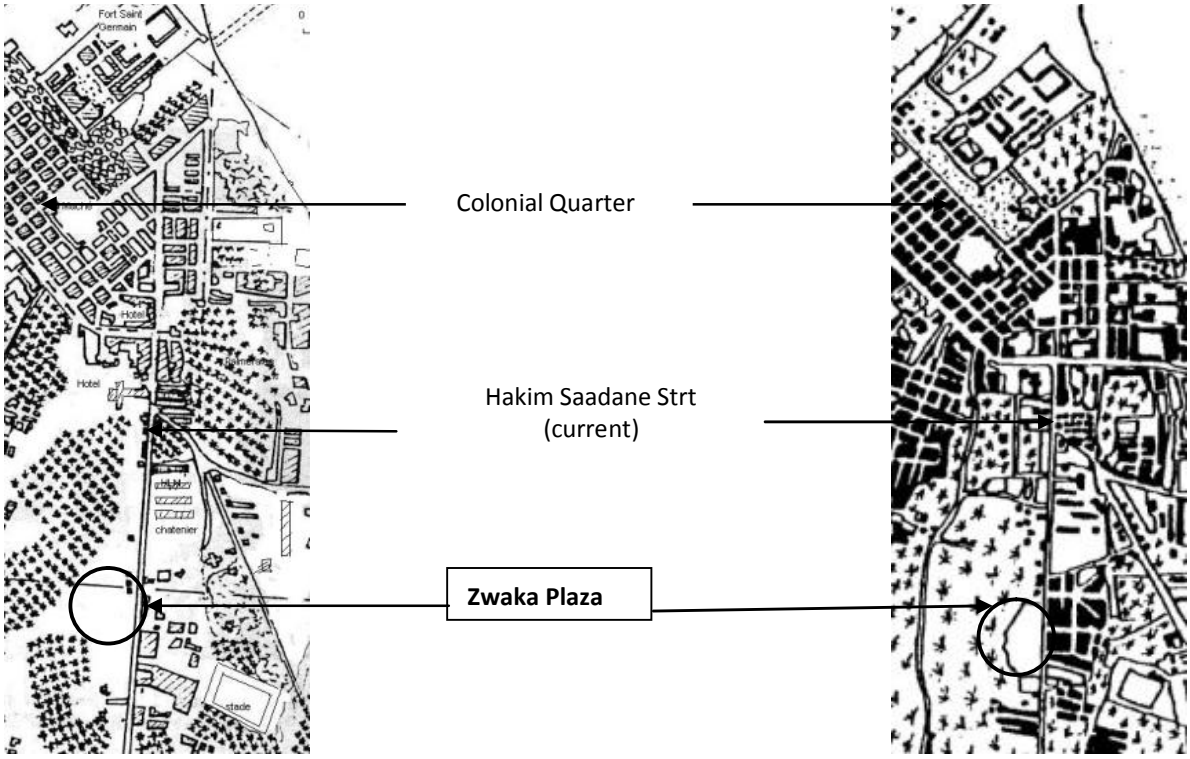
b)

Figure V. 5: El Houria Plaza a) plan of the plaza and its vicinity b) A photo showing El Houria plaza within its surrounding (Google earth, 2011)

Its selection has been dictated by its good situation, by its frequent usage and by the affordance of few services (café, shops and so on) that may not alter the objective of the experience. Two main busy streets go parallel on two opposite sides of the plaza.

V.3.2 'Zwaka' Plaza

Zwaka Plaza is situated within mostly a residential area, Hakim Saadane, one of the major streets of the city, passes through the plaza and constitutes the major link to the rest of the city (fig.V.7). The layout of the plaza basically involves a green space crossed by a pattern of pathways together with a fountain, some sitting places, and little service activities.



a) Zwaka Plaza in 1959 b) Zwaka Plaza in 1972

Figure V. 6: the transformation of Zwaka Plaza, throughout the city growth

It is situated within mostly residential area. Historically this open space was not really designed to be a public space such as a plaza (in term of urban design) rather it is a left over open space that has been used for a diversity of public activities; from a weekly flea market (souk) to space for some cultural festivities. Not long time ago, the city has improved somehow this space by a landscaping work. The layout of the plaza is basically a green flat

space crossed a by a pattern of pathways with a fountain and sitting places. However, few services are provided; only some neighborhood stores and cafe along the main street ‘Hakim Saadane’.

a) Photos showing the plaza layout.

Figure V. 7: Zwaka Plaza within its surrounding (Google earth, 2011)

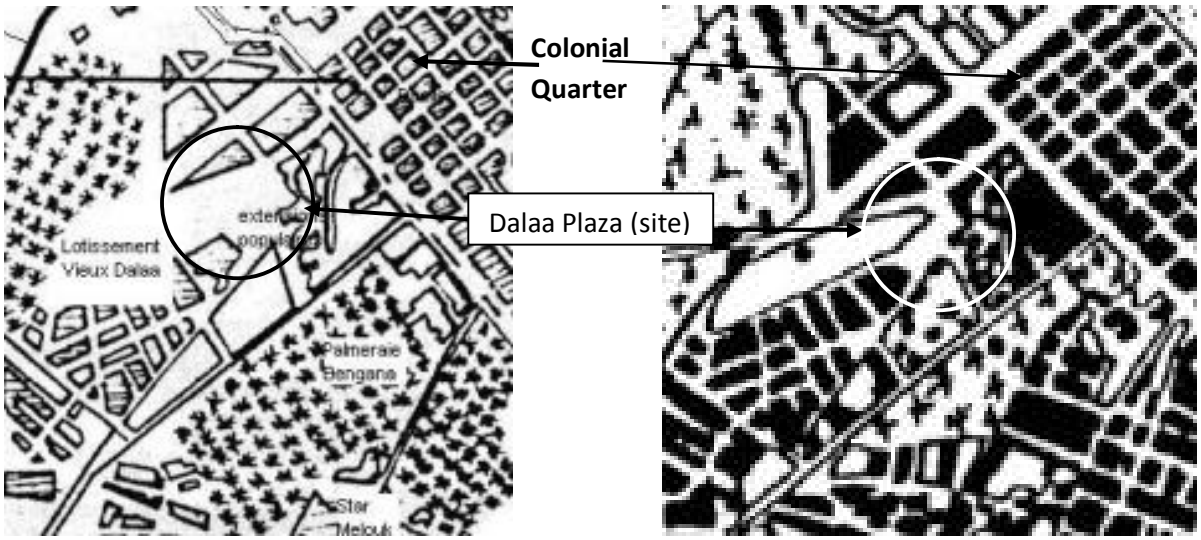
The plaza is oblong shape spatially well structured on four sides. Individual houses, a college, and some window stores on street level (houses in 2nd level) form its boundaries. They are mostly two to three-level building presenting no noticeable architecture style.

Hakim Saadane which is one of the major streets of the city passes along north-south direction through the east side of the plaza. It is one of the major streets of the city. It provides the major link of the plaza to both the city center and the rest of the city. A secondary vehicular way street, along east-west direction, borders the plaza on the south side and connects to the neighboring areas. Moreover a vehicular way to serve the college and the individual houses encircles the plaza.

V.3.3 Dalaa Plaza

In fact, the Dalaa plaza has not been designed to be as such, it is the result of the urban growth of the city's different urban fabrics. The plans in the figure V.8 show how the Plaza's space has evolved from being a vague space (in the midst of palm tree gardens and some built environment to more urban structured space) (fig. V.8, a).

Dalaa Plaza is typically characterized by its irregular shape resulting from the presence of a rocky hill within the built area (fig. 9). The plaza is linked to its surroundings by a number of streets. Its layout includes some fountains, sitting places and mixed-use of boutiques and cafes.



a) Plan of Dalaa Plaza in 1959 b) Plan of dalai Plaza in 1972

Figure V. 8: Plans showing the growth of Dalaa Plaza

Plan of the Dalaa Plaza layout (Aliouat architecture office, Biskra)

b) The center of the plaza

c) The rocky hill occupying the center of the plaza

Figure V. 9: Showing the limits of Dalaa Plaza within its surrounding (Google earth, 2011)

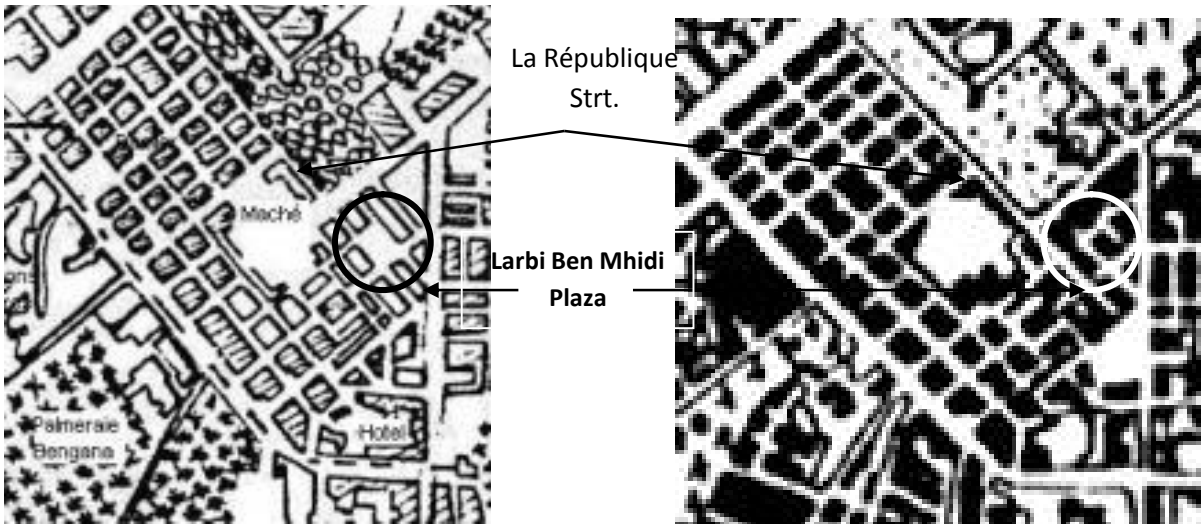
Dalaa Plaza is situated in a residential area within the city center. Its location is characterized by being close to two major streets of the city, Zaatcha Boulevard at the west and El Emir Abdelkader at the north. Besides this, it is a place into which many streets converge. All this conferred the plaza a good situation within to streets network of the city and a good connectivity to the neighboring areas.

Dalaa Plaza is typically characterized by its irregular shape resulting of the presence of a rocky hill within the built area. This plaza has no definite boundaries, it is amorphous. The presence of the hill subdivided the plaza in sub-spaces with no visual relation between each others. This typical situation has generated interesting urban spaces; some around the hill and other next to the surrounding buildings, separated by a vehicular road. Architecturally, the limiting buildings which are mostly individual houses provide the plaza with no clear architectural style; the character of ‘unachieved’ constructions.

Historically as cited earlier this plaza was considered as a vacant space. So it had been an abandoned urban space with no specific use, for a long time, before becoming a place for bus

stops to respond to public transportation‘s need (buses) due to the rapid growth and the extension of the city. Finally the bus stops have been relocated in another area in order to reduce the increasing problem of traffic congestion that the city center is facing. And the current layout of the plaza is the result of an architectural competition launched by the municipality. So the layout is confined only to some landscape work; pavement of some areas, creating sitting places, some canopies (pergolas), tree planting and a series of fountains. In term of land use, the plaza presents mixed-use activities with window boutiques, some services such fast-food, multimedia, cafes and so on. All these activities that locate in the street level of houses limiting the plaza create a kind of liveliness within the plaza.

V.3.4 Larbi ben Mhidi Plaza



a) Larbi Ben Mhidi Plaza in 1959 b) arbi Ben Mhidi Plaza in 1972

Figure V. 10: Larbi Ben Mhidi Plaza in different periods

Larbi Ben Mhidi Plaza is situated within the gridiron fabric near a covered market. It is linked to its surroundings by eight streets and its layout is mainly covered with a bunch of trees in its core that give it a garden like aspect (fig.V. 10). The mixed–use activities of the plaza consist of small boutiques, cafes, and a bank, make it a livable place.

Figure V. 11: Showing the limits of Larbi B. Mhidi Plaza within its surrounding (Google earth, 2011)

Larbi Ben Mhidi Plaza is situated within the colonial district. It is a well defined space and smaller in size comparatively to the other plazas. What distinguishes it from the other case study's plazas is that of being designed to function as plaza in 1936's urban plan scheme of the city (seen earlier). So it is part of the gridiron fabric and linked by eight streets to its surrounding. *La république* boulevard, which is the major street of the colonial district passes through the plaza along an east-west direction. In addition to this, being close to a market square (covered market) and a public garden (Le *jardin public*) has strengthened its importance.

The surrounding buildings are characterized by a 'colonial' style architecture; a sort of mix of western architecture and some elements known as Islamic and vernacular architecture elements (moors architecture). The plaza layout consists of a central 'tiny' garden with a bunch of trees, vegetation and some sitting places. A pedestrian side walks –like space around this garden that take in a terrace café and some sitting areas. A vehicular way encircles the plaza. The land use presents a mixture of activities and services, food stores, bookstores, a café and a bank. This like-garden plaza with its greenery seems providing an urban ambience alike the other plazas. It is remarkably used space.

CHAPTER VI

RESEARCH METHODOLOGY AND INVESTIGATION OF THE FOUR PLAZAS

INTRODUCTION

Space syntax is the method that is chosen to be used by this thesis to investigate into the case study. This choice is based on the fact that space syntax deals principally with the topological aspect of space and provides techniques and tools that allow considering and measuring quantitatively the environment through a myriad of variables. In addition, it permits to perform and calculate the spatial properties related to vision and visibility that, it seems, are the most important and the most appropriate to the topic and the goal of this thesis. Besides all that, space syntax showed its efficiency in many fields' studies and the encouraging results, principally those inherent to the relationship of people behavior (space use) and the spatial configuration.

First, the aim of this research is to investigate to pattern of occupation of plazas inherent to stationary activities or position: sitting and standing people; moving people (crossing the plaza) are not considered. The study consists of investigating of the use of each plaza and a comparative study of the four plazas of the case study. The investigation is based on three sets of study: first, an in-situ investigation consisting of observing, counting people and mapping their locations within each plaza. Second, an analytical study of the plazas using space syntax method as a principal analysis tool; by using Depthmap program to calculate isovists and syntactic values of the four plazas, to generate graphs (values maps and scattergrams), and simulations (agents). Third, a correlative study and a comparative study; to investigate for eventual correlation of people's spatial use (stationary positions) and syntactic and isovist values of space (Fig: VI.1).

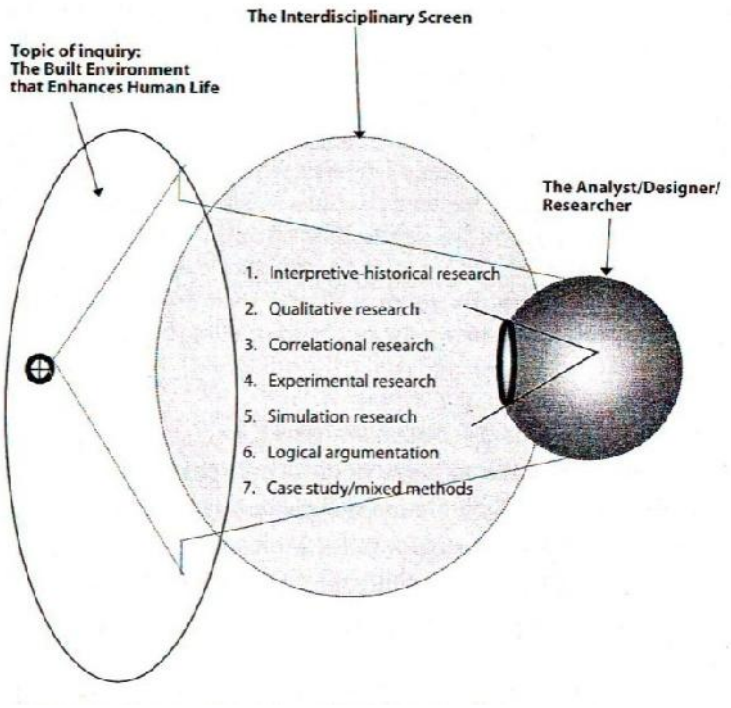


Figure VI. 1: Interdisciplinary research approach (Lang, 1987)

VI.1. METHODOLOGY: Process of investigation

VI.1.1 Objectives

First, the aim of this research is to investigate the pattern of occupation of plazas inherent to stationary activities or positions: sitting and standing people; however, moving people (crossing or walking around the plaza) are not considered. Second, is to look if there is any correlation between the space use (used and underused space) and the spatial properties of a given space; to look for links between visibility and spatial use. So to know in details the distribution of people, in other word the number of people throughout all the zones or subspaces or sub-settings of the plaza and the properties (isovist and syntactic) are a requisite for this study.

VI.1.2 Process of investigation

The process of investigation is based on three levels:

- First, the in-situ investigation that consists of observing, counting people and mapping their locations within each plaza, the snapshot method (defined in the previous chapter) has been used throughout the four plazas.
- Second, the isovist and syntactic analysis of each plaza (and its sub-settings): exploiting space syntax method by using Depthmap program to calculate isovists and syntactic values of the four Plazas, to generate graphs (values maps and scattergrams), and simulations (agents). This isovist and syntactic analysis is done on two levels: first, by considering the plaza in a 'large' urban structure as for this case the urban center district, in other words the plaza as a 'part' of a large 'whole' (surrounding). Because this thesis assumes that the use of space is governed by two major factors, its attractiveness in terms of movement, i.e. how easy for people to move in as its being to *movement* of *through-movement* space, and the conduciveness of its visual properties, such as visibility, (within a large surrounding) for people's activities. Second, by considering each plaza within its limits (its closure) and within a 250 meter-radius perimeter (surrounding) in order to explore the in details the properties (isovist and syntactic) of its parts, starting from the belief that a space may have many sub-settings or subspaces and that its use is determined by the affordances of and the properties of these sub-settings or subspaces. So the goal is to calculate and investigate the properties of these subspaces within the close surrounding.
- Third, a correlative, comparative, and interpretive study; to investigate for eventual correlations between on one hand people's spatial use (stationary positions) in terms of number and distribution of people (location) and on the other syntactic and isovist values of space (locations); measurements of isovist syntactic and values on both levels: the urban center district, and the 250 meter-radius surrounding. The comparative study aims to compare the four plazas use in term of the number of people engaged in stationary activities. Then to compare between the rate of use of each plaza and its spatial properties vis-à-vis the urban structure; looking for any eventual correlations.

VI.1.3 Basic theoretical notions and tools of the investigation

It is believed that there is a correlation between spatial configuration, i.e. intelligibility of the space, and people's behavior, movement and use of these spaces. According to Hillier (2005), spatial configuration of the street network shapes movement of people and that the position of a street in the overall grid affects to-and through- movement on this street. So configuration may be implicated in to-movement; directing to a specific destination or space that it is considered topologically more accessible than the other spaces in the layout (Hillier, 1992). He argues that that 'accessibility of destinations is a factor in the choice of destinations'. Space syntax considers movement as morphological issue where the relation between spaces is more topological than dimensional. In urban space, the configuration of the network of streets or the urban grid provides the means for people to get to the plazas and may have effects on people movement (choice). Thus the goal of this study is to examine the accessibility and attractiveness (not the built-form attractiveness) of the location of each plaza within the broader network, i.e. city center district, using space syntax techniques. So the investigation of each plaza is based on two scales; city scale and the surrounding scale. For The city scale, this study considered a sector that encompassed all the four plazas of the case study. The delimitation of this sector has just tried to cover as much area of the city center. For the surrounding scale, a 250 –meter radius area has been considered, the center of the plaza as origin. This is based on the literature pertinent to this matter (people navigation) that considers that spatial decisions rely on more proximal or nearby information.

VI.1.3.1 Syntactic Measurements

In space syntax, each space has two spatial properties: "local" inherent to its relations to its neighbors and "global" inherent to its position in the urban layout as a global whole. Therefore the measures which to be calculated for the four plazas are divided into two orders. The 'first order' measures are direct measures of the each plaza and the system (the zone selected for) and consisting mainly of 'local' measures: *connectivity* how many other lines are only one step of away from each line), *visual control*; (what degree of choice does each space represents for its immediate neighbors as a space to move to) and "global measure": integration (how many lines are up to *n* steps away from each line. The second order measures

are the relations among the first order measures, in term of correlation coefficient. The one that is considered in this analysis, which is the most important in space syntax, is "intelligibility" that represents the correlation between connectivity and integration. It permits to show to what degree 'the whole can be read from the parts' (Hiller, 1992). This would show how easy to get the plazas. Furthermore, some other values will be used such as Connectivity, visual control, and relativized entropy.

VI.1.3.2 Isovists and visual access

The visual access that is the degree to which different places and features can be seen and also the location from which people in a particular environment can see particular places and features (Montello, 2007). The visual access measure is examined using point isovists taken from the most integrated streets that surround or junctions that lead to the plazas to see to what degree is their overall layout is visible. The syntactic measures are calculated, first, considering the plan of the city center district including all four plazas examined, and then considering each plaza by itself within its surrounding of 250 meter radius from its center; It is supposed that walking people use spatial information up to 200 meter during navigation.

Syntactic analysis has been carried out for the plazas examined using Depthmap 07 software program developed by Alasdair Turner from UCL. The results of the analysis of the plan of the city center district including all four plazas and those of each plaza within its surrounding area have been given in Tables: measures of visual integration (HH), Connectivity, Visual Control, Relativized Entropy.

Overlapping these measures with the occupancy values of each plaza is the approach to look for any correlation.

VI.1.3.3 The pattern of use: people's spatial occupancy

The detailed analysis aims to explore why within each plaza some parts are busier and more preferred by people than others. In the analysis, it is intended to see if there is a relationship between stationary activities, both sitting and standing positions, and the syntactic and isovist properties of space. The plaza has been subdivided into subspaces based on its physical properties.

VI.1.3.4 Visibility graph analysis (VGA) method

Visibility graph analysis (VGA) method, i used to calculate the visual integration of each space, is limited only to the boundary of the public space (the observer being inside). The results were analyzed according to the position of people in stationary activity.

VI.1.3.5 Isovists

The convex isovists method has been used to analyze the size of the visual field from 'hot spot' for stationary activity inside the square. Then the visual fields areas of public spaces (including surrounding spaces) have been quantified and compared individually in order to see if there is any correlation between the stationary's people location and the size of the visual field.

VI.1.3.6 Agents Simulation; human like movement

In order to examine these findings and to look into the assumption that people avoid movement spaces for stationary activities such as sitting and relaxing, an agent test has been carried out using Depthmap program. It consists of releasing a number of agents which show human-like movement with a 170° field of view (Turner, 2003) within El Houria Plaza at a 150-meter radius to track their movement trajectories.

VI.2 IN SITU OBSERVATION: Direct observation

VI.2.1 Preparation of the observation: observation documents

Many site visits have been made in order to prepare prior the observation in order to get fixed up and avoid unpredictable situations. This showed that it would be more effective to have more than one observer by plaza. The large size of some of them and the invisibility between parts of the plaza itself (due to the obstruction of physical elements) would make the

observation inaccurate. So the solution is to subdivide each plaza to subspaces, using some physical objects as landmarks for their delimitations. Therefore observers do not have to move from place to place, they could just stay in any location to see the entire space to be observed. Moreover, to make the observation and people counting easier and more accurate detailed layout plans (using Archicad) of these plaza's subspaces have been drawn; indicating all physical elements of the site; any urban furniture: poles, flower beds, seats and so on.

This subdivision is as follows:

El Houria plaza

This plaza has been divided into six subspaces (A,B,C,D,E and F) to facilitate the observation. As explained earlier this subdivision is made so each subspace could be observed easily from any point within it. One observer is affected to each subspace. A detailed plan of only the subspace affected to, showing the important physical features and the space boundary, is handed out to each observer (See appendix) accordingly seven observers were affected to this plaza.

Dalaa Plaza

This plaza too, due to its important size and irregular shape, was divided into three subspaces (A, B and C). Therefore three observers were affected to this plaza, one to each subspace with a detailed plan indicating all the existing features and the boundaries (landmarks used for the purpose of this investigation). Three observers were affected to this plaza (See appendix).

Zwaka plaza

Zwaka has been divided into three subspaces (A, B and C). As the layout consist mostly of greenery with crossing pathways, trees create a visual buffer between different parts of the plaza. So the subspaces cannot be visually observed fully from one point. This situation called for the observer to move within the subspace affected to in order to get the people observation done efficiently. Three observers were affected to this plaza (See appendices).

Larbi Ben Mhidi Plaza

Due to its small size this plaza has been divided into two subspaces (A and B). However observers needed to move slightly in order to visually dominate all the area because of the existing trees that prevent visibility.

VI.2.2 In situ observation

Just before the start of the observation, a short seminar had been organized with the observers to talk about the survey, how to proceed, and the instructions to follow. After that we proceeded to the dispatching of the observers; each one has been affected to a subspace and handed out a plan. Then I went with each group to the affected plazas, and showed them the limits of each subspace, and emphasized on the physical elements (to be used later as landmark during people counting and location). So the duration and the precise time the observation were given to the observers.

The survey has been done by a group of students (high school and university) and university lecturers.

The method consists of static snapshot. To count people in stationary activities within the subspace; people considered by this research are divided into two different categories: according to sitting and standing. So the task of the observers is to record these two forms of occupation and their locations; to indicate these observations on the plan: sitting people with a dot and standing people with a circle. Two things are not carried out by this observation: type of activity people are engaged to and moving people, because these are not relevant the present study.

Surveys were done on two days; a weekday and a weekend, on the 4th and 7th of August 2008 in the late afternoon from 7pm to 8pm. This observation time was chosen where the weather is conducive to outdoor activities in order to avoid the impact of the climatic factors which may alter completely the use of the squares mainly and as well as the goal of the investigation. Taking as reference Hillier findings that weather does affect static behavior, although does little on natural movement (natural movement...). All the plazas were observed

at the same time for 20 minutes period. So the observation consisted of reporting and counting people in stationary activities; not moving. Nevertheless, static people are being sorted into two categories of those sitting in the formal sitting places and those in standing position or sitting in informal places such as on the trees borders, the flower walls and so on. The type of activity people are engaged to is not relevant the present study.

In this research, only the total number of all static people is considered for the three plazas: Dalaa, Larbi Ben Mhidi, and Zwaka. Meanwhile for El Houria plaza that is the space to be deeply investigated, all the survey details will be considered.

VI.3 INVESTIGATION OF THE FOUR PLAZAS

VI.3.1 El Houria Plaza Analysis

There are six subspaces, A, B, C, D, E, and F, determined and presented in Figure VI.3. The main physical property that determines the subspaces are the level difference of 1.20 meters, which is connected by series of steps. Within these two zones created by level differences there are subspaces that are defined by the layout of the plaza furniture such as sitting benches, vegetation pods, and the memorial wall. The upper level is subdivided into two subspaces, A and B by the presence of the memorial wall, while the lower space is subdivided into four subspaces, C, D, E and F by the built-in sitting benches and the row of the boutiques. The subspace E embraces the main movement axis of the plaza with a linear fountain (Fig: VI.2).

Figure VI. 2: El Houria plaza within its surrounding (Google earth, 2011)

VI.3.1.1 Pattern of occupancy: static people mapping

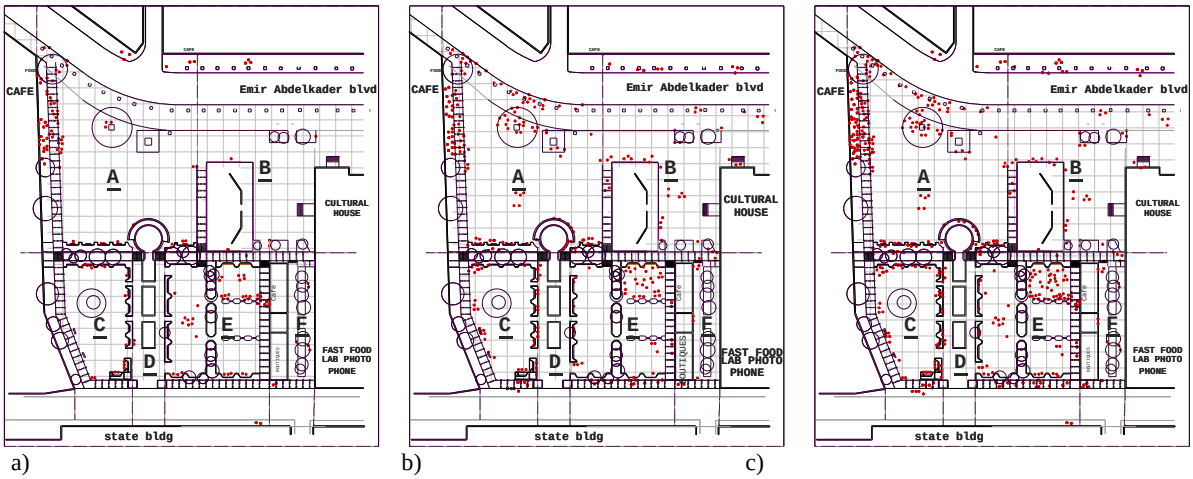
The results showed on table.VI.1 and represent static people distribution throughout all the plaza; over all the subspaces (A, B, C, D, E, F). The counting of static people differentiates three categories: people sitting in formal sitting places, in terrace café and standing or sitting in informal spaces. Therefore the results may give several ways of interpretation. For the present thesis the goal is to look for any link between people use and occupancy (static) of space and the properties of that space no matter of the type of people's activities. However, static people counting has included people sitting in terrace café, assuming that people are attracted more by the sitting places rather than by the service since there are more than on café in the plaza (possibility of people to choose). Despite this situation, the results can be interpreted into three ways in the perspective to have better understanding of the issue according to this thesis' goal. First, if, we consider all static people, no matter where they are sitting or standing, the results show that the subspace (A), situated in the upper part of the plaza, presents the higher number of people (245) and the subspace (F), situated in the lower part, presents a number of (114), however, the subspace (F) of the lower part of the plaza presents the t least number (09). Second, if we consider all static people without considering those sitting in terrace café, the results show that the subspace (A) still presents the higher number of people (148), followed by the subspace (C) with a number of (60); it is important

to mention that this space does not have any sitting places. Third, if we consider only people standing or sitting in informal space (in this case people are attracted by neither sitting places nor services), the results show that, yet again, the subspace (A) presents the higher number of static people (103) followed by the subspace (B) with a number of (60). It is important to recall that these subspaces are situated in the upper part of the plaza limited by the El Emir Abdelkader Boulevard.

These interpretations illustrate that people's spatial occupancy is not principally governed by services provided within the plaza and that the existence or not of the formal sitting places (benches, seats). This is well illustrated by the subspace (B) that presents the second higher number of people (60). Although it does not provide any formal seating (Table:VI.1).

Table VI.1: Shows the number people of each type of static position according to subspaces of the plaza.

Plaza name		Static activity type / subspaces	Sitting–Formal Sitting Places Nbr. of people	Sitting in terrace café Nbr. of people	Standing and sitting in informal spaces Nbr. of people	Total number of all static people
El Houria Plaza	Higher Space	A With sitting places	45	97	103	245
		B No sitting places	00	00	60	60
	Lower space	C With sitting places	57	00	13	70
		D With sitting places	16	00	00	16
		E With sitting places	18	58	38	114
		F No sitting places	00	00	09	09
			136	155	223	514



a) b) c)

Figure VI. 3: number of all static people within the subspaces A, B, C, D, E and F of El Houria plaza (people represented by dots): a) Weekend b) Weekday c) Two date aggregate.

The first assessment about the behavior mapping of the spatial occupancy of the plaza shows that the space occupancy of the upper zone, which is connected to a major street, is remarkably higher than the lower zone mainly on the weekday. For subspaces A and B located on higher zone, the number of people is 99 on weekend and 216 on weekday. However for the subspaces C, D, E, and F, located on the lower zone, the number of people is 78 on weekend and 132 on weekday. However, if we consider only the stationary people of standing position or sitting in informal space, the number of people represents 43% of the total number of people using the plaza; moreover if we also omit people sitting in the cafes this rate would increase to 62%. It is also seen that most of standing people (3/4 of all standing) occupy the edge of the higher zone along El Emir Abdelkader Boulevard and the rest (1/4) occupy the lower zone along the street leading to a popular market. This observation suggests that people's choice and preference of their locations is not tied directly to the availability of sitting areas. The effect edge is noticeable on the map both for the plaza as a whole and for the subspaces created within the plaza. Within the subspaces that provide formal sitting places, it seems that the subspaces C and A are preferred by people for sitting, meanwhile, the subspace D that is considered as the main axis of movement within the plaza and the space E shows very weak occupancy rate. (Table VI.2)

VI.3.1.2 Visibility analysis and patterns of occupancy of the plaza: overlapping static people map with syntactic and isovists measurements.

Syntactic and isovists measurements of El Houria Plaza is given in Table VI.2, while the visual graph analysis overlapped with behavior mapping of the plaza is given in figureVI. 4. As it can be seen from the figure, the most integrated zones (VI.4 = 0.92) are used by stationary people in standing or informally sitting position and that stationary people in sitting position overlap with less integrated spaces (VI= 0.56) corresponding to some of the sitting places of the plaza. Results on Table VI.3 show that for the subspaces A, B and E there is a correlation of the integration value and number of all static people; the higher integration value the higher the number of people(Fig VI.4, VI.5) Moreover, it can also be seen that for subspaces A and B, stationary people in standing position or sitting in informal spaces, which represent more than four times those sitting in formal sitting spaces, are found around the intersection of the two longest lines of sight (Fig:VI.8). However, exception is for the

subspace C that has a low integration value and a high number of people. Furthermore, this subspace is secluded from the main lines of sight and has the lowest visual control value (0.41). It must be mentioned here that sitting positions represent around 80% of all stationary people in this subspace C (Fig VI.6,b); it is considered as a secluded area that may match the earlier results (Campos, 2005; Papargyropoulo, 2006) that sitting activity takes place more in visually secluded spaces. Nevertheless, these sitting spaces do provide a certain control of the view of their surroundings. As it can be seen from the figure 9(a), the isovist taken from the center of the busiest subspace C for sitting position covers only visual field within the plaza (Fig VI.9 ,a), while the isovist taken from the busiest subspace A for standing position, given in Figure VI.9 (b), provides visual fields covering all the plaza space and even extending to the surroundings.

Table VI.2: Shows the number people of each type of static position according to subspaces of El Houria plaza and their corresponding Syntactic and isovists measurements.

Plaza name		Static activity type / subspaces	Sitting–Formal Sitting Places Nbr. of Peopl.	Sitting in terrace Café Nbr. of people	Standing and sitting in informal spaces Nbr. of people	Total number of all static people	Intgr. (HH)	Visual Ctrl.	Connec--tivity
El Houria Plaza	Higher Space	A-With sitting places	45	97	103	245	0.78	0.60	0.76
		B-No sitting places	00	00	60	60	0.66	0.54	0.61
	Lower space	C-With sitting places	57	00	13	70	0.57	0.41	0.54
		D-With sitting places	16	00	00	16	0.65	0.44	0.57
		E-With sitting places	18	58	38	114	0.69	0.49	0.68
		F-No sitting places	00	00	09	09	0.54	0.42	0.28
			136	155	223	514			

Table VI.3: Syntactic and isovists measurements of El Houria Plaza

	Integration HH	Visual control	connectivity	Nbr of people
Subspace: A	0.78	0.60	0.76	148
Subspace: B	0.66	0.54	0.61	60
Subspace: C	0.57	0.41	0.54	70
Subspace: D	0.65	0.44	0.57	16
Subspace: E	0.69	0.49	0.68	56
Subspace: F	0.54	0.42	0.28	09

Figure VI. 4: Visibility graph analysis overlapped with two-day aggregate stationary people behavior mapping, El Houria Plaza. Standing zones (encircled) overlap with the most integrated spaces of the plaza (the darkest color)

a) b)

Figure VI. 5: El Houria Plaza , photo (a) showing the use of the edge of the plaza along El Emir Abdelader Blvrd , Photo (b) the central part (fountain) deserted.

a) **b)**

Figure VI. 6: Photos, showing parts of El Houria plaza a) the higher part along Emir Abdelkader Blvd and its high usage despite the lacks of seating places, b)The low part totally empty despite the availability of seating places.

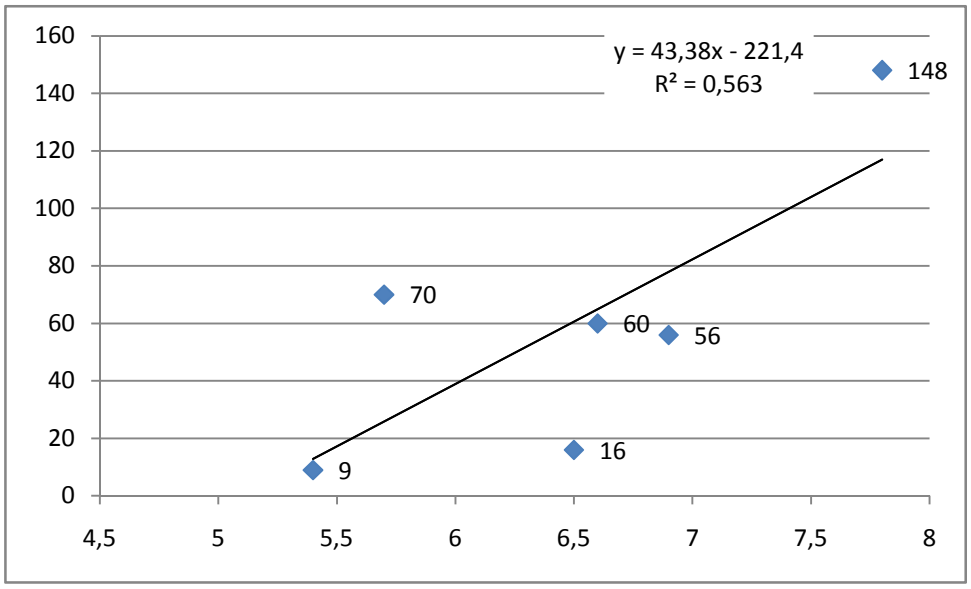


Figure VI. 7: Scattergram *for integration (HH) values against static people of A,B,C,D,E and F zones of El Houria Plaza (excluding those sitting in terrace café).*

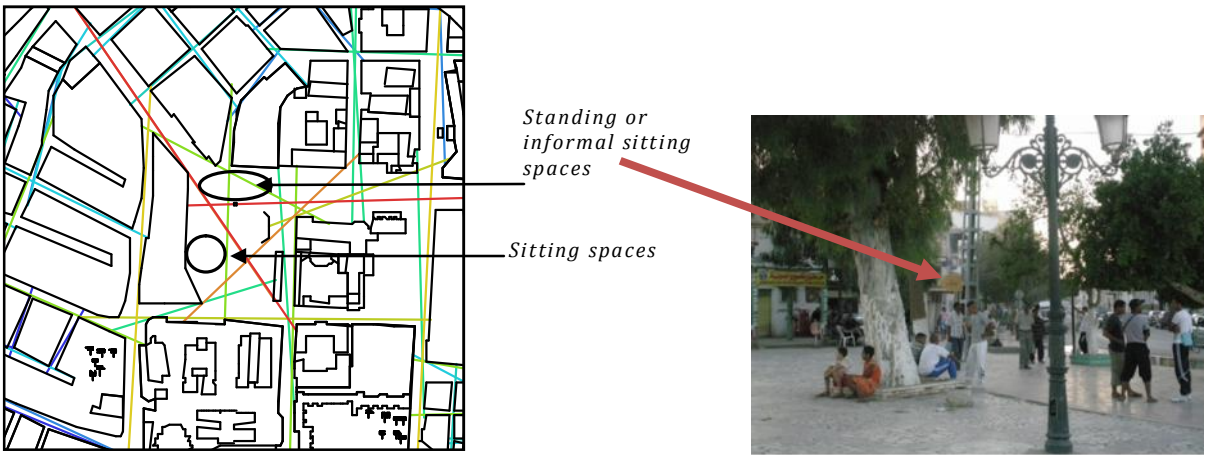


Figure VI. 8: Axial Map (few lines the locations of activities According to the longest lines).

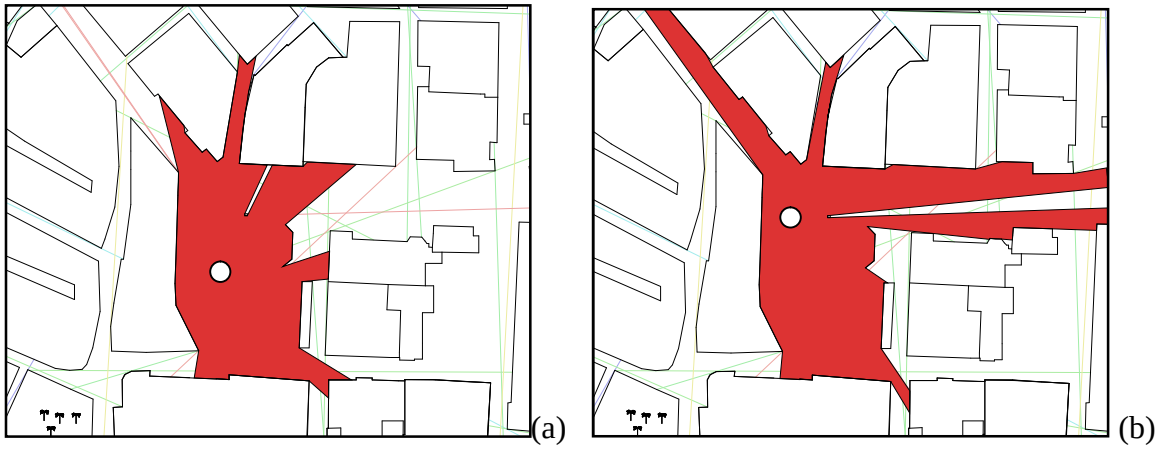


Figure VI. 9: (a) Isovist from the busiest sitting space; large isovist provides local views. (b) Isovist from the busiest space for stationary activities for standing positions or sitting informally; a "spiky" isovist, views towards covering plaza and the surrounding.

Figure VI. 10: Photos from the root of isovist (b) ; showing the vistas provided

Figure VI. 11: Photos from the root of isovist (a); showing the vistas provided from this area.

VI.3.1.3 Agents simulation

In order to examine these findings and to look into the assumption that people avoid movement spaces for stationary activities such as sitting and relaxing, an agent test has been carried out using Depthmap program. It consists of releasing a number of agents which show human-like movement with a 170° field of view (Turner, 2003) within El Houria Plaza at a 150-meter radius to track their movement trajectories. The results show that the busiest sitting spaces, subspaces A and C, correspond to the least spaces used as there are few traces by the agents or not used at all (Fig VI.12) Thus these sitting spaces are away from people's natural movement, which is believed to be guided by the spatial configuration of the spaces, and consequently provide a seclusion aspect. However, the sitting spaces, the subspace E and D overlap partially by the agents' trajectories. This might be interpreted that the reason why these subspaces E and D are not as much used as the other sitting subspaces, despite their

affordance of sitting areas, as being too much visually exposed. Comparatively, the spaces used by standing people overlap with the 'medium' density of agents trajectories.

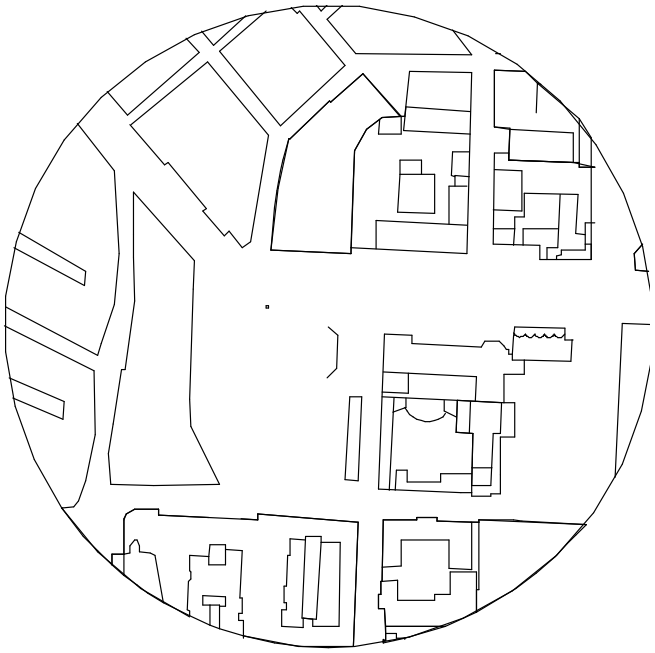


Figure VI. 12: ***A test of the behavior of the agents showing their traces within El Houria Plaza and its surrounding***

VI.3.2 Dalaa Plaza analysis

Dalla Plaza is characterized by its irregular shape (Fig VI.13). For the sake of the observation (to be handier) Dalaa Plaza has been divided into three zones (A, B, and C). However the plaza is in fact composed of three distinct zones divided vehicular ways; a zone as continuity of some surrounding buildings (Z2), and a zone bounded by a vehicular way (an island like) (Z3); a zone around the hill (Z1), for the purpose of the analysis this zone has been also divided into three sub-spaces (Z1,A; Z1,B and Z1, C) due to Its irregular shape (lack of intervisibility).(Fig VI. 14)

Figure VI. 13: Dalaa Plaza within its surrounding.(Google earth, 2011)

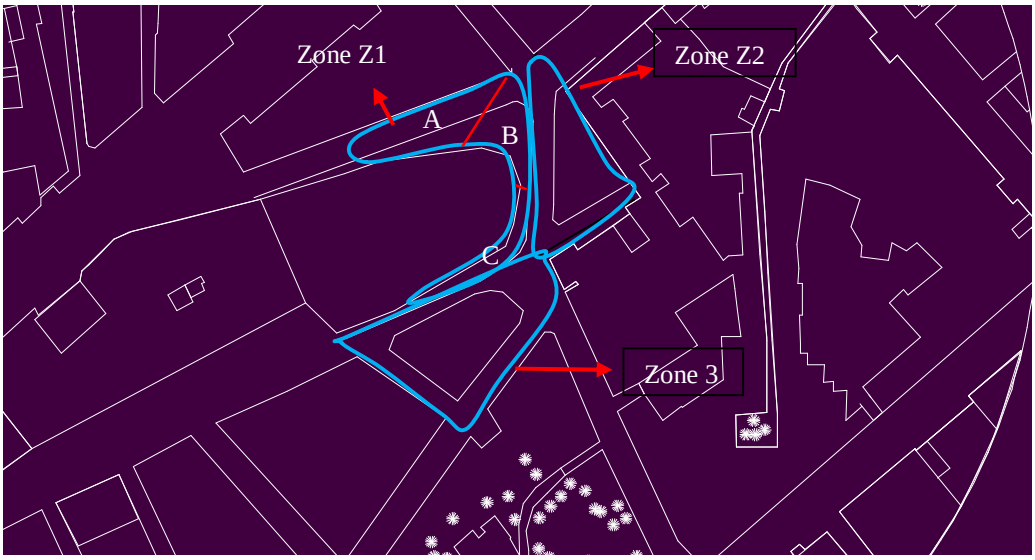


Figure VI. 14*: Dalaa Plaza: Pedestrian space consists of three major zones; a zone around the hill (Z1) which is subdivides into three sub-space A,B, and C.; a zone as continuity of some surrounding buildings (Z2);, and a zone bounded by a vehicular way (an island like) (Z3);*

VI.3.2.1 Pattern of occupancy: static people mapping

Static people are set into three categories: those sitting in formal seating places; those just standing (not moving), and sitting in informal places (not on sitting benches); and those sitting in terrace café. In order to make the investigation more accurate in terms of the relationship between people spatial occupancy and the spatial properties, people sitting in the terrace café in zones Z2 and Z3 have been excluded (though being counted during)

observation survey). However zone Z1 has no terrace café. So the counting shows that the number of people on two-day aggregate is as follows: Z1 (A, B, and C) is 80; Z2 is 82; Z3 is 103. (Table VI.04).

Table VI.4: Shows the number people of each type of static position according to subspaces of the plaza; Z1,Z2, and Z3.

Plaza name		Static activity type / subspaces		Sitting–Formal Sitting Places Nbr. of People	Sitting in terrace café Nbr. of people	Standing and sitting in informal spaces Nbr. of people	Nbr of static people excluding those of terrace cafe	Total number Of all static people	Intgr. (HH)	Connec--tivity
Dalaa Plaza		Z1- With sitting places	Z1,A	12	0	24	36	36	0.73	0.35
			Z1,B	11	0	14	14	24	0.82	0.46
			Z1,C	02	0	18	18	20	0.64	0.44
		Z2 - With sitting places		10	21	72	82	103	0.77	0.46
		Z3- With sitting places		20	24	83	103	127	0.61	0.36
				53	45	212	265	310		

According to people counting it seems that the three zones attract almost the same number of static people. However the people counting map (Fig VI.15) shows that people distribution over space is unlike. In the Zone Around the hill people's spatial occupation is diffuse despite some density at the corner. The zone at the boundary of some buildings despite having the less number of people shows a very dense occupancy mainly on the corner.

The overlapping of syntactic and isovists maps reveal much information. The zone the most integrated represented in red and circled (Fig VI. 17) is on the zone at boundary of buildings. The number of static people inside this most integrated zone is 72; around 23.29 per cent of the total number of static people within the plaza, which is important if we consider the smallness of this zone's area comparatively to the plazas.

Figure VI. 15: ***All static people map*****, Dalaa Plaza**

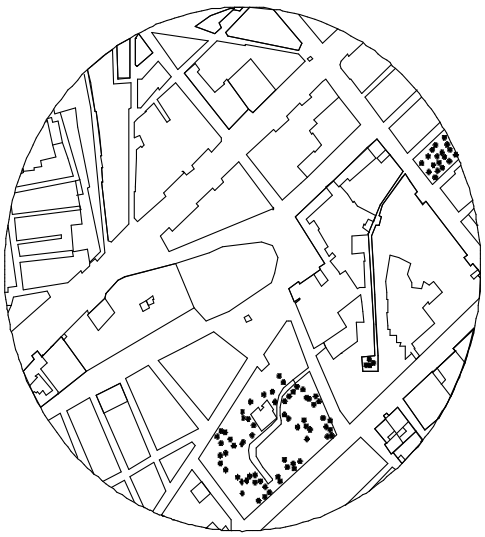
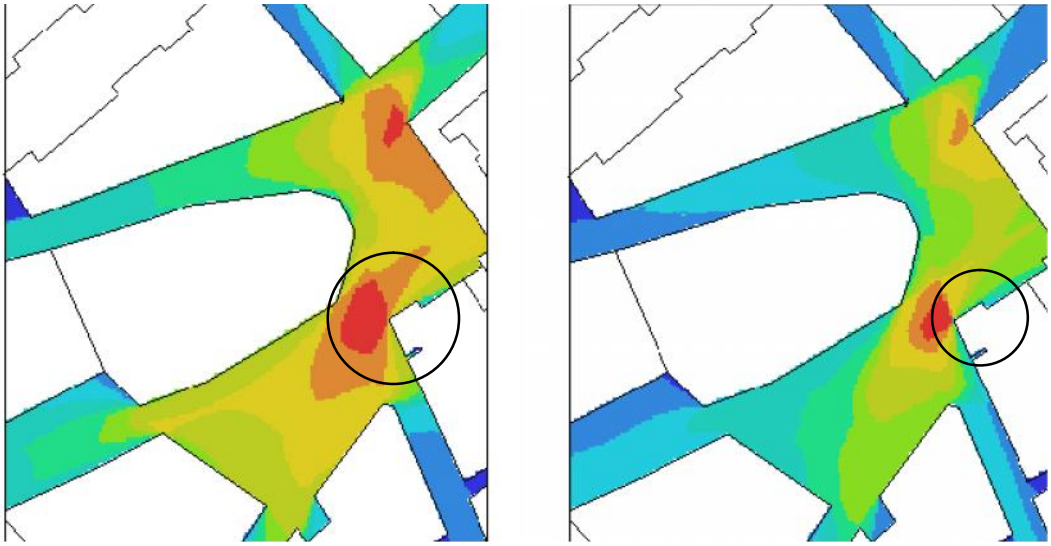


Figure VI. 16: ***Visual integration within a 250 meter-radius perimeter***



a) b)

Figure VI. 17*: VGA Dalaa Plaza (within the plaza's boundaries): a) connectivity b) integration*

VI.3.2.2 Visibility analysis and patterns of occupancy of the plaza: overlapping static people map with syntactic and isovists measurements.

In order to look if there is any correlation of spatial occupation and visual fields many isovists were generated. Furthermore two parts are considered within each isovist's polygon: the root area which is the neighboring area around the isovist's vantage point, taken randomly at a 10-meter radius area; and the rest of the polygon area (subtracting the root area). The goal is to compare between people that watch and those being watched within the same isovist's polygon (believing that people's main purpose in public space is to watch other people). In other words, to see the number of people (occupying the root area) whose visual perception is similar to the isovist.

First, isovists were drawn from densely occupied root positions to investigate the nature of the isovists and if there is any correlation between visibility and the presence of people in these spaces rather than others. This isovist also permits to see the number of people 'covered' within it (away from the root area); to verify what was mentioned in the literature part of this thesis that people's main activity in public spaces is to watch other people. So the isovist drawn from the most dense zone (Z2) (the highly integrated) shows that the polygon of the isovist covers all the used spaces of the plaza (Figure:VI.19); in other words from this

isovist's root area all static people using the plaza are visible; say 100%. However the isovist generated from the second densest zone (Z3), which is bounded by vehicular way, covers partially the people using the plaza (Fig VI.20). So the isovist covers only the most integrated zone. If we abstract the people within the root area, the isovist covers 55.4 % of the total number of people using the plaza.

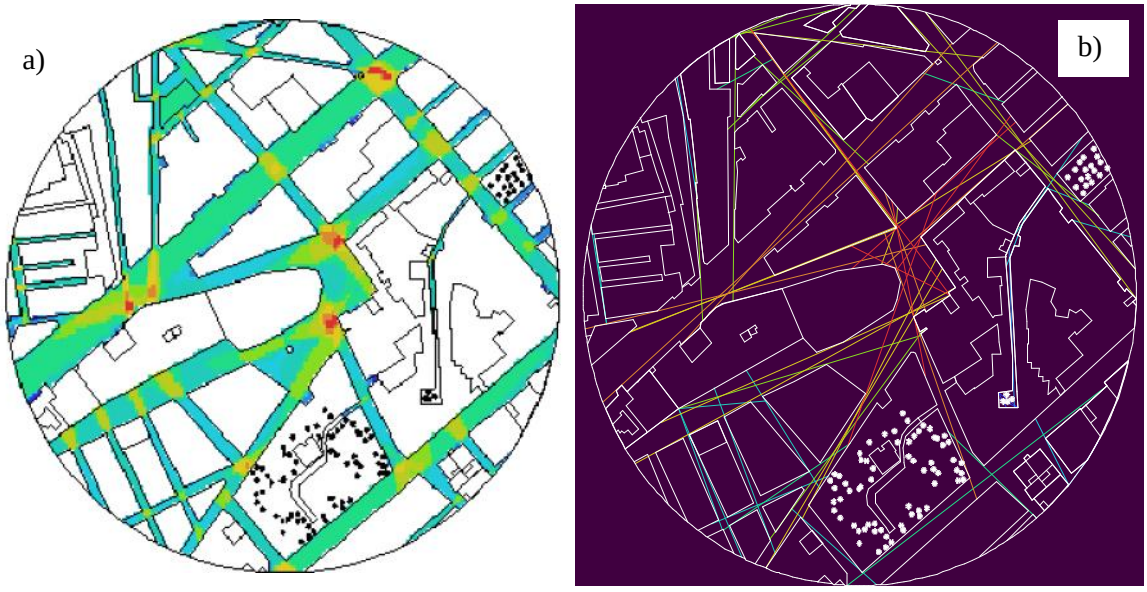


Figure VI. 18*: Syntactic measurements within a 250 meter-radius perimeter, Dalaa. a) Visual control value b) the fewest lines map coincide, the well integrated lines (red) match with the most occupied zones.*

The isovists from the less dense zone (Z1) are diversified due to the geometrical shape and the obstruction created by the presence of the hill (Fig VI.21) Therefore three isovists were generated from three different vantage points (according to the subdivision carried out earlier). They showed that isovists shape change shapely. For instance, f the isovist (Z1,A) covers 105 people , excluding those around the vantage point (20 people), which is about 33.8% (table VI.I5). However the present isovist covers deeply the vehicular way passing by the plaza. Figure VI.24 shows how the compactness of the isovist grows progressively and cover simultaneously a greater number of people. But what is noticeable is that the number of people around the vantage point does not follow the same logic, because in figure VI.34 it is shown that despite the covering of an important number of people using the plaza, people present around the vantage point of the isovist (Z1, C) is the least; 1.7% of the total people

covered by the isovist area. This is also in spite of the shape of the isovit that cover deeply a street that leads to a major boulevard.

It is important to mention about the spatial occupation of the plaza that the most integrated space is not really the most occupied zone compared to the other zones; however, is the densest space if we consider the number of people and the area of this zone(fig VI.19). Furthermore, this zone layout does not provide a lot of sitting places comparatively to its high occupancy.

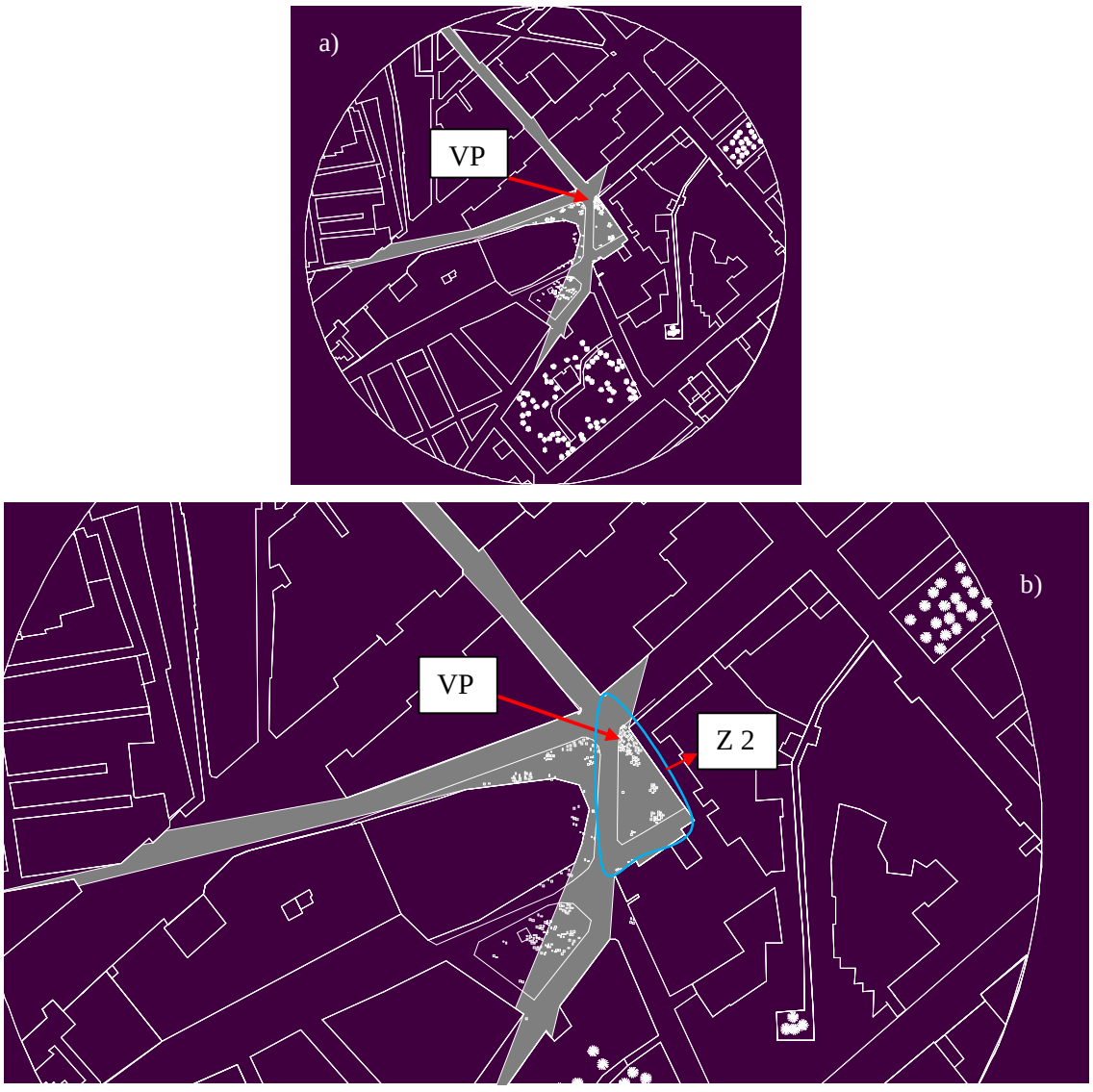


Figure VI. 19*: a and b showing the isovist drawn from the most integrated zone (Z 2) (vantage point (VP) at most densely used space) and people (represented in white dots) covered by this isovist: a) shows the 'spikeness' of the isovist, how deep (several visual directions) is in the surroundings; b) show the parts of the all static people being covered by the isovist.*

Figure VI. 20*: Showing the isovist drawn from the most used zone (Z 3) (though not the most integrated) as vantage point showed in red, and people (represented in white dots) covered by this isovist.*

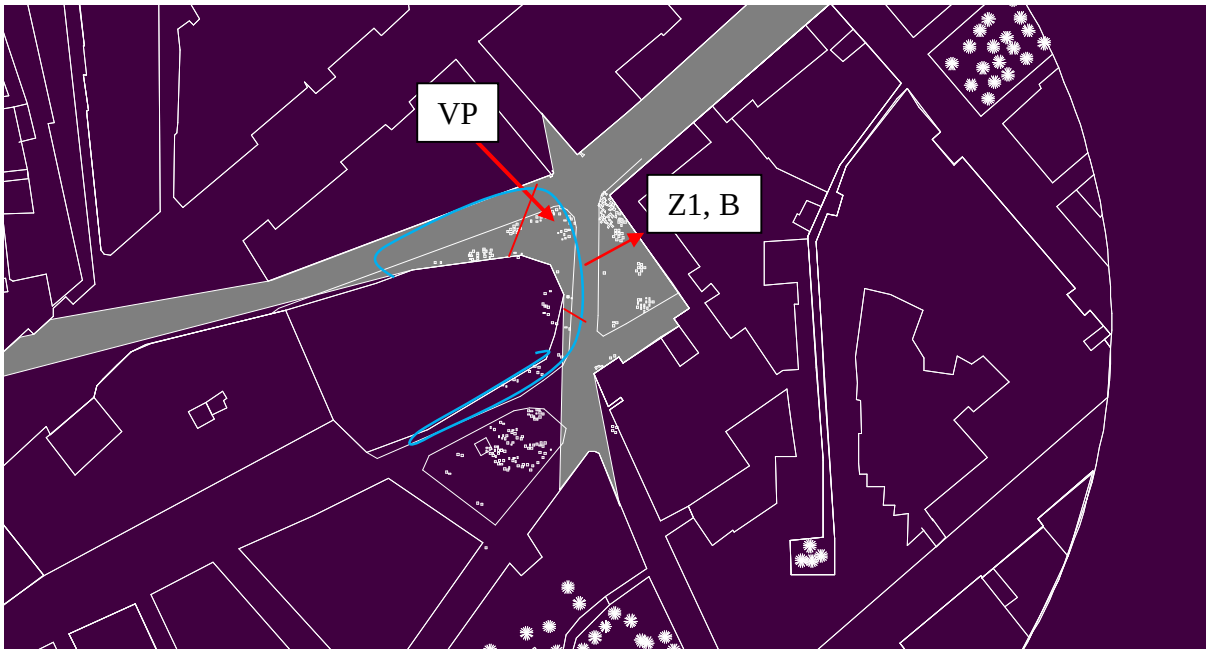


Figure VI. 21: Showing the isovist drawn from the 2nd most used zone (as vantage point at Z1,B) and people (represented in white dots) covered by this isovist.

Figure VI.22: ***the isovist drawn from the less used area [vantage point in red in the zone (Z1,C)] and people using the plaza covered by the isovist.***

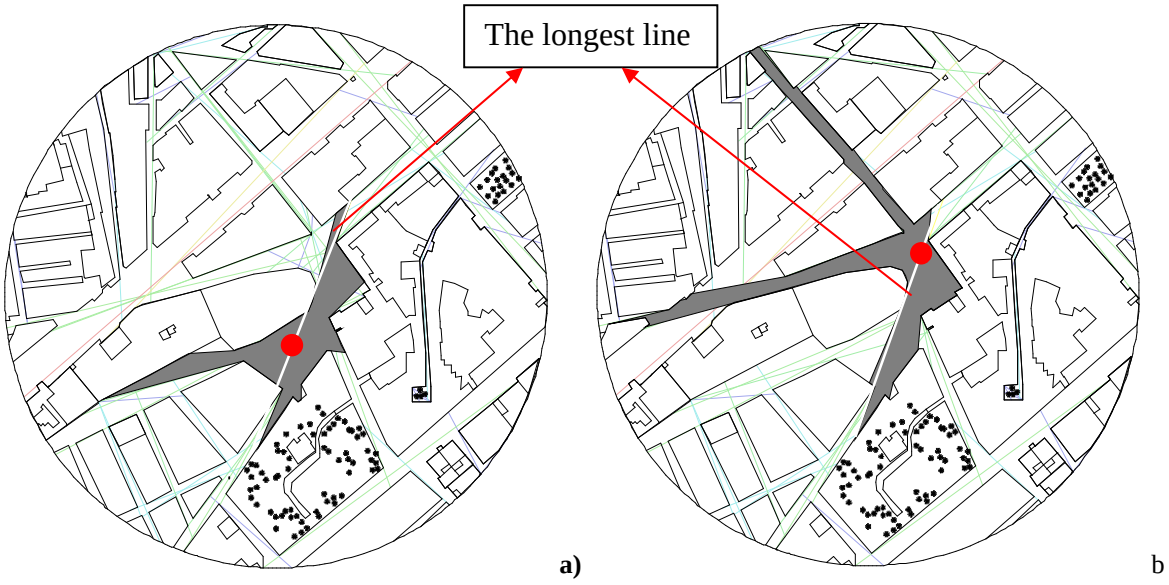


Figure VI.23*: isovists from the two most used zones ; a) from a vantage point on the longest line passing through the plaza; a 'fat' isovist b) from a vantage point the intersection of three longest lines passing through the plaza. This coincides with the densest used zone, a 'spiky' isovist.*

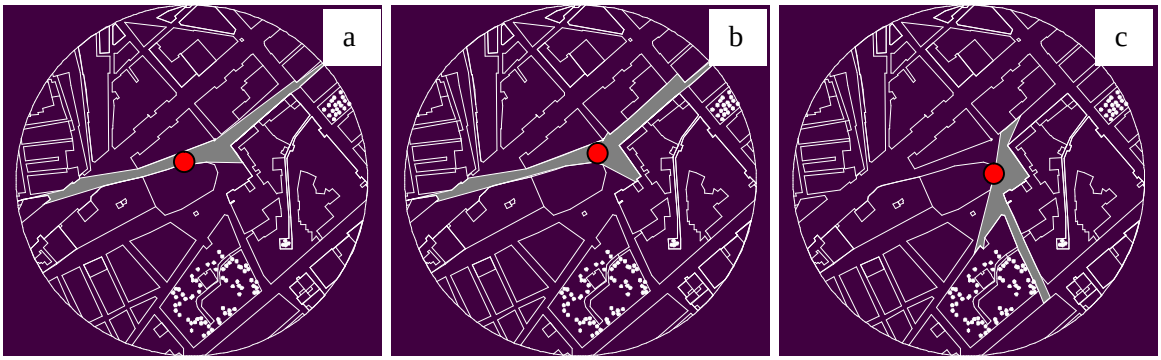


Figure VI.24*: Isovists from different vantage points of the less dense zone (sparsely) (Z 1: Z1,A; Z1, B;Z1; C). This shows that that in 'a) and (b) isovists are less compact, more linear.*

VI.3.2.2.1 Visual access: The Plaza attractiveness

As a seen in literature, visual access is a decisive factor in public spaces' use (Montello, 2007). It is to know about whether a space provides some visual 'hint' or not in order to be accessed by people moving within its surroundings. The investigation relied on two tools. First, it consists of drawing isovists from the main streets junctions leading to the plaza, frères Saouli street, The Zaatcha street and El Emir Abdelkader street (fig VI.25). Second, it is done through agents' simulation using Depthmap program. It seems that isovists polygons shape as being 'spiky' do not give people moving within the surrounding much information (visual) about the plaza that has mostly a sense of enclosure. This has been confirmed by the agent's simulation, which was indented to see how agents move around the surrounding urban areas and how they get into the plaza. Therefore agents were released within a 250-meter radius area at the five main streets junctions at the periphery of the plaza; leading to the plaza. 10 agents were released on each junction. This would indicate how visually is attractive (visual access) to moving animates, and obviously simulating people's movement (purposive) within the surrounding areas. The results of the agents' trails (their density) show that animates (agents) released on the street junction of Zaatcha Street, which is the most important street of the city, did not choose or take barely the street that leads into the plaza. (fig VI.26). In other words not enough information of the plaza are provided from this junction to invite animates to go in; lack of visual access. However those released on the streets junctions of El Emir Abdelkader boulevard and of The frère Saouli Boulevard with the streets linking to the plaza did go in a greater number (the highly dense agents' trails indicate the degree movement from that junction; either into or out of the plaza).

The overlapping of agents trails and the all static people map shows that most used spaces are out of the movement patterns of agents except for one area (the zone surrounded by vehicular roadways). But it is noticeable that the dense agents' traces overlap with the vehicular roadway of the plaza. This would let some doubts about the people's spatial occupancy; whether they purposely avoided intentionally the space of dense movement or it is just a consequence of the layout of the plaza, where the vehicular roadway overlap with the dense agents traces; that evidently could not be used by pedestrian for static activities.

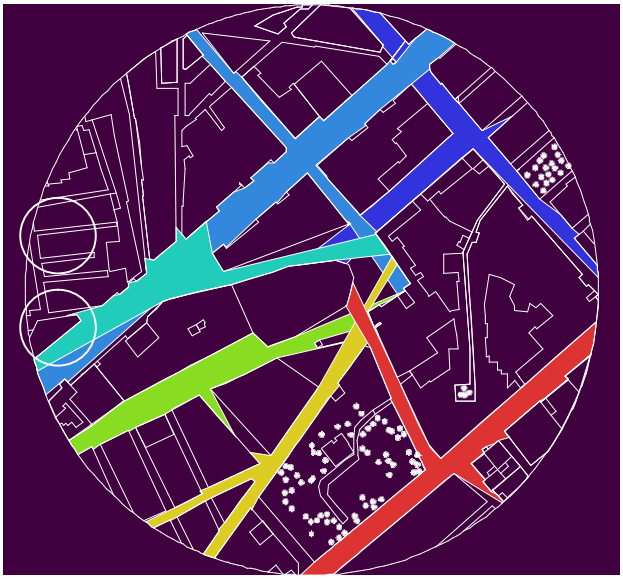


Figure VI.25: ***Isovists from the accesses (six streets) to the plaza; this shows how is visually exposed while getting in the plaza and that the zones the best covered (superposition of isovists) overlap with the most used zones.***

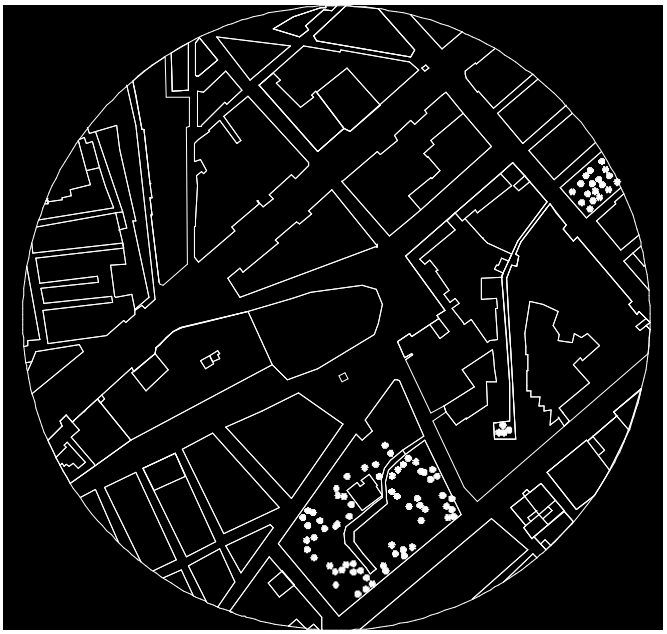


Figure VI.26: Agents's traces

a)

b)

c)

Figure VI.27*: a, b, c; overlapping people's spatial occupation and visual integration map (different scale).*

VI.3.2.2.2 People distribution and Isovists' polygon

In order to investigate people's spatial use according to the concept of *refuge* and *prospect*, developed in the literature section, that deals with people use of space in term of 'seeing'; to see (to control and dominates the scene; to watch other people) or to be seen (by others; exposed).Therefore this investigation assumes that the isovist's polygon has two major zones: a root area which dominates and covers visually all the isovit's area, and a the rest of the isovist polygon that may cover just a partial parts of the isovist's area; depending on the shape of the polygon's shape. Subsequently, two spaces are considered in isovist's polygon in people (covered by the isovist) counting: a space of 20-meter diameter around the vantage point (dimension taken at random), and the rest of the isovist's polygon.

Table VI.5*:* Number of people per isovist field; the vantage point area (root area) and the zone covered by the isovist polygon for three zones of the plaza

Isovists Root Zone of Isovists / nbr Of people		Isovist From Zone (Z 2); (vantage at the most dense zone)	Isovist from zone (Z3); (vantage at the most dense zone)	Isovist from the less integrated zone ; Z1		
				(Z1, A); (vantage at the average dense zone)	(Z1, B); (vantage at the most dense zone)	(Z1,C); (vantage at the lesst dense zone)
Nbr. Of people	Root area	66	117	20	35	4
Nbr. People Excluding those of the root	Zone covered by the isovist	244	211	105	121	235

Figure VI.28: Isovist from Z2 and photos showing the real vistas (1,2,3,4) seen by people occupying the root area of that isovist.

a)

b)

Figure VI.29*: Isovist Z 2: a) all the isovist's area and b) showing the number of people within the root area (20-m diameter circle) of the isovists from the most integrates zone.*

Table VI.6: ***Syntactic values of root areas of isovists drawn from the most occupied zones and number of people within the root area and those covered by each isovist: Dalaa plaza.***

Measurements / Root area		Intgr. HH	Clustr. Coef.	Visual Entropy	Visual Control	Connectivity	Nbr.People within the root area	Nbr.People covered by the isovist
Isovist : Zone (Z 2);		0.88	**0.10**	0.25	0.72	0.62	66	244
Isovist : zone (Z3) ;		0.57	0.43	0.40	0.42	0.34	117	211
Isovist :Zone (Z1)	Z1,A	0.73	0.23	0.19	0.56	0.48	20	105
	Z1,B	0.82	0.46	0.27	0.38	0.37	35	121
	Z1,C	0.62	0.33	0.46	0.50	0.43	**04**	235

Table VI.7: ***Isovists' polygons measurements and number of static people; Dalaa Plaza.***

Syntactic/ Occupancy / Isovist		Isov. Compact.	Isov. Drift Angle	Isov. Occlusivity	Nbr.People within the root area	Nbr.People covered by the isovist
Isovist : Zone (Z 2);		0.06	187.24	809232	66	244
Isovist : zone (Z3) ;		0.11	71.44	44702	117	211
Isovist :Zone (Z1)	Z1,A	0.056	107.57	13527	20	105
	Z1,B	0.05	171.36	748611	35	121
	Z1,C	**0.07**	264.43	521560	**04**	235

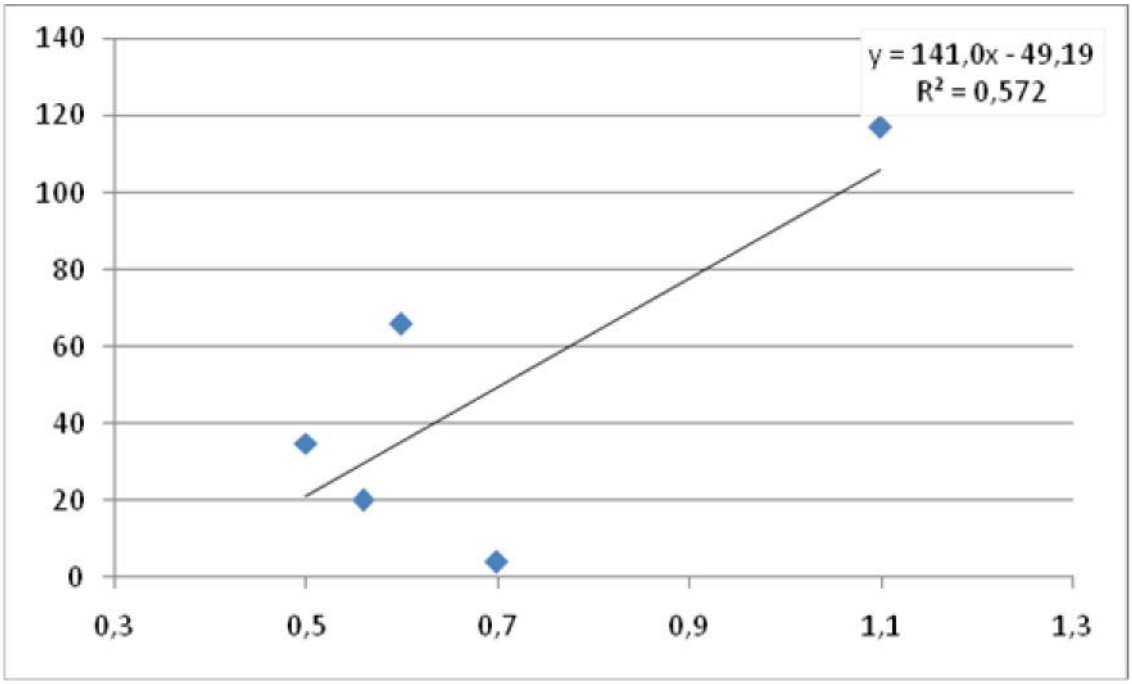


Figure VI.30: ***Scattergram isovists compactness values against the number of static people within the root area of isovists Z1,A; Z1,B;Z1,C; Z2; Z3, Dalaa Plaza.***

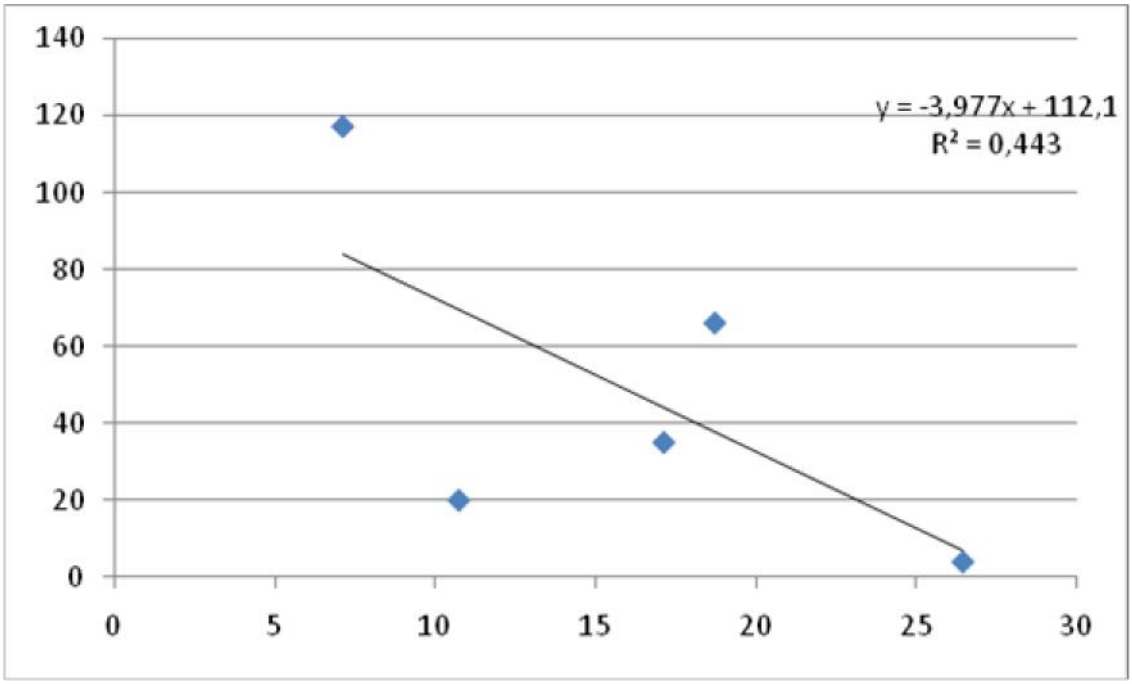


Figure VI.31: ***Scattergram isovist Drift angle values against the number of static people within the root area of isovists Z1,A; Z1,B;Z1,C; Z2; Z3, Dalaa Plaza***

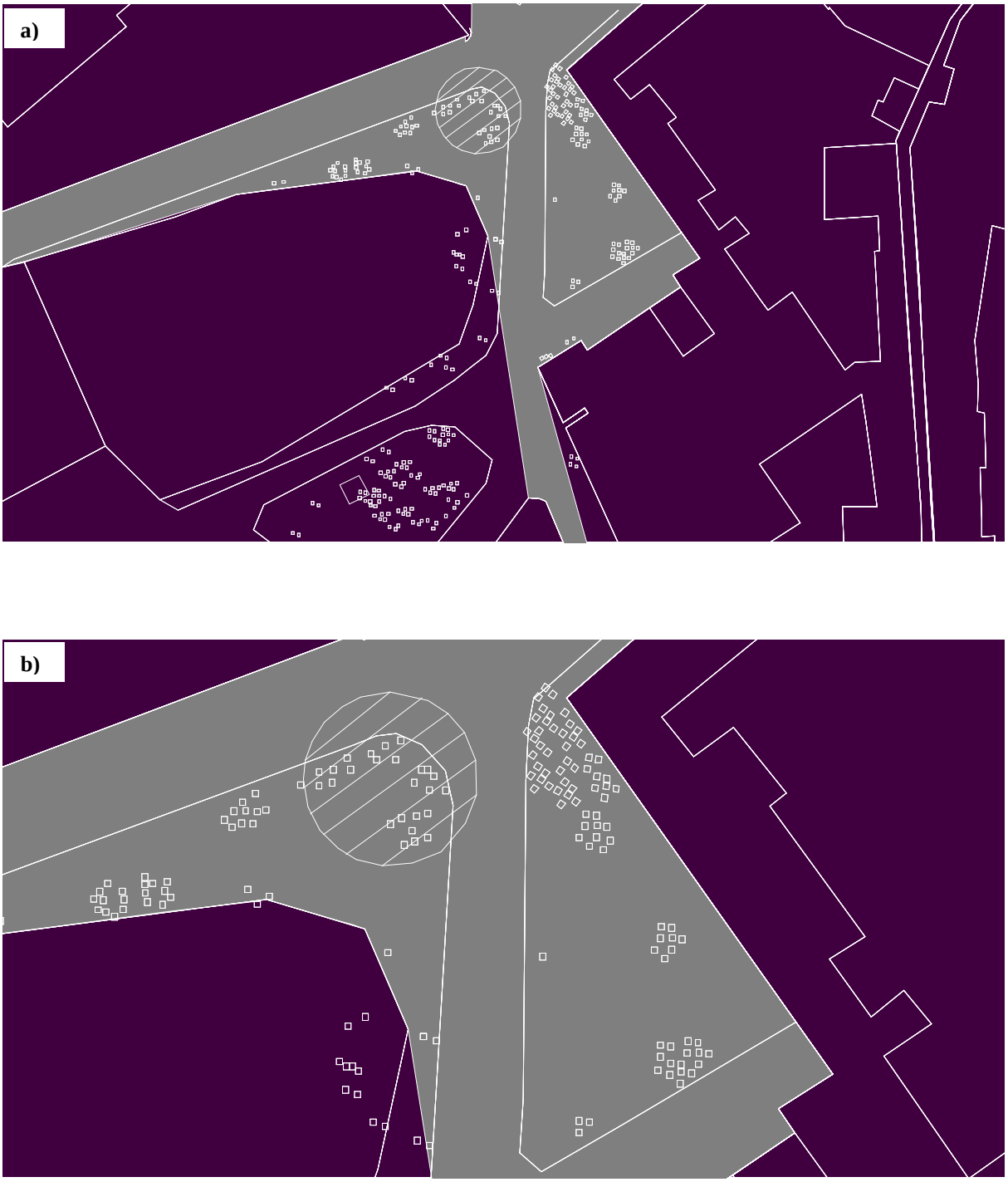


Figure VI.32: Isovist Z1 B: showing the number of people within the root area (20-m diameter circle) of the isovists from the the 2nd most integrates zone.

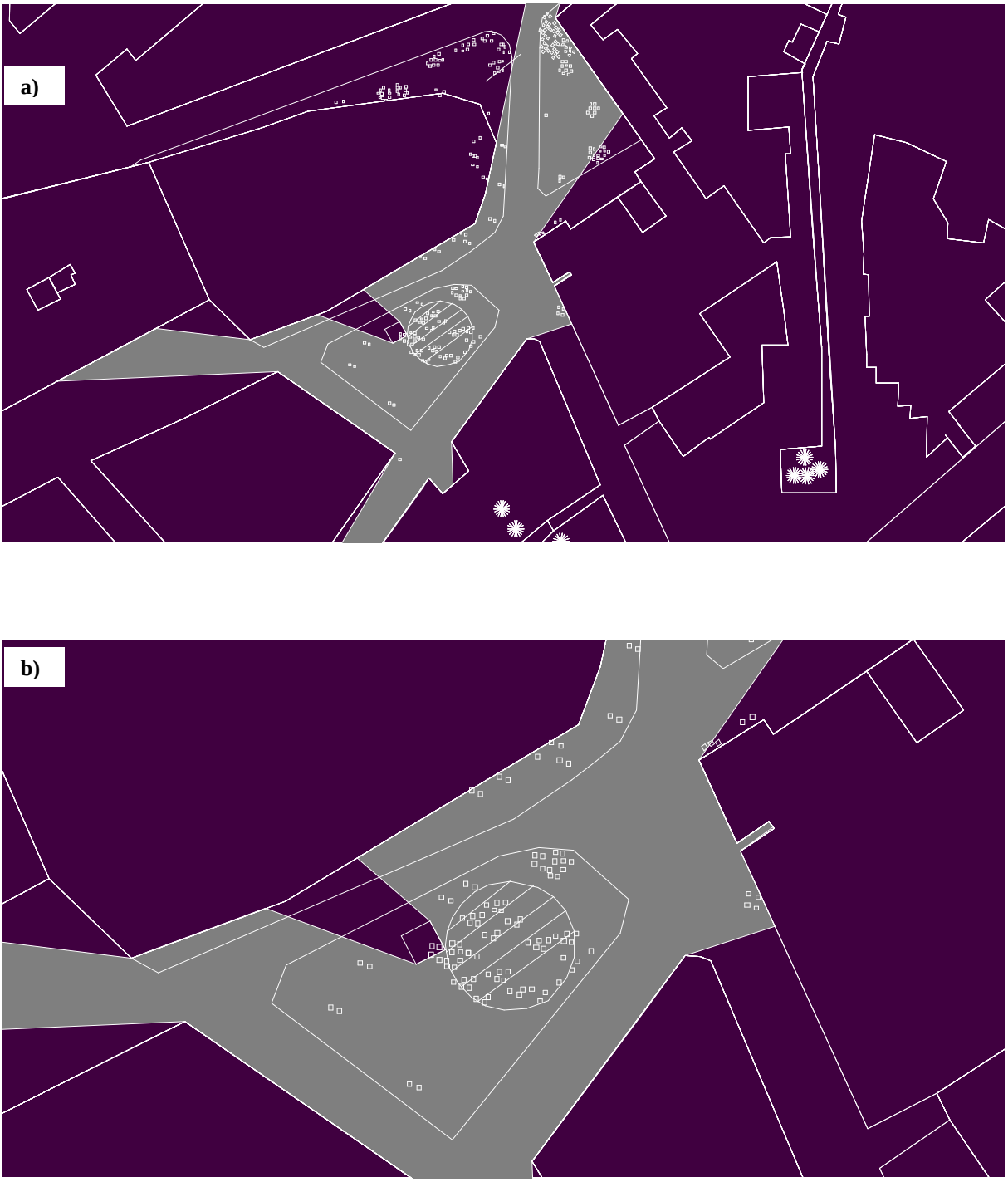


Figure VI.33: Isovists Z3: showing the number of people covered by the isovist's polygon: a) all the isovist area; b) within the root area (20-m diameter circle).

Figure VI.34: Isovists Z1,C: showing the number of people within the root area (20-m diameter circle) of the isovist from the less used zone (though on a very long axial line).

This investigation showed some remarkable results. The isovist (Z1, C) that covers the second greatest number of people has the fewest number of people within its vantage point area (20-m diameter), around 1.7% of the total people within the isovist area, in spite of its important integration value (0.62) and its highest visual entropy (0.46) as an accessible space (visually), table 6 and 7, and figure (82, b). The belief that people's main activity in public space is to watch other people seem to be questionable for this area (root area) where the isovist covers 75.5% of the total number of static people using the plaza.

VI.3.2.2.3 Agents simulation

In order to see how agents move around and go into the plaza according to the visual field provided by urban environment. Moreover the aim was the see if the plaza really provides a visual access (Muntello, 2007). So the simulation consisted of releasing 10 agents at each of the five streets junctions (periphery streets) that lead to the plaza within a 250-metre radius area. This would indicate how visually attractive (visual access) is the plaza to moving animates, that they are obviously simulating people's movement (purposive) within the surrounding areas. The overlapping of agents trails and all static people map shows that most used spaces are out of the movement patterns of agents except for one area (the zone surrounded by vehicular roadways). But it is noticeable that the dense agent's traces overlap with the vehicular roadway of the plaza. This would let some questions about the people's spatial occupancy; whether they purposely avoided intentionally the space of dense movement or it is just a consequence of the layout of the plaza, where the vehicular roadway overlap with the dense agents traces; that evidently could not be used by pedestrian for static activities.

In terms of visual access, the simulation map shows that the street that links the main street Zaatcha to the Dalaa Plaza presented the least agents traces. This indicates that the agents released at that junction have not chosen that street; it seems that the plaza presents no perceivable visual access that attracts people from that junction. However the two streets that link *Les Frères Saouli* Boulevard to the plaza present better visual access.

Figure VI.35: Agents simulation; trails of 5o agents released at the five access points (junctions) in the surrounding streets within the 250-meterradius perimeter of Dalaa Plaza.

Figure VI.36: Overlapping agents trails with all static people map.

VI.3.3 Zwaka Plaza analysis

VI.3.3.1 Pattern of occupancy: static people mapping

Zwaka Plaza is situated within mostly a residential area, Hakim Saadane, one of the major streets of the city, passes through the plaza and constitutes the major link to the rest of the city. The layout of the plaza basically involves a green space crossed by a pattern of pathways together with a fountain, some sitting places, and little service activities (fig VI.37).

As explained earlier the plaza has been subdivided into three zones (A, B, and C) to better proceed to people counting. This is due to its size at the presence of vegetation (trees and shrubs) that occludes visibility between parts of the plaza. Static people map shows that people gathering is more important in the zone (A) (strip-like space) parallel and adjacent to the main street Hakim Saadane.

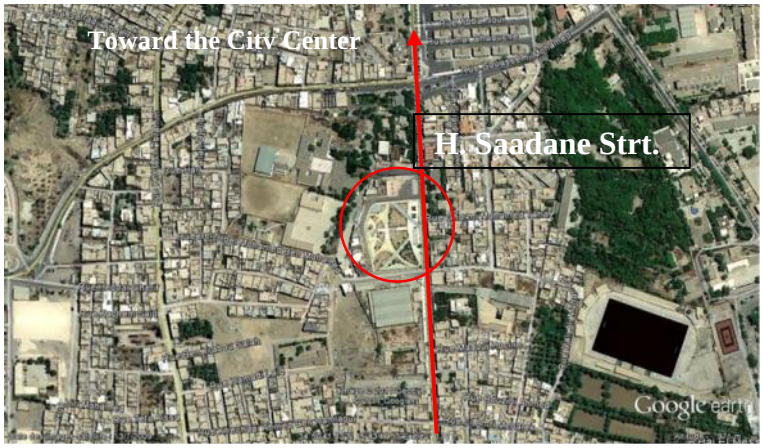


Figure VI.37: Zwaka plaza within its surrounding.

The static people map (fig VI. 38) shows the distribution of people over the entire plaza is uneven. The major pattern of occupancy is mainly spread along the street of Hakim Saadane, within the subspace (A) and, the number of people is 124 i.e. 75.9% of the total number of static people using the plaza (166). The number of people either in standing or sitting in informal spaces represents 69.3% of the total number of static people using this subspace

(table VI.8). This indicates that people prefer this subspace to the others that provide sitting places (formal). However it important to avow that the static people spatial occupancy is also concentrated in one area close to the crossing streets , Hakim Saadane and the street linking to the residential areas , not spread evenly throughout the subspace. The spatial occupancy of other subspaces is insignificant and its layout is sporadic. It could be concluded that this plaza is underused according to its size.

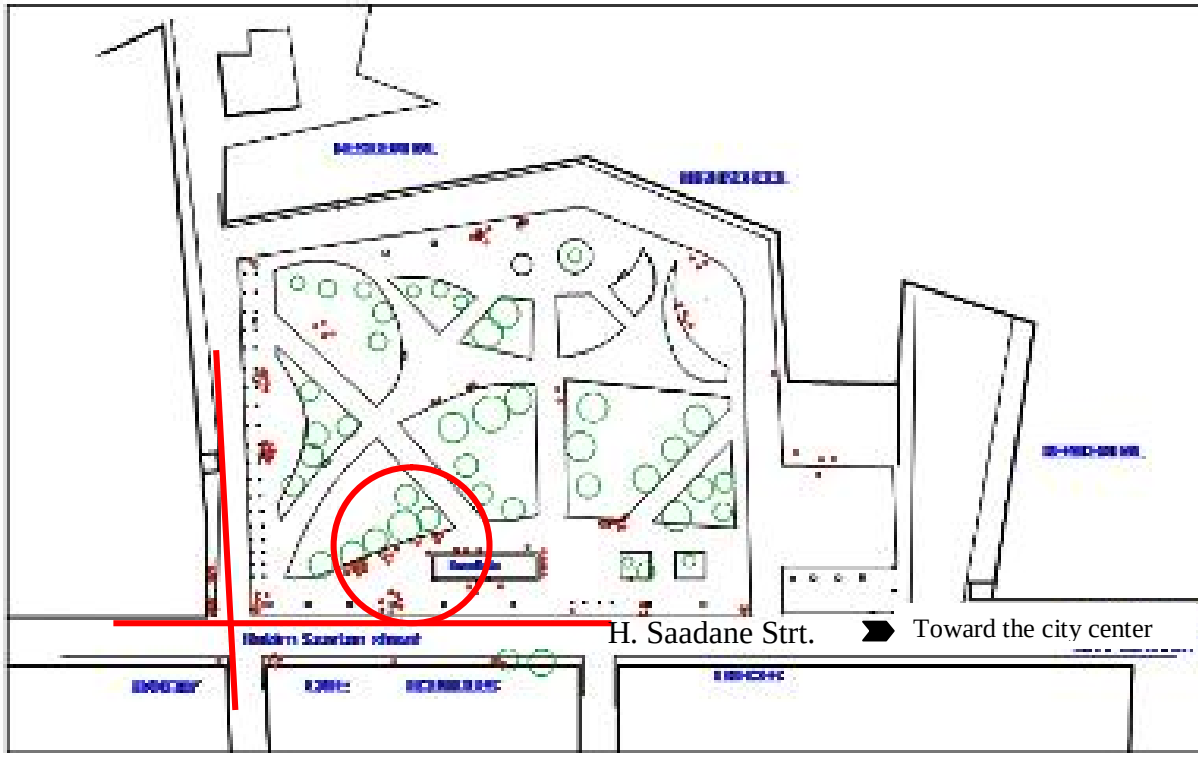


Figure VI.38: ***Zwaka plaza, two-day aggregate static people map (in red dots), the densest and most used area encircled.***

VI.3.3.2 Visibility analysis and patterns of occupancy of the plaza: overlapping static people map with syntactic and isovists measurements.

All vegetations that constitute visual obstruction such as trees and bushes have not been considered in visibility graph analysis. The visual integration (HH) map showed the integration value is the utmost (0.90) at the junction (crossing vehicular roads) of Hakim Saadane Street and the street that cross the plaza and links two major residential areas; So

integration value along this street and Hakim Saadane is around (0.72) then it decreases progressively towards the inner of the plaza; from 0.72 to 0.56. (figVI.41,a), a sort of 'strips' parallel to the main street (Hakim Saadane) going decreasingly from this street towards the inner of the plaza. The overlapping of static people spatial occupancy and visual integration (HH) (figVI.41, b) shows that most people occupy the most integrated areas 'strips' along these two streets (table VI.8). Furthermore the overlapping of Axial map (the fewest lines map) and the all static people shows that the important people's locations are approximately along the longest and most integrated lines (deep visibility towards the surrounding, Hakim Saadane street) (fig VI.42).

Table VI.8: Shows the number people of each type of static position according to subspaces of the plaza. (This plaza has no terrace café)

Plaza name	Static activity type / subspaces	Sitting–Formal Sitting Places Nbr. of Peopl.	Sitting in terrace café Nbr. of people	Standing and sitting in informal spaces Nbr. of people	Total number of all static people	Intgr. (HH)	Visual Ctrl.	Connec--tivity
Zwaka Plaza	A- With sitting places	38	0	86	124	0.56	0.36	0.61
	B- With sitting places	04	0	34	38	0.72	0.46	0.80
	C- With sitting places	00	0	04	04	0.59	0.35	0.65
		42	0	124	166			

Figure VI.39: ***Connectivity within a 250 meter-radius perimeter***

Figure VI.40: connectivity map , (red zones= high connectivity)

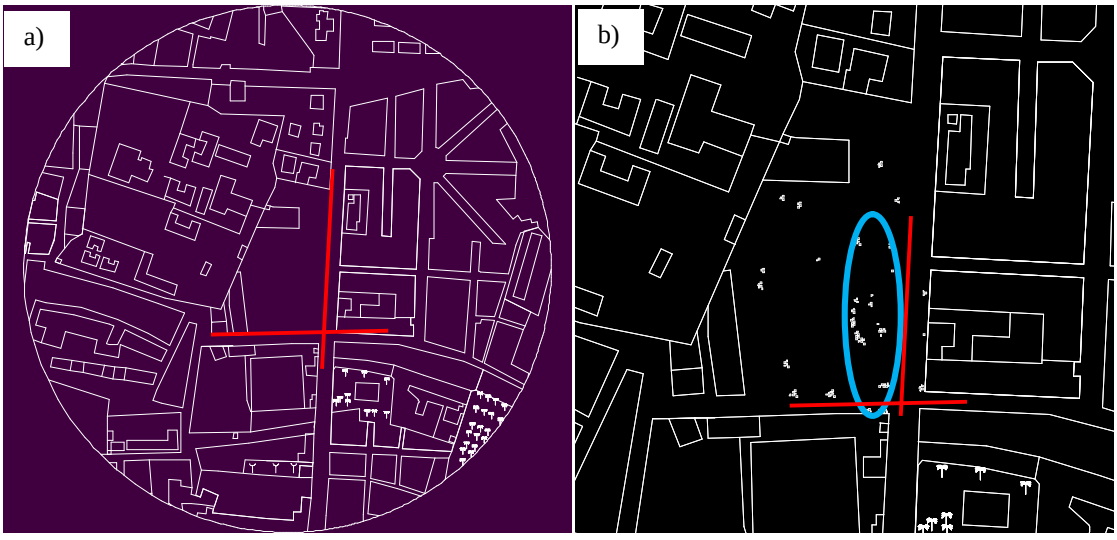


Figure VI.41: overlapping static people spatial occupancy and visual integration (HH): a) integration value as strips parallel to two the axis; b) shows people's occupancy of the most integrated areas 'strips' along the two streets (red axis).

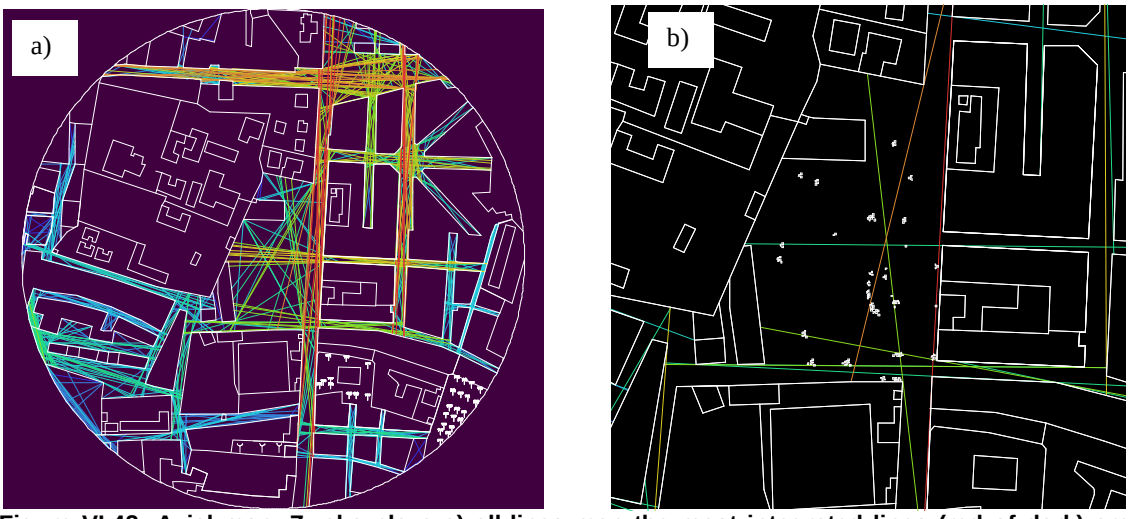


Figure VI.42: Axial map, Zwaka plaza a) all-lines map the most integrated lines (red of dark) are at the periphery of the plaza along the main street. b) fewest-lines map overlapped with all-static people map; important gathering are next to the longest and most integrated lines.

VI.3.3.2.1 Visual access:

To investigate the degree of visual access of the plaza two sets of isovists have been drawn from Hakim Saadane, in both directions toward and backward the city center, first vantage point at the intersection of two longest and integrated lines passing through the plaza, and the second at 60 meters (taken at random), in both directions toward and backward the city center (fig VI.43). The isovists' shapes are commonly 'linear' and do not reveal much information about the plaza; just the 'strip' that represents the most used space.

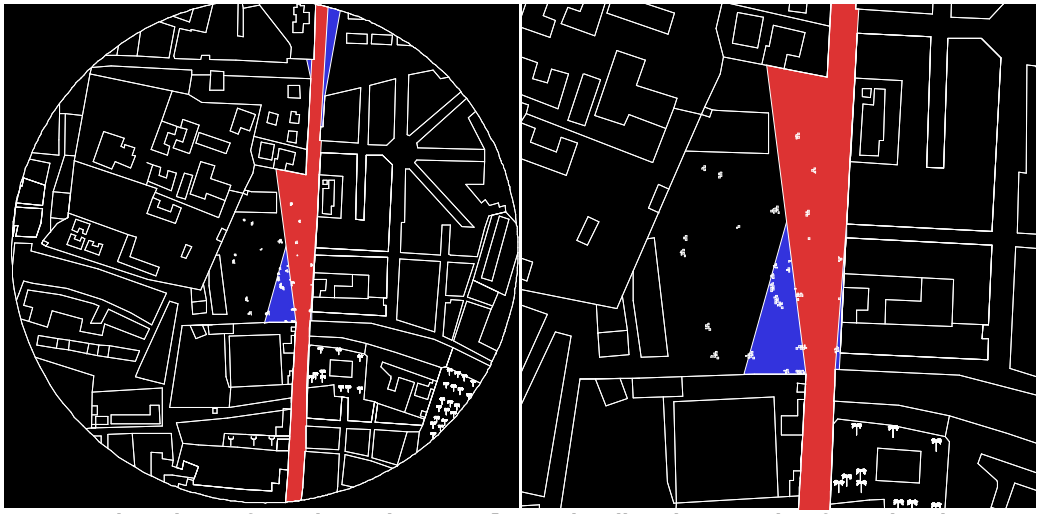


Figure VI.43: Isovists drawn from the main street [opposite direction; coming from the city center (bleu) and a residential area] , vantage point at the intersection of two longest and integrated lines passing through the plaza. It seems that the two isovists polygons overlap with the dense zone of the all static people map.

VI.3.3.2.2 People distribution and Isovists

All the isovists drawn from the plaza (vantage point within the limits of the plaza) cover basically all the parts of the plaza (of course by omitting the vegetations). However there is a bit difference in their 'spikiness'; axial lines (sight lines) that go deeper into the surroundings mainly toward the main street Hakim Saadane (figVI.47). This may explain people preference in occupying some parts that permit some visual 'permeability'. This could be confirmed by the overlapping of fewest-line map, behavior map and isovist drawn from the most used space (figVI.48). In spite of its 'fatness' (high compactness) the isovist presents a bit of 'spikiness' that matches with a longest line 257.178 m (of the fewest-line map) toward the city center that means that the vantage area has an overall view of the plaza and a deep view (direction of the city center) on Hakim street. However the photos taken from this vantage point do not really give a clear view due to the obstruction caused by the presence of some trees (fig VI.45).

The isovists drawn from the 'back' zone, at vantage points far from Hakim Saadane Street, present some compactness, Isovists 2 and 5 (table 9) ; therefore, the visual field does not go beyond the boundaries of the plaza. This may explain the underuse of this zone (fig VI.47. 1).

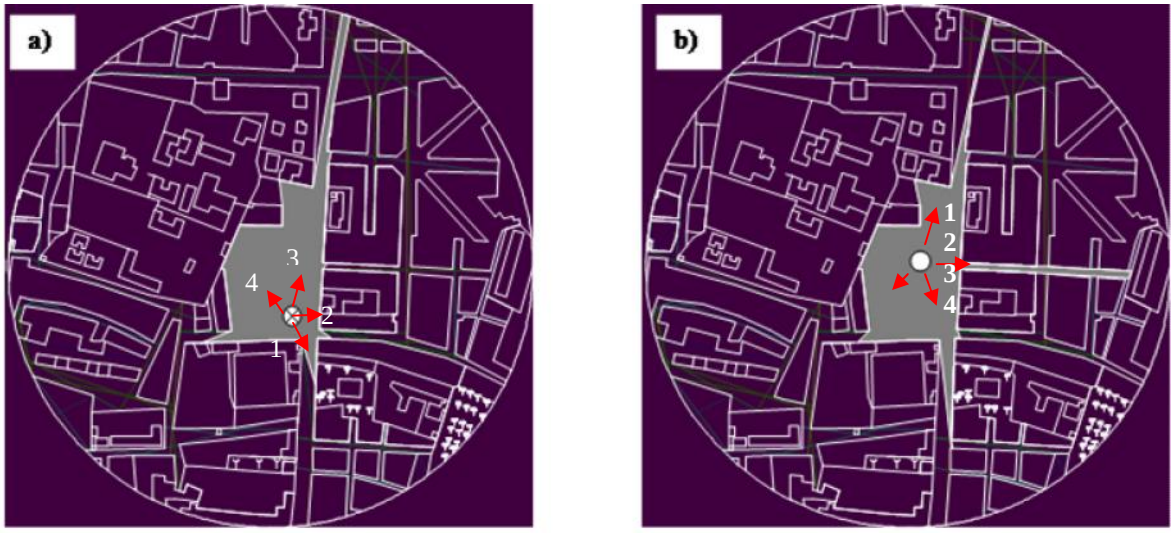


Figure VI.44: b) isovist from a vantage point on the longest and integrated line and a median line passing through the center of the plaza; though the importance of this isovist area value, this zone is not highly used.

1 2 3 4

Figure VI.45: Photos (taken from the root of the isovist) corresponding to isovist (b)in fig: VI.44 corresponding to isovist taken at a vantage point on the longest and integrated line and a median line passing through the center of the plaza; though the importance of this isovist area value, this zone is not highly used.

Figure VI.46: Photos (taken from the root of the isovist) corresponding to isovist (a) of fig:VI. 44; a vantage point at the center of the most used zone.

Figure VI.47: overlapping of fewest-line map, behavior map and isovist drawn from the most used space (vantage point in red); a fat isovist ,with a longest line 257.178 m toward the city center that means that the vantage area has an overall view of the plaza and a deep view on the street passing through the plaza.

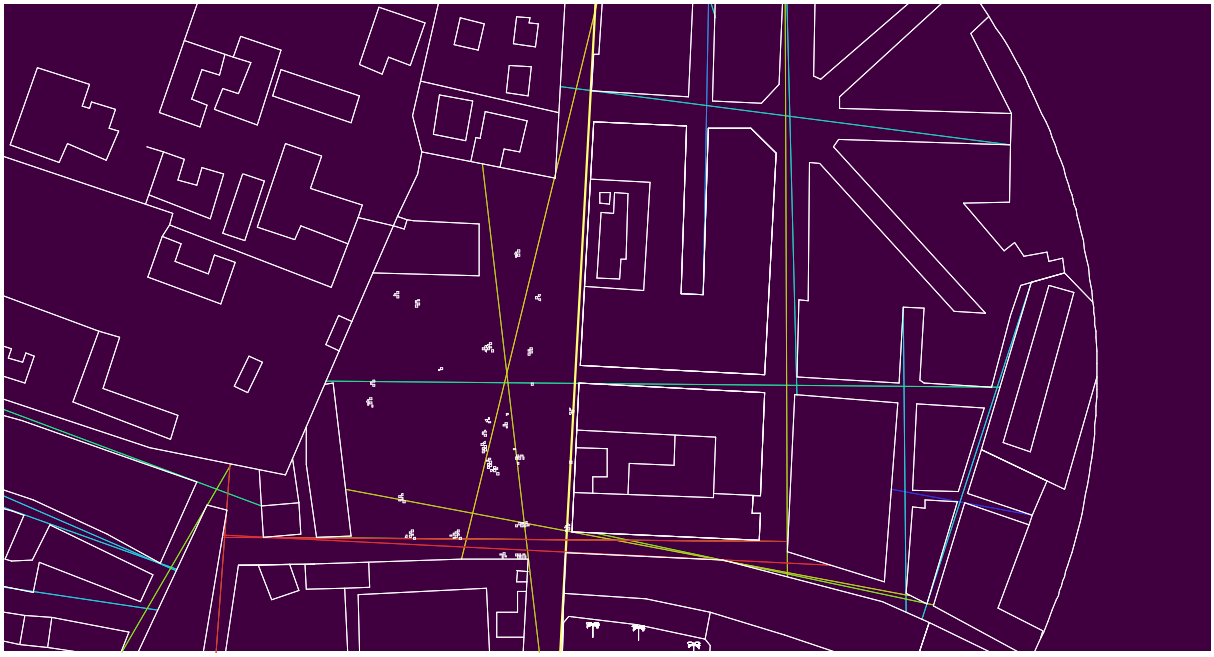
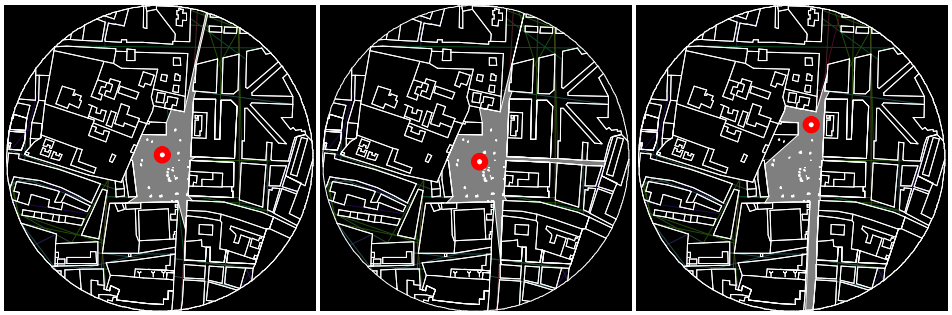


Figure VI.48: ***overlapping of fewest-line map with behavior map of Zwaka plaza:***



1) Isovist 1 2) Isovist 2 3) Isovist 3

4) Isovist 4 5) Isovist 5

Figure VI.48: isovists drawn from inside the limits of the plaza at vantage points from: 1,2,and 3, different points of the densely used zone adjacent to Hakim Saadane street ;4 and 5 points at the 'back' zone of the plaza, away from the main street.

Table VI.9: Measurements of five isovist drawn from inside the limits of Zwaka plaza.

Isov. Meas. / Isovits	Isov.Area	Isov.Compac	Isov.Drift Angle	Isov.Drift Magnitude	Isov.Max radial	Isov.Min radial	Isov.Occlus..	Isov. Perimeter
01	131913	0.17	102.65	34922.3	274146	27550.8	415025	967566
02	141763	0.08	264.90	7064.15	242685	27672.8	556030	1408706
03	025087	0.22	57.35	54608.5	185407	16727.8	302630	838502
04	114589	0.41	13.35	33740.5	138884	19774.1	154206	591571
05	117695	0.19	263.18	73760.4	288914	13669.2	367930	87317

VI.3.3.2.3 Agents simulation.

The animates' trails show that the most used space for movement is the center of the plaza; a rounded space (of course this simulation did not consider the layout of the plaza). People's spatial occupancy, which is mainly on the strip parallel to Hakim Saadane street, seems to be close the movement lines (fig VI.49).

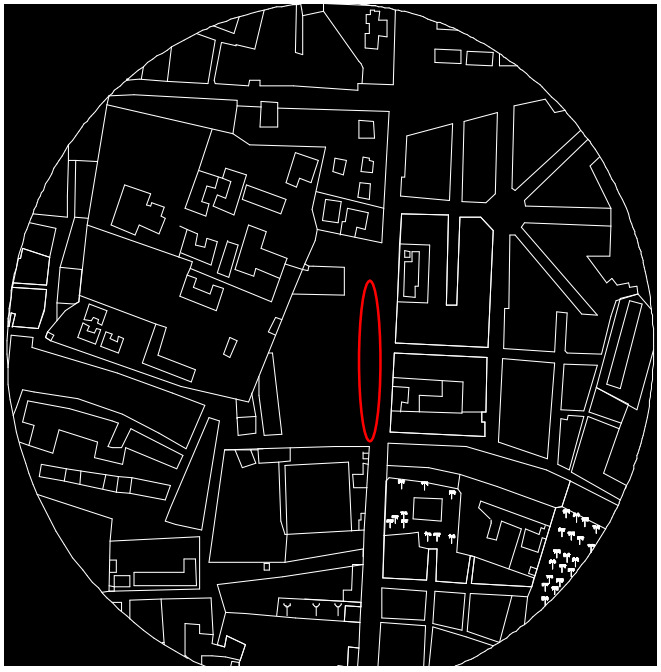


Figure VI.49: Agents simulation; agents' trails, most used area (static activities, in circle)) seems adjacent to the heavy traffic line (of the agents).

VI.3.4 Larbi Ben Mhidi Plaza

Larbi Ben Mhidi Plaza is situated within the colonial district. It is a well defined space and smaller in size comparatively to the other plazas. What distinguishes it from the other case study's plazas is that of being designed to function as plaza in 1936's urban plan scheme of the city (seen earlier). So it is part of the gridiron fabric and linked by eight streets to its surrounding. The major street (*La république Boulevard*) of the colonial district passes through the plaza along an east-west direction. In addition to this, being close to a market square (covered market) and the 'public garden' has strengthened its importance. The plaza layout consists of a central 'tiny' garden with a bunch of trees, vegetation and some sitting places. A pedestrian sidewalk-like space around this garden that take in a terrace café and some sitting areas, a vehicular way encircles the plaza (fig VI.50). The land use presents a mixture of activities and services, food stores, bookstores, a café and a bank. This like-garden plaza with its greenery seems providing a particular urban ambience unlike the other plazas. So its situation next to the market makes this plaza very lively and crowded mainly in the morning hours but scarcely used in the afternoon.

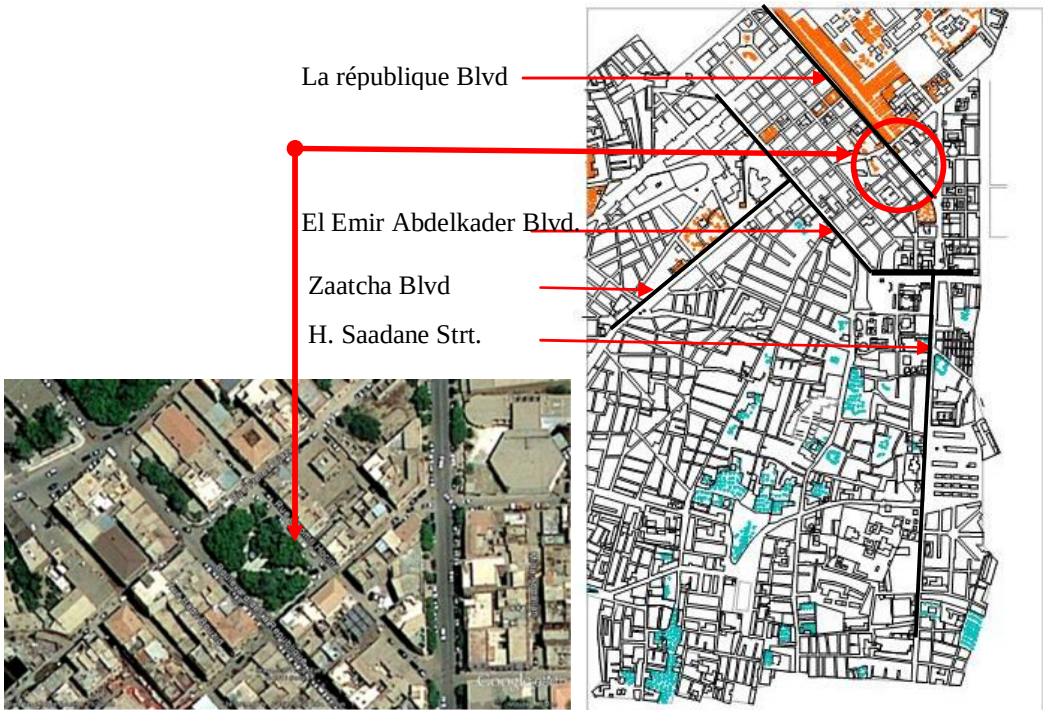


Figure VI.50: left, Google image of the plaza within its surrounding; right the situation of the plaza within the city center district.

VI.3.4.1 Pattern of occupancy: static people mapping

The survey has been done according to the procedure mentioned earlier. The plaza was subdivided into two subspaces A and B. People counting considered three categories of static people; formal sitting, sitting in terrace café, and standing or sitting in informal spaces. The number of all static people for two-day aggregate is 108 (tableVI.10). This seems disproportional to the morning use of the plaza (not the purpose of this research).

Table VI.2: Shows the number people of each type of static position according to subspaces of the plaza.(subspace B has no terrace café)

Plaza name	Static activity type / subspaces	Sitting–Formal Sitting Places Nbr. of People	Sitting in terrace Café Nbr. of people	Standing and sitting in informal spaces Nbr. of people	Total number Of all static people	Intgr. (HH)	Connec--tivity
Larbi B. Mhidi Plaza	A - With sitting places	0	23	27	50	0.6	0.3
	B - With sitting places	10	0	48	58	0.67	0.34
		10	23	75	108		

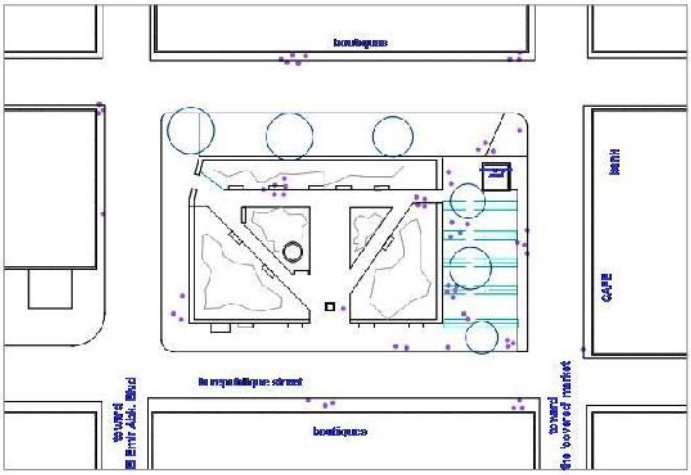


Figure VI.51: Two-day aggregate (weekday and weekend) static people occupancy map, Larbi Ben Mhidi Plaza

VI.3.4.2 Visibility analysis and patterns of occupancy of the plaza: overlapping static people map with syntactic and isovists measurements.

All the vegetations either trees or shrubs have been omitted in the visibility graph analysis (VGA) of this plaza. Besides the underuse of this plaza (during the survey period), people's distribution over the plaza is very sporadic as shown on the occupancy map (fig VI.52). The plaza (within a 250 meter-radius perimeter) presents very low integration value (o.6) as show on table VI.10 and figure VI.53. However, the all-line map shows how the plaza is at the crossing of two major streets; *La République* Boulevard and *frères Djazzar* Street (Fig VI.53).

The overlapping of the integration map and the occupancy map showed no correlation (fig VI.54). Furthermore, people's occupation of the plaza has no relationship to visibility despite the longest axial lines passing through the plaza (fig VI.55).This is confirmed by shape of the isovist taken from the most used zone, that is limited roughly to the plaza's boundaries (fig VI.56). Therefore it seems that, for this plaza, people's use of space is not based on visibility matters but maybe on other criteria such as services.

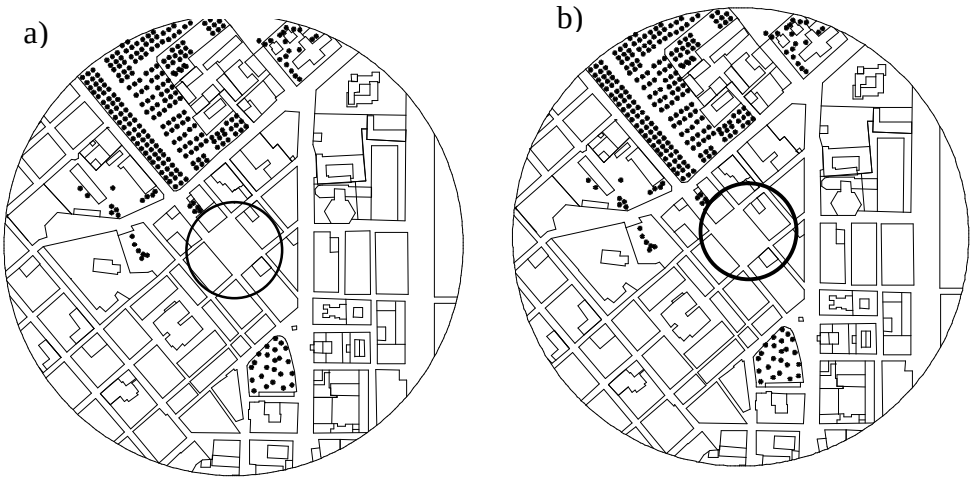


Figure VI.52: syntactic map a 250 meter-radius perimeter, L.B. Mhidi. a) Visual integration, b) Visual control.

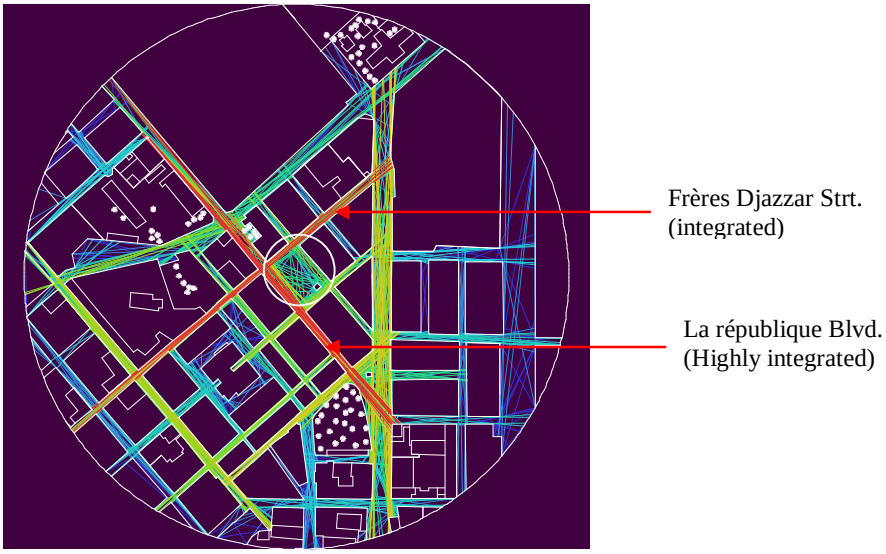


Figure VI.53: All-line map within a250 m radius, Larbi B. Mhidi plaza is at angle of two most integrated streets (red).

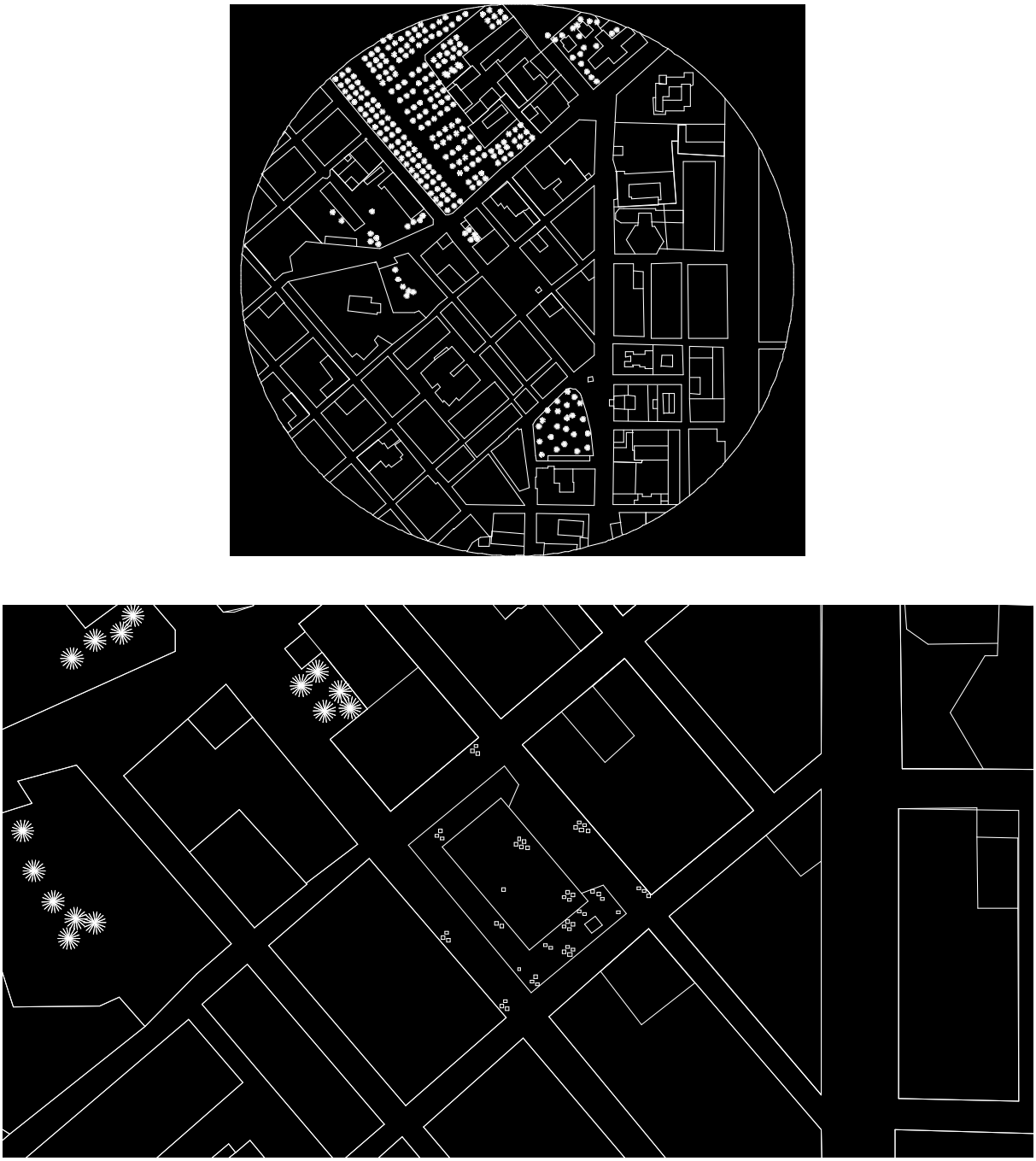


Figure VI.54: integration 250-m radius area, overlapped with behavior map, Larbi Ben Mhidi Plaza.

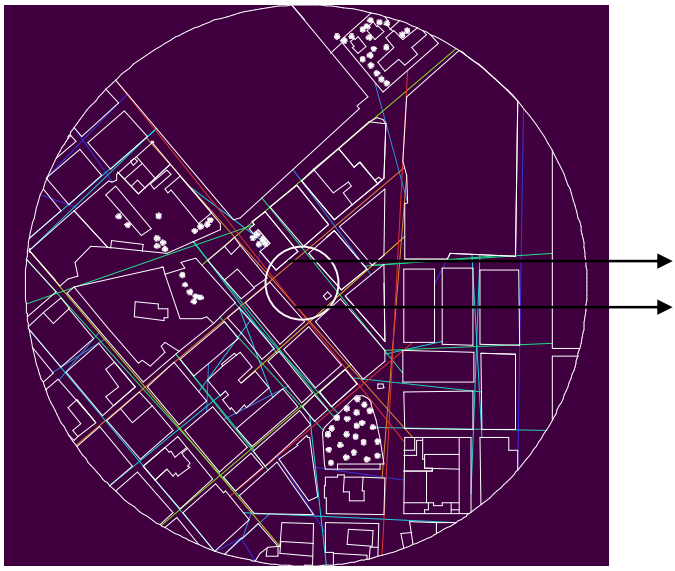


Figure VI.55: Fewest-line Map within a 250 m radius, shows that Larbi B. Mhidi plaza is bounded by the three longest lines (highly integrated).

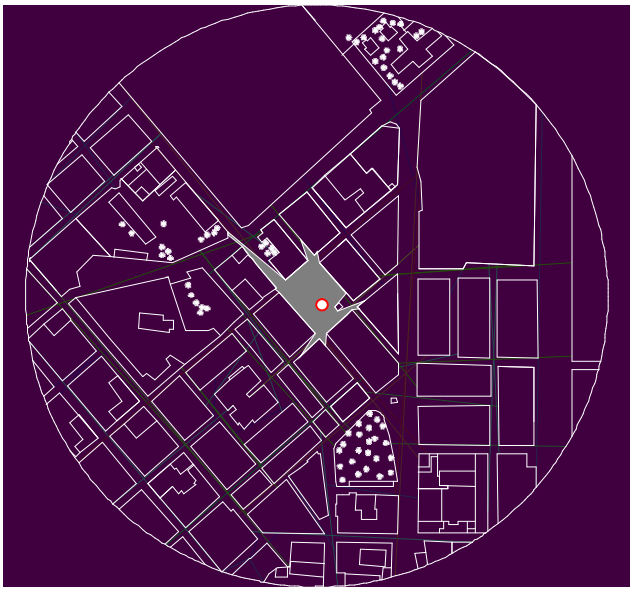


Figure VI.56: isovist from the most used zone of the Plaza, it limited roughly to the plaza's boundary.

Visual access

Figure VI. 57 illustrates how the plaza is secluded (within the 250meter-radius perimeter). The isovists drawn from the main streets' junctions leading to the plaza do not give much visual information about the plaza.

Figure VI.57: isovists having as vantage points the access from the main streets (highly and moderately integrated). this shows that the plaza does not present a high visual access (not really visible from the surrounding).

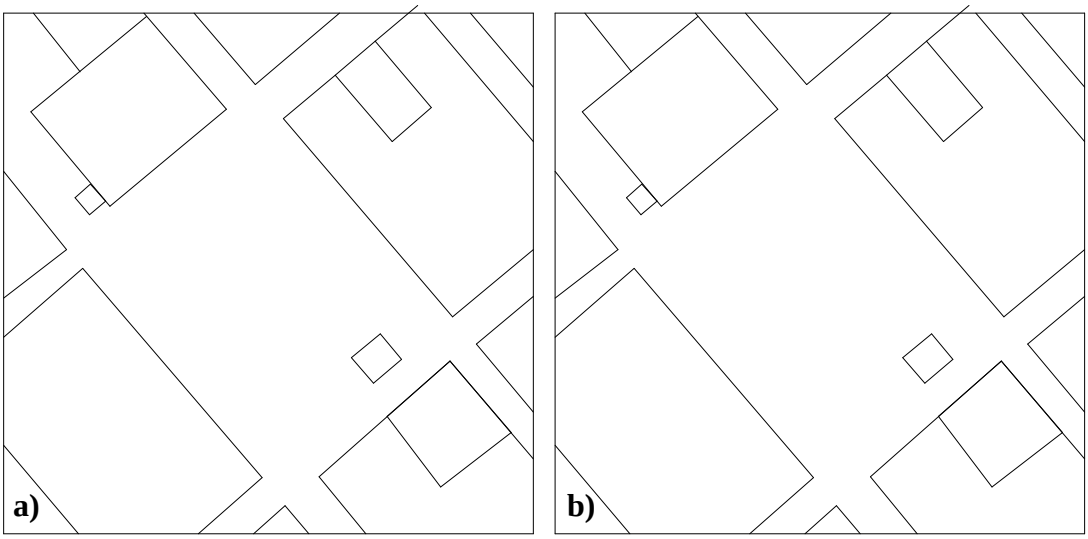


Figure VI.58: VGA; a) connectivity map, b) integration map, Larbi B. Mhidi plaza

VI.4 COMPARATIVE ANALYSIS OF FOUR PLAZAS

VI.4.1 Pattern of occupancy

Considering all static people either sitting in formal (seating places) or informally (other than seating places) and standing during two-day aggregate period, El Houria Plaza seems to be the utmost used space with of 514 users and Dalaa Plaza as the second major used space. However the least used space is Larbi B. Mhidi plaza with 108 users (figVI.60). In the mean time this plaza is known to be very used and crowded during the morning. It may be due to other factors than spatial properties, such as the services provided within that period and being close the market that is considered as a 'magnet' in the city (this is not the goal of this thesis), what matters most is how spatial properties influence the plaza use by being 'attractive' or 'repulsive' to people.

The results show that the category of people in standing position or sitting in informal spaces (walls, flower beds, road curves etc) represent more than 50% of all static people for each of the four plazas. This of course is no evidently due the unavailability of seating places, but to other parameters; people space selection seems to be based of visual considerations. (table VI. 11)

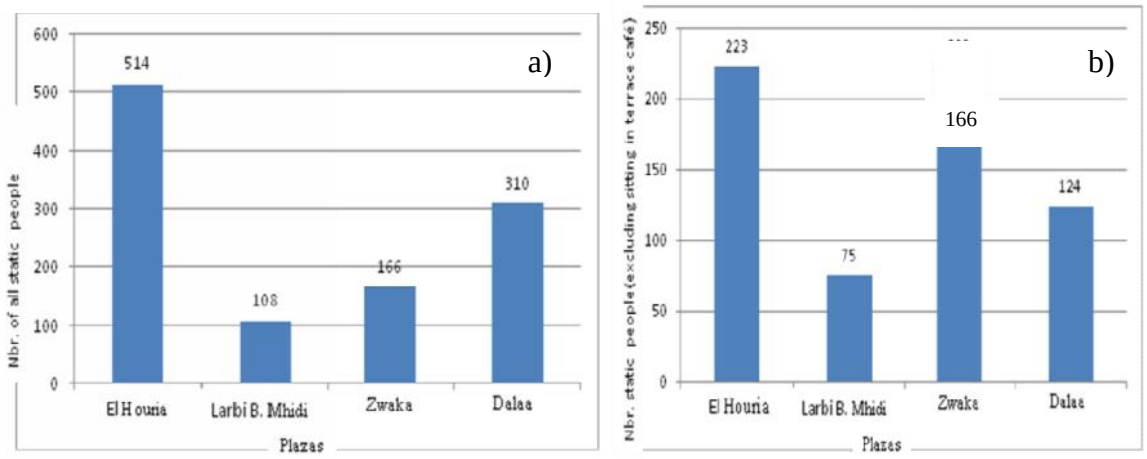


Figure VI.59: The number of static people according to time two-day aggregate period For the four plazas: a) all static people, b) all static people excluding those sitting in terrace café.

Table VI.3: Shows comparatively the number people of each type of static position for the four plazas.

Static activity type / plaza	Sitting–Formal Sitting Places Nbr. of People.	Sitting in terrace Café Nbr. of people	Standing and sitting in informal spaces Nbr. of people	Total number Of all static people
El Houria	136	155	223	514
Dalaa	53	45	212	310
Zwaka	42	0	124	166
Larbi B. Mhidi	10	23	75	108
	241	**223**	**634**	**1098**

VI.4.2 Visibility analysis and pattern of occupancy

It is believed that there is a correlation between spatial configuration, i.e. intelligibility of the space, and people's behavior, movement and use of these spaces. According to Hillier (2005), spatial configuration of the street network shapes movement of people and that the position of a street in the overall grid affects to-and through- movement on this street. As the network of streets provides the means for people to get to the plazas, our goal is to examine the accessibility and attractiveness of the location of each plaza within the broader network, i.e. city center district, using space syntax techniques.

Two sets of measures are considered. The first measures are those relevant to spatial properties of each plaza: global measures of integration and relativized entropy that indicate how ordered the a system is from a location, and local measures of connectivity and visual control that indicate the degree of choice each space represents for its neighbors to move into. The second measure is the visual access that is the degree to which different places and features can be seen and also the location from which people in a particular environment can see particular places and features (Montello, 2007). The visual access measure is examined using point isovists taken from the most integrated streets that surround or junctions that lead to the plazas to see to what degree is their overall layout is visible. The syntactic measures are calculated, first, considering the plan of the city center district including all four plazas examined, and then considering each plaza by itself within its surrounding of 250 meter radius from its center.

Syntactic analysis has been carried out for the plazas examined using Depthmap 07 software program developed by Alasdair Turner from UCL. The results of the analysis of the plan of the city center district including all four plazas and those of each plaza within its surrounding area have been given in table VI.13. A comparative interpretation of the different measures reveal that in term of integration value that El Houria plaza is the best integrated within the system with a value of 0.78 and the least integrated is Dalaa plaza. However, in the local measure, connectivity both El houria and Zwaka plaza have the higher connectivity value (table vi.12).

The visual integration (HH) map provided in figure VI.60, highlights the high value of two streets (dark color), El Emir Abdelkader Boulevard passing by El Houria plaza and closer to Dalaa plaza and Hakim Saadan Street passing by Zwaka plaza and closer to Larbi Ben Mhidi plaza, where La Repuplique Street connects Hakim Saadane Street to this plaza. As can be observed from the figure, El Houria Plaza is remarkably integrated within the system. The map also indicates that there are quite a number of integrated axial lines, lines of sight and movement, crossing this plaza contrary to Dalaa plaza which is crossed with fewer lines.

Overlapping these measures with the occupancy values shows that the most integrated plaza, El Houria's highest visual integration (HH)) value of 0.78 correlates with the highest number of static people. However, integration measures of Dalaa plaza show two different values: very low value when considered within the city center district and a relatively high value when considered within its immediate surrounding area (table VI.13 and VI. 14)).

Intelligibility measures also highlight El Houria Plaza as the most intelligible space with a value of 0.78, which might be though at first as an indication of its relatively high usage. However, the value of Zwaka plaza of 0,73, which is very close to that of El Houria Plaza, does not correlate with the number of static people using it. Furthermore, Larbi Ben Mhidi plaza showed the least intelligibility value and low use of space, which is a paradox to the character of this plaza that is known to be a very livable place during the morning and early afternoon hours, which might be due to land uses consisting of a market and banks. However, figure VI 60 that there not a strong correlation between intelligibility and the number of static people using the plazas.

Table VI.12: Syntactic and isovist measurements of the plazas within the perimeter of the city center district and within the perimeter of 250 meter radius of their center.

Syntax measrts / Plazas	Visual Integration (HH)		Connectivity.		Visual control		Relativized entropy		Intellig i-bility
	City center distr.	250-m radius	City center distr.	250-m radius	City center distr.	250-m radius	City center distr.	250-m radius	250-m radius
Dalaa	0.55	0.67	0.22	**0.41**	0.42	**0.48**	0.17	0.17	0.52
Larbi BMhidi	0.68	0.57	0.13	0.34	0.40	0.45	0.15	0.20	**0.23**
El houria	**0.78**	0.69	0.33	**0.63**	0.41	**0.53**	0.13	0.10	**0.83**
Zouaka	0.62	0..63	0.38	**0.68**	0.38	0.38	0.10	0.07	0.73

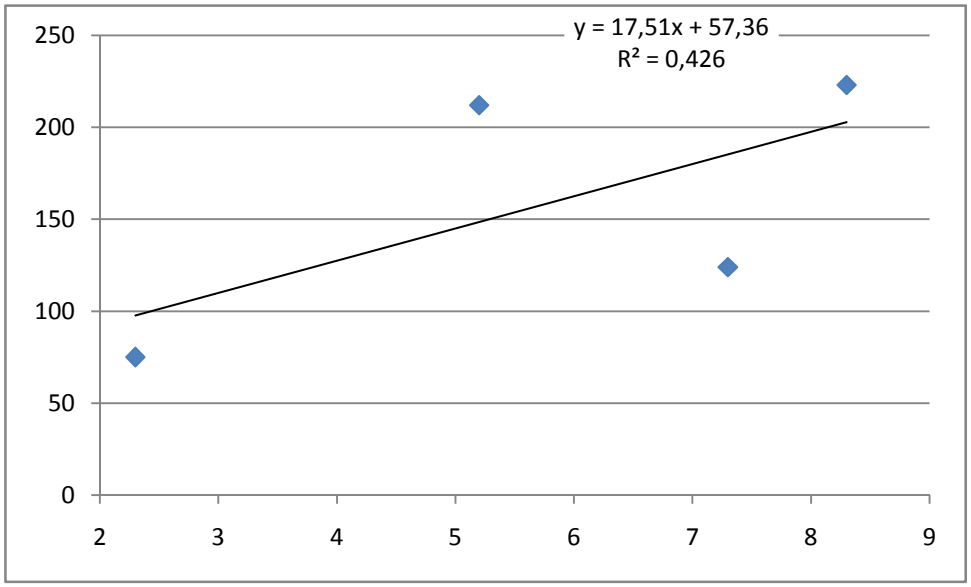


Figure VI.60*: Intelligib 250 versus all static people (excluding siiting in terrace café),for thr four plazas*

Table VI.4: Showing some syntax and isovist measurements of the plazas within the perimeter of the city center district.

Syntx Vals. / Plazas	Visual Integr. (HH)	Connectivity.	Visual control	Relativized entropy
Dalaa	0.55	0.22	0.42	0.17
Larbi Ben Mhidi	0.68	0.13	0.40	0.15
El houria	0.78	0.33	0.41	0.13
Zouaka	0.62	0.38	0.38	0.10

Table VI.5: showing some syntax and isovist measurements of the plazas within the perimeter of 250 meter radius of their center.

Syntax measrt. / Plazas	Visual Integration (HH)	Connectivity	Visual Ctrlt	Relativized Entropy	intelligibility
Dalaa	0.67	0.41	0.48	0.17	0.52
Larbi B.Mhidi	0.57	0.34	0.45	0.20	0.23
El houria	0.69	0.63	0.53	0.10	0.83
Zouaka	0..63	0.68	0.38	0.07	0.73

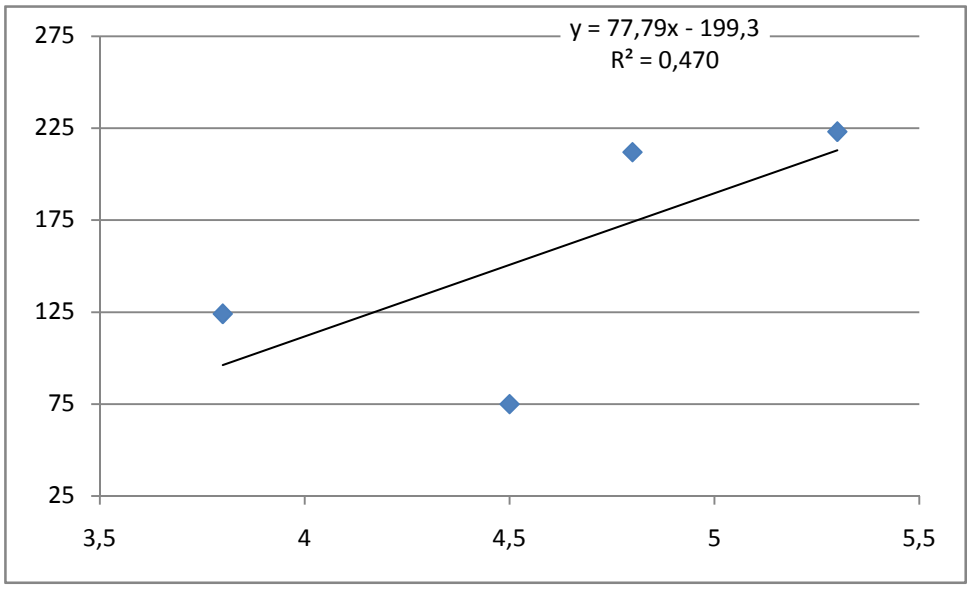


Figure VI.61: Visual control (250m) versus number static people (excluding sitting in café)

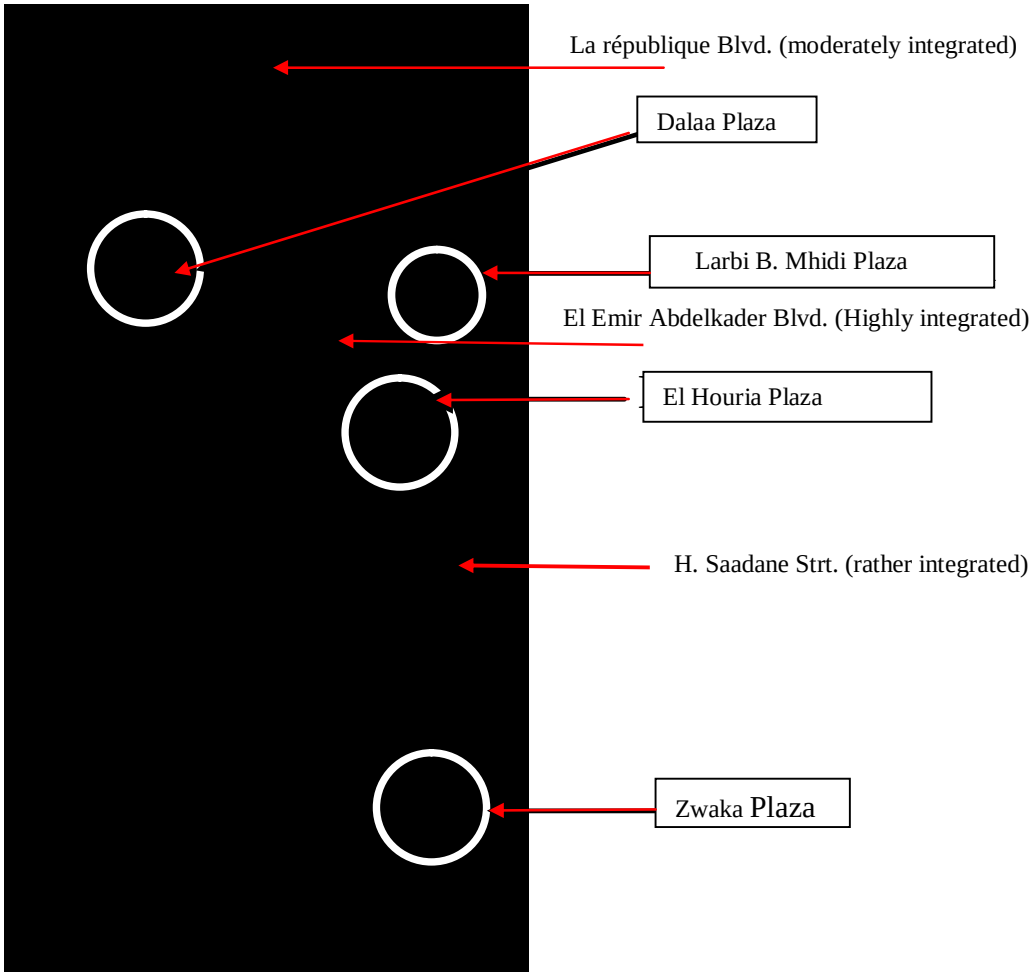


Figure VI.62: Visual integration (HH) of the city center embedding the four plazas

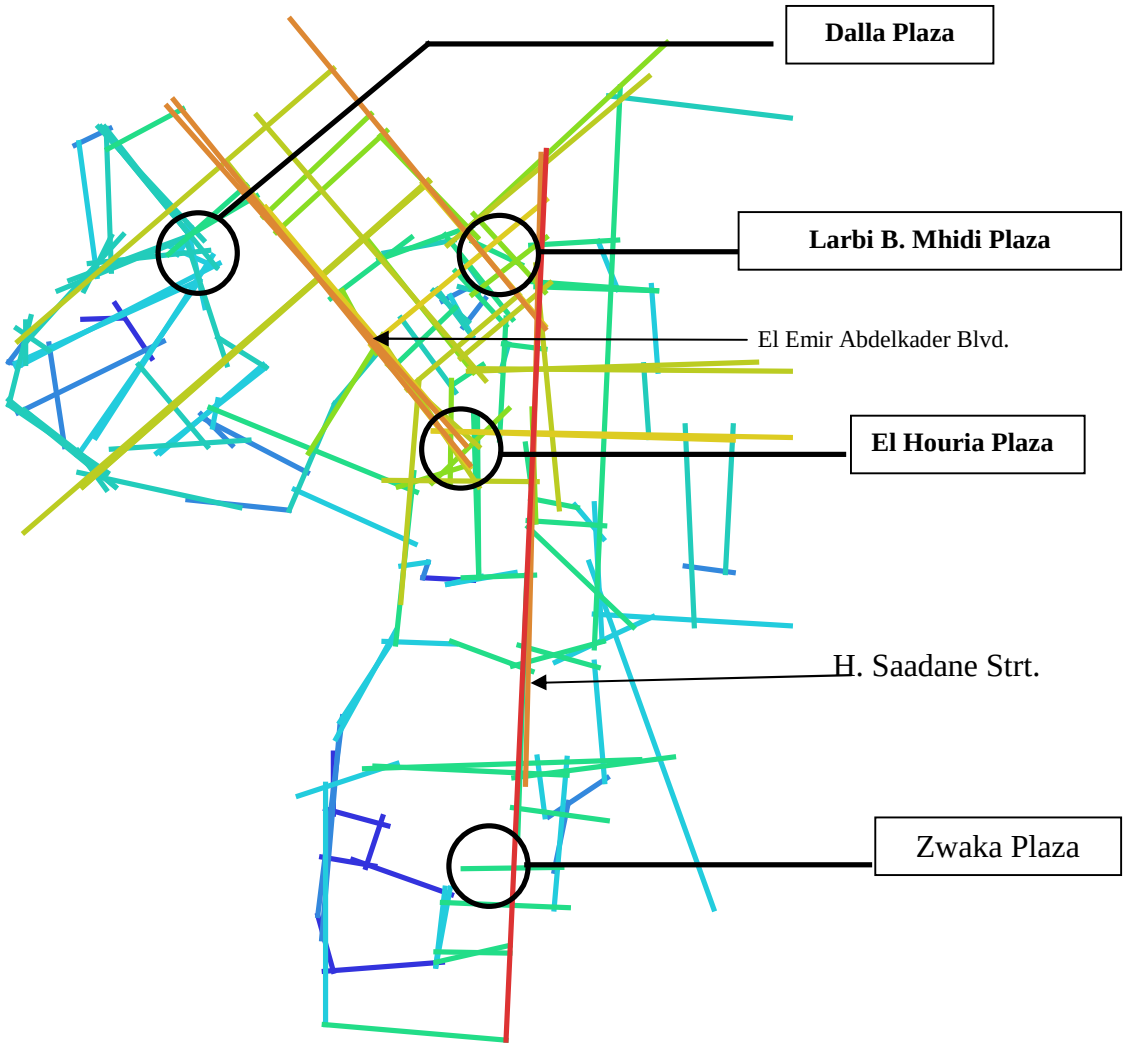


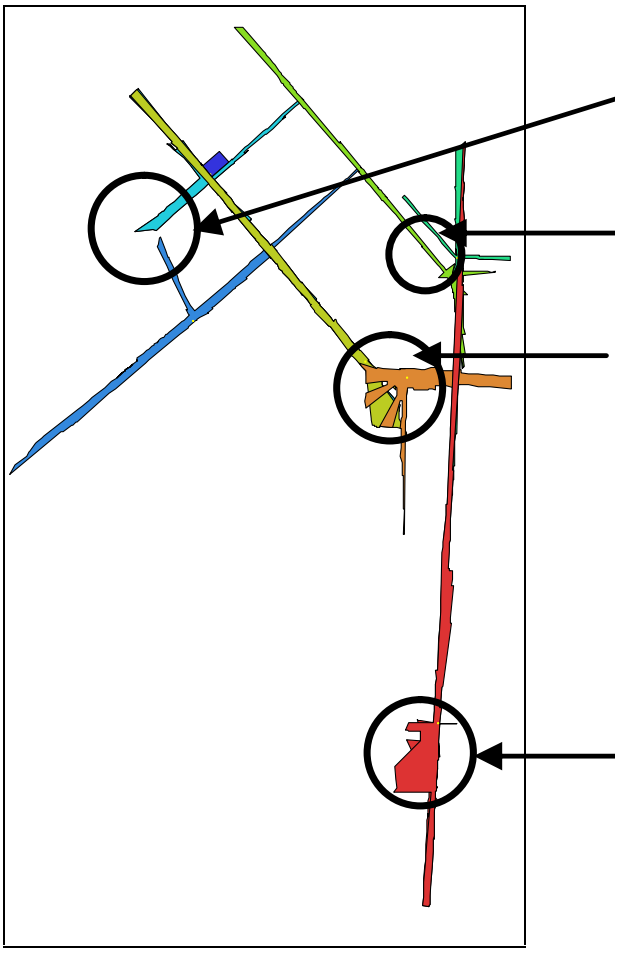
Figure VI.63: Axial map (fewest lines) of the city center District.

The axial map (fewest lines) reveals that El Houria, zwaka and Larbi Ben Mhidi plazas are trespassed by very integrated lines; yet Dalaa Plaza is crossed by lines of low integration values (Fig:VI.64).

VI.4.3 Visual access

In terms of the visual access measures, i.e. the shapes of isovists that correspond to the potential view of an observer and taken from the most integrated streets leading to plazas are examined. A larger isovist shape means more visual information is available of the plaza for

people moving on the most integrated streets, El Emir Abdelkader. The analysis shows that El Houria presents higher degrees of visual access, while for Dalaa and Larbi Ben Mhidi, the isovists are "linear", and i.e. less visual information is available.



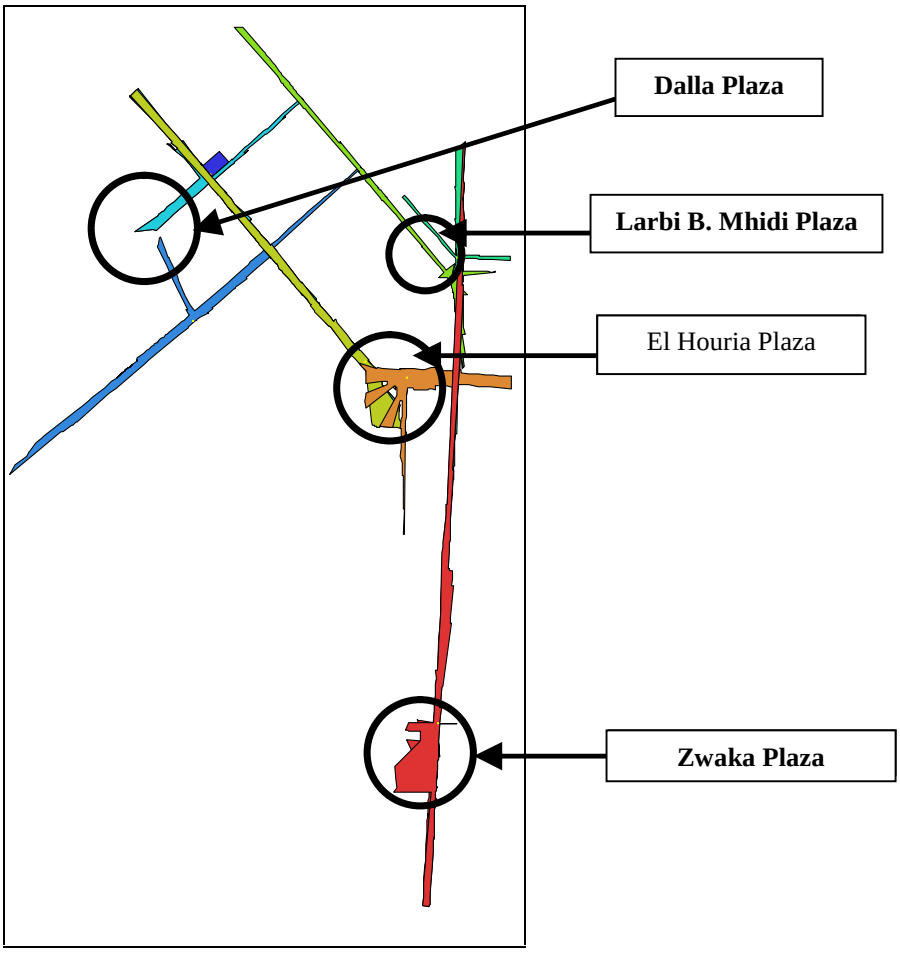


Figure VI.64: Visual access: isovists drawn from streets leading to the plazas.

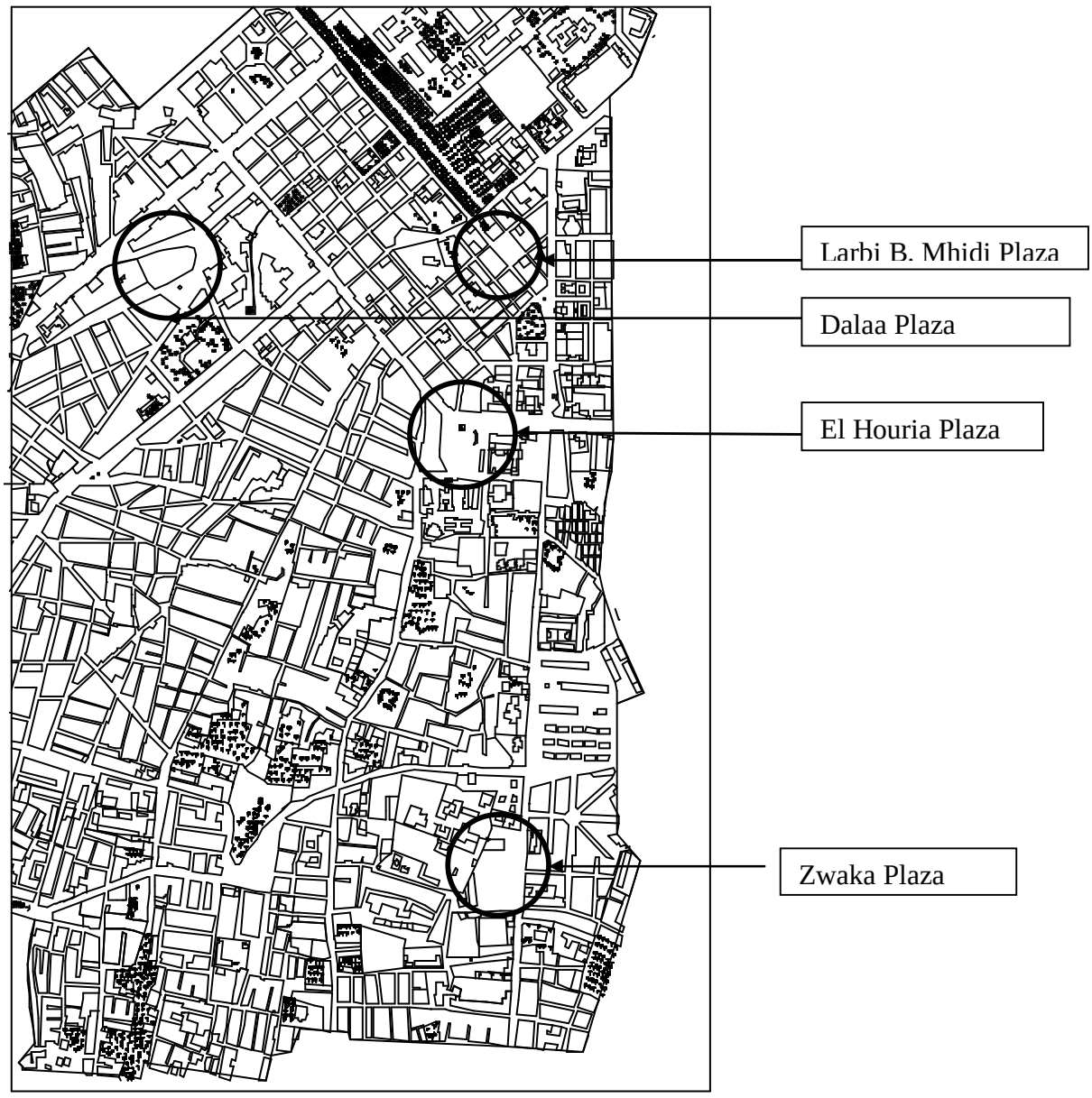


Figure VI.65: Connectivity value of the city center embedding the four plazas.

Table VI.6: Showing some syntax and isovist measurements, and intelligibility ratio of each plaza within the perimeter of the city center district.

Plaza	Connecti-vity	Integration (HH)	Visual R. Entropy	Visual C. clustering	Visual control	Intelligibili-ty	Total static people
Dalaa	0.25687	0.55999	0.173728	0.51685	0.50281	0.45	310
Larbi B.M	0.134531	0.677652	0.16148	0.708893	0.393586	0.19	108
El Houria	0.34511	0.781909	0.106189	0.631593	0.42034	0.44	514
Zouaka	0.385534	0.630016	0.135068	0.807051	0.394594	0.62	166

The results of local measures of connectivity and visual control as indicators of the degree of choice of a space represent for its neighbours to move into; how is 'inviting' is the space for people in the surrounding spaces, show that Dalaa Plaza and Larbi B. Mhidi present, either within the city center perimeter or the 250-meter radius area, the lowest values of connectivity; respectively (0.25 - 0.41) and (0.13 - 0.34). This may be explained by their spatial 'closure' and by being 'deep' spaces, because they are remote from the main axis of the urban structure. However both El Houria and Zwaka Plazas present higher values (0.34 - 0.63) and (0.38 - 0.68) (table VI.16). This is may be due to the fact that these two plazas present some openness by being crossed by major streets (integrated).

Table VI.7: Comparative values of plazas according to zones: within 250-m radius perimeter and the city center district.

Plaza	Connectivity		Integration (HH)		Visual R. Entropy		Visual control		Intelligibili-ty		Total static people
	250-m R	City Cter	250-m R	City Cter	250-m R	City Cter	250-m R	City Cter	250-m R	City Cter	
Dalaa	0.41	0.25	0.67	0.55	0.17	0.17	0.48	0.50	0.52	0.45	310
Larbi B.M	0.34	0.13	0.57	0.67	0.20	0.16	0.45	0.39	0.23	0.19	108
El Houria	0.63	0.34	0.69	0.78	0.10	0.10	0.53	0.42	0.83	0.44	514
Zouaka	0.68	0.38	0.63	0.63	0.07	0.13	0.38	0.39	0.73	0.62	166

As a local area is considered intelligible if its co-efficient value is higher than the one of the global area, we can say that El Houria plaza is the most intelligible. ..

CONCLUSION: Discussion of the results

Concerning the plazas' attractiveness (visual access), in term of movement, measures of Dalaa plaza show a noticeable variance of integration and connectivity measures taken within the perimeter of the city center district with those taken within the 250 meter-radius perimeter; as shown on Table VI.16. Thus it can be concluded that Dalaa plaza is more integrated within its surrounding than within the whole district. This could be explained by

the importance of the number of lines (despite their low integration values) crossing the plaza, on the axial map. This may be interpreted that the plaza is locally a *through- movement* space. However the agents' simulation showed a bit contradictory results not all the streets leading to the plaza used with the same intensity; the plaza is not really appealing with the same degree from the surrounding urban streets, in term of visual information.

The study of El Houria Plaza use, subdividing the stationary activities in two categories sitting (using the available sitting places) and standing or sitting informally (using other than the formal sitting places) shows that the preferences or the choice for the location of these activities are not the same, the former is for more secluded spaces (low integration value) and the later for more exposed spaces (high integration value). The busiest space in the plaza, mostly with stationary people in standing position, is remarkably around the axial lines intersection point of the longest lines of sight (not crossing the plaza). This finding does not validate the results that the use of plazas depends on the amount of sitting spaces provided. People may accept some discomfort (standing or sitting in informal spaces) for the sake of visibility matters.

As approach of the partition the plaza into subspaces that reposed mainly on the plaza layout gave more detailed results but the rules defining the subdivision, raised by many researchers, still to be investigated. Because the behavior map, in this paper, shows that space occupied by people is amorphous and does not correspond the orthogonal layout of the plaza.

Studying urban open spaces such as plazas need considering the space layout and all its components, and land topography, in order to understand the nature of spatial use. It should be remembered that some minute details that might be insignificant in representation could completely change the spatial properties of space versus the perceived space and thus a subdivision of a space examined into sub-spaces may be the appropriate approach.

The belief that a good space is a used space leads to investigate what makes some spaces crowded and preferred by people than others in looking on the person-environment relationship, and to emphasize the visual "affordance" of spaces and the spatial properties needed for a particular pattern of activity. To conclude, the understanding of visibility and people's perception is not only a key to analytical purposes, but also a tool to producing more livable spaces.

GENERAL CONCLUSION

GENERAL CONCLUSION

This thesis tried primarily to tackle and to understand the essence of the use of space in order to try to respond to the main questions of the thesis problem's statement about the uneven use of plazas; within both between parts of the same plaza and between different plazas. Therefore it has been organized in a way to apprehend major features relevant to man-space (or environment) interaction. This implied the exploration of many fields such as psychology, sociology, geography, urban design and architecture with the purpose of getting through all the knowledge linked to the topic. This topic required on one hand the understanding of man (user) as perceiver that involves all the senses and on the other hand the understanding of space (or environment) that contains and affects man and his behavior. To stay in the frame of the thesis goals the most emphasis was put on visual perception and its affect on man's use of space. Moreover, a particular focus was set on the spatial properties that affect most the use of space in order to contribute to space design knowledge that would help to design more functional, livable and used urban spaces (plazas).

It was shown through the literature the importance of urban spaces in enhancing the social and the urban life quality, and to the city functioning in terms of how people experience: use, navigate in space, and also about imageability and legibility of space. The way they are designed has a great impact on shaping the behavioral patterns. They could either places for pleasureness or places of 'sadness', 'fear' and 'delinquency'. This would imply a lot of aspects and questionings about their design process. This it is not the thesis goal; however it tried to focalize and to find out the features or the spatial properties that affect people's behavior and experience in real environment.

The thesis got through the major explanations and concepts of visual perception of man's experience of a real environment; how he perceives and how he is affected (emotionally and behaviorally). What is common for all the approaches is that all of them link perception to motion. There are scholars who are concerned on how the spatial properties could have affective impact (emotion), those who are concerned with aesthetic appraisal (like, dislike, pleasure), and those who are concerned with the attractiveness in term of use of space.

It has been revealed through the literature that spatial experience is majorly linked to visual perception. Hence numerous evaluation methods and theories considered vision as the medium to asses a given space or environment. This evaluation ranges from colonization of space, movement itineraries (traffic lines), quality and the aesthetics of space, to imageability, and legibility of the environment.

This thesis has considered space syntax as theory and method as the best appropriate tool to investigate into the problems inherent to the use of urban plazas (as case study). Since space syntax theory foundation links between space configuration, visibility and the use of space (Hillier), it is suitable to functionality of space that constitutes the core of urban design and architecture. Moreover, space syntax provides analysis tools that permit to either represent graphically or to quantify the spatial proprieties of a given space; graph drawing or computing values using software programs such as Depthmap which is mostly used in this matter. This program performs isovists' fields as really experienced by people and quantify them in values.

The syntactical and isovists study of the four plazas and its correlation to people's occupancy of space, which was discussed in details earlier, showed some convincing results and some questionable results, vis-à-vis the hypothesis of the thesis that static people choose their locations according to visibility considerations.

This thesis intends to avoid extensive and exhaustive conclusions. Despite the effectiveness of the isovist-based approach, used in investigating and analyzing the use of plazas, that showed remarkable correlations between isovists' measures and the rate of the people's occupancy of space, this requires a completion by other measures that address people's assessment of space in terms of affective response and aesthetic evaluation as experienced.

Theories that relate affective responses and aesthetic appraisals to physical properties could be useful to deepen the understanding of people‘s use of space. Despite their subjective aspect, these theories and methods could be helpful to understand man-space interaction that consequently may have great implications on the design process; in order to create more functional and more appropriate space. That's why the affective qualities are usually left to the personal sensitivity and appreciation of the designer (urban designers and architects). Since some researchers showed that people prefer to be in space with a high aesthetic values and positive affective impact (Nasar, 1988).

Isovit's measures cover values such as area, perimeter, occlusivity and values related to intervisibility between spaces – how much and how deep you can see – but do not really measure what you see. This approach would be more accurate and an effective tool in analyzing space as experienced by people only if it is coupled with other measures and values. This could be by considering the three-dimensional aspect of the isovist and the space (isovist) aesthetic assessment using for instance either static or dynamic displays (photos and videos) of the 'scene' of a given isovist's polygon. This would permit to grasp all the proprieties of the isovist as experienced by people. Obviously, this may lead to further insights into individual and cultural differences of the observed people. Therefore such approach would require intercultural comparative studies, with the intention of determining a bottom line about affective and aesthetic appraisal approaches. So this kind of research that combines objective and subjective 'values' may require an actually comprehensive theoretical framework.

In the same point of view it would be also interesting to investigate the isovist's property in correlation with some spatial factors such as symmetry, proportion that constitute the basis of the normative architectural knowledge about space design.

Another drawback of the isovists technique as mentioned by some researches is the non-consideration of the tri-dimensional aspect that has a great impact on visual perception and how space is experienced by people. For instance the presence of the greenery such as trees with their ever changing foliages (deciduous) that cause an ever changing perception of the environment; the same spatial configuration (if we consider the isovist's polygon) provides different visual perception of the same environment (in term of visibility of some urban components). This technique to evaluate the "scenery" of the isovist has been used by the exploratory study of the four plazas undertaken by this thesis by taking photos from the point of the isovist just to see what really look like the isovist's 'scene' (3D). But it was not adopted as a major tool of the investigation in the research methodology, so there are no genuine results from it.

This thesis has been prepared with a great conviction of the importance of the topic. It was a great opportunity to round up various theories of different fields related to man-space (environment) interaction. The outcome of this thesis is neither complete nor exhaustive. It is

just is one step or an approach to understanding people' use of space that is a requirement prior any act of space design. This is one approach; however scientific work always requires open-ended approaches to tackle issues.

REFERENCES

REFERENCES

Alexander, R. C., 2003, Designing Cities: critical readings in urban Design, Blackwell Publishers Ltd, London

Alexander, C, 1965, The City is not a Tree, The architectural Forum, April/May 1965.

Alexander, C., Ishikawa, C., Silverstein, M., 1977, A Pattern Language: Town, Buildings, Construction, Oxford University Press

Altman, I., 1975, Environment and Social Behavior, Brooks/ Cole, Monterey

Appleton, J., 1977, The Experience Of Landscape, John Wiley, London

Appleyard, D., 1969, City Designer and the Pluralistic city. Planning for urban growth and regional development, MIT press, Mass.

Appleyard, D., 1970, Note on Urban Perception and Knowledge, Proceedings of the 2nd Annual environmental Design Research, Oct.1970, Pittsburg, Pennsylvania, Carnegie-Mellon University

Ashihara, Y., 1970, Exterior Design in Architecture, Van Nostrand Reinhold Co. New York

Alberti, L.B., 1955, Ten Books of Architecture, James Leon,Tiranti, London.p. 161

Amedeo,D., Golledge, R.G, and Stimson, R.J., 2009 , Person Environment Research: Investigating Activities and Experiences in spaces and environments, The Guilford Press, New York

Arnheim, R., 1956, Art and Visual Perception, A Psychology of a Creative Eyes, Faber and Faber Ltd, London

Bafna, S., 2003, "Space Syntax: its Logic and Analytical Techniques", Environment Behavior, 35, pp.17-29

Baily , A.S., 1977, la perception de l'espace urbain, centre de recherche d'urbanisme, paris

Baker, R. G., 1968, Ecological Psychology: concepts and methods for studying environment and human behaviour, Stanford University Press.

Baker, R. G., stimulation theories; arousal theory, Overload Theory and Restricted Environmental Stimulation, in Gifford, R., 1997, Environmental Psychology: Principles and Practices, Allyn and Bacon,Ca, pp.6-15

Barnett, J., 1982, Introduction to Urban Design, Harper and Row, New York.

Bechtel, R. B., 1987, Methods in Environmental and Behavior Research, University of Michigan

Benedikt, M.L., 1979, "To Take Hold of Space: Isovists and Isovists Fields", Environment and Planning B: Planning and design, pp.47-65.

Berlan-Darque, M.,Buhl, Y.P,Terrason, D.,2007, Paysages de la connaissance à l'action, Editions Quae.

Berlyne, D.E., 1971, aesthetics and psychobiology, Appleton century Grofts, Michigan

Bulmer, M. 1986, The Chicago School of Sociology, institutionalization, diversity and the

rise of sociological research-online.

Buttimer, A., and Seamon, D., 1980, the Human Experience of Space and Place, Taylor and Francis

Calthorp, P., Fishman, R. And Lerup, L., 2005, New Urbanism, University Of Michigan (online)

Chastain, T. and Elliot, A., 1998, Cultivating Design Competence, Proceedings of ACADIA (association of computer and aided design- on line))

Christopher, A., 1977, A Pattern language, oxford University press.

Campos, A. M. B., 1999, Strategic Spaces: Pattern of Use in Public Squares Of The City of London, Proceedings, 2nd International Space Syntax Symposium, Brasilia.

Campos, A. M. B., 1997," Strategic Spaces: Patterns of Use in Public Squares in the City of London", Proceedings, 1st space syntax symposium, London, 26.1-26.11.

Campos, A. M. B., 1999, All That Meets The Eye: Overlapping Isovists as Tool for understanding preferable location of static people in Public squares, Proceedings, 2nd International Space Syntax Symposium, Brasilia.

Campos, A.M.B., Golka, T., 2005, "Public Spaces Revised: A Study of the relationship between Patterns of Stationary Activities and Visual fields", Proceedings, 5th International Space Syntax Symposium, Delft.

Canter, D., 1977, The Psychology of Space, New York, St. Martin's Press, New York

Carmona, M., 2003, Public Spaces, Urban Spaces: New Dimensions of Urban Spaces, Architectural Press

Conroy Dalton, R., 2003, "The Secret Is To Follow Your Nose", Environment and Behavior.

Chua, B.H, and Nor, E., 1992, Public Space: Design, Use and Management, Singapore University press, Singapore

Cullen, G., 1961, Townscape, The architectural Press, London.

Dalton, C,; 2003, " The Secret Is To Follow Your Nose", Environment and Behavior.

Dalton, C.& Bafna, S., 2003, "The syntactical Image of The City", proceedings of the 4th International Space Syntax Symposium, London,2003.

Davies, C., Mora, R., Peebles, D., 2006, Isovists for orientation: Can space syntax help us predict directional confusion? , proceedings of space syntax and spatial cognition workshop, spatial cognition, Bremen, Germany

Doxiadis, C., 1968, Man and Space around him, Saturday Review Dec. 1968 , London

Ellin Nan, 1999, Postmodern Urbanism, Princeton Architectural Press

Franz, G., 2005, An Empirical Approach to the Experience of Architectural Space, Tubingen University and the Bauhaus University, Weimar (on line)

Franz, G., Wiener, J., M., 2005, "Exploring Isovist-based Correlates of Spatial Behavior and Experience", Proceedings of the 5th International Space Syntax Symposium, Delft.

Gehl, J. 1987, Life Between buildings, Using Public Space, Van Nostrand Reinhold, New York

Gibberd, F., 1955, Town Design, The architectural press, London p 230

Gibson, J.J., 1979, An Ecological Approach to Visual Precept, Houghton Mifflin, Boston

Giddens, A., 1984, The Constitution of society: outline of the theory of structuration, University of California Press

Gideon, S., 1982, Space , Time and architecture, the Growth of New Tradition, Harvard Press.

Gifford, R., 1997, Environmental Psychology: Principles and Practices, Allyn and Bacon; Ca

Goetz, B., 2001, la dislocation. Architecture et philosophie, les editions de la passion, Paris

Gosling, D, and Maitland, B., 1984, Concepts of Urban Design, Academy Editions, London

Groat, L. and Wang, D., 2002, Architectural Research Methods, John Wiley and sons, Canada

Guttman, R., 1978, The Street Generation, in Anderson, S, On Streets, MIT Press, 249-264

Hall, E. T., 1966. The Hidden Dimension, doubleday, Garden City, N. Y.

Heft, H. (1996). The Ecological Approach to Navigation: A Gibsonian perspective. In J. Portugali (Ed.), *The construction of cognitive maps* (pp. 105-132). Dordrecht, the Netherlands: Klu- wer Academic Publishers)

Hillier, B. and Hanson J, 1984, The Social Logic of Space. Cambridge University Press, Cambridge

Hillier, B.; Musgrove, J.; &O'Sullivan, 1984, Knowledge and Design , Developments in Design methodology, John Wiley and Sons, New York, pp. 254-263

Hillier, B., Burdett R, Peponis J, Penn A, 1987, "Creating Life: Or, Does Architecture Determine Anything?" Architecture and Behavior. Vol 3 P 233-250

Hillier, B., Penn A Hanson J, Grajewski T, Xu J, 1992, "Natural Movement: or, Configuration and Attraction in Urban Pedestrian Movement" *Environment and Planning B: planning and design*, pp.29-66

Hillier, B., 2000, "The Art of Place and the Science of Space", Word Architecture, pp.96-102

Hillier, B., 1996, "Space Is The Machine, Cambridge, University press.

Hillier, B., 2004, "What it Looks from Here: questions and conjectures about spatial cognition from a 'syntactic' point of view" workshop 8, Mental Conceptions of Emergent spaces in Architectural Design, Design computing cognition 04, 9-20

Hillier, B; Vaughan, L, 2007, "The City As One Thing", Progress in Planning, 67 no 3 , pp. 205-230

Jarvis, R. K., 1980, Urban environment as visual art on a social setting, Town Planning Review, V 51 P 50-56

Kaplan, S. and Kaplan, R. 1987, Humanscape: Environments for People, Ulrich's Books, Inc, Ann Arbor, Michigan.

Kaplan, S. and Kaplan, R., 1982, Cognition and Environment, Praeger, New York

Katz, D., 1951, Gestalt Psychology, Melthven and Co Ltd, London

Kim, Y.C., 1979, Placeness of Space in the case of, Edinburgh architectural research vol 6, Edinburgh University

Kohler, W., 1975, Gestalt psychology: an introduction to new concepts in modern Psychology, University of Michigan

Krier, R., 1979, Urban Space, Academy Edition, London

Kurt, L., 1951, Field Theory in Social Science, Harper and Row, New York

Lang, J., Burnette, C., and Moleki, W., 1974, Designing for Human Behavior, Dowden, Hutchison, and Ross Inc, Pennsylvania

Lang, J., 1987, Creating Architectural Theories, Van Nostrand Reinhold, New York.

Lang, J., 1994, Urban Design: The American Experience, John Wiley and sons, Inc, New York

Le Corbusier, 1967, The radiant City, Faber and Faber, London (p 121- 123)

Lynch, K. Rivkin, M., 1959, A Walk Around The Block, in Prohansky, H.M, Ittelson, W.H, and Rivlin, L.G., 1970, Environmental Psychology, Rinehart, and Winston, Inc, New York

Lynch, K.,1960, The Image of The City, The MIT Press

Le Corbusier J, 1967, The radiant City , Faber and Faber, London

Jacobs, J., 1961, The Death and life of American Cities, Random House, New York

Marcus, C.C. and Francis, C., 1997, People Places: Design Guidelines For Open Space, Wiley and Sons,

Mauron, C., 1975, Aesthetics and Psychology, Kennikat Press, NY

Marion, R. And Clara, G., 2001, Approaching Urban Design, Pearson Education Ltd, London

Millon, T.; Lerner, M. J.; Weiner, I. B., 2003, Handbook of psychology: Personality and social psychology, John Wiley and Sons, New York, pp.432

Montello, D. R., 2007, "The Contribution of Space Syntax to Comprehensive Theory of Environment Psychology", Proceedings, 6th International Space Syntax Symposium, Istanbul

Moore, G. T. and Marans, R. W., 1987, Advances in Environment, Behavior, and Design: toward the integration of theory, methods, research and utilization ; Springer, pp.71-79

Morris, A. E. J.,,1986 , History of Urban Form , John Wiley and Sons, New York

Moser, G., Weiss, K., 2003, Espaces de Vie: Aspect de la relation Homme-Environnement, Armand Colin, Paris

Moughtin, C., 1996, Urban Design: Street and Square, University of Nothingam

Mumford, L., 1951, The City in History, Secker and Warburg, London

Norberg-Schulz, C., 1971, Existence, Space and Architecture, Praeger, New York

Norberg-Schulz, C., 1980, Genius Loci: Towards a phenomenology of architecture, Academy Editions, London

Nasar, J.L, and Heft, H., 2000, "Evaluating Environment Scenes using dynamic versus dynamic Displays", Environment and behaviour, 32, 301-322

Newman, O., 1966, Defensible Space, People and Design in the violent City, Macmilan, New York

Papargyropoulo, P., 2006, “park interpretations: Explorations of the Spatial Properties and Urban Performance of Regent’s park, London and Pedion Areos Park Athens”, MSc thesis, The Bartlett School of Graduate studies, University College of London.

Peponis, J., 1997, Geometries of Architectural Description: Shape and Spatial Configuration, Proceedings space syntax first international symposium, London, 1997

Peponis, J., Wineman, J., Rashid, M., Kim, S.,and Bafna, S., 1997, On the Generation of the Linear Representation of Spatial Configuration, Proceedings vol. III of space syntax first international symposium, London, 1997

Perrin, C., 1970, With Man in mind: An Introduction Prospectus For environmental Design, The MIT Press, Cambridge, Mass

Porteous, J.J., 1971, Design With People, Environment Behavior , No 2. P 206-223

Prohansky, H.M, Ittelson, W.H, and Rivlin, L.G.,1970, Environmental Psychology: Man and His Physical ; freedom of choice and behaviour, Setting, Holt, Rinehart, and Winston, Inc, New York

Rapoport , A., Kantor.R. E.,1968, Complexity and ambiguity in environmental design, journal of American Institute and planners, July, 1968, 3. A

Rapoport, A., 1976, The Mutual Interaction of People and Their Built Environment, Mouton Publisher, Paris

Rapoport, A, 1990, History of Precedent in Environmental Design, Plenum Press, London

Rhode, E.A, 1973 “the human squares: Athens, Greece” Ekistics, no 35, p. 124- 132

Russel, B., 1914, Our Knowledge of External World as a field of Method in Philosophy, Open court Publishing, Chicago

Russel, B., ..., Our Knowledge of The external World as a Field for Scientific Method in Philosophy, open court publishing , Chicago

Salingaros, N. A., 1999, Architecture, Patterns and Mathematics, Nexus Network Journal, Texas University- on line

Scott, G. (1947) The Architecture of Humanism, A Study In he History of Taste, Constable, London

Sebastiano, S., 1982; The Five Books of architecture, Dover Publications, New York

Sitte, C., 1945, The Art of Building Cities, Hyperion Press, Connecticut.

Sitte, C.,1986, he Birth of Modern City Planning, Rizzoli International Publication, New York.

Sommer, R (1969) Personal Space: The behavioural Basis of Design, New Jersey

Spreiregen, P.D., 1965, Urban Design: the Architecture of Towns and Cities, Magraw-Hill, New York

Stephan, C., Rivlin, G., Francis, M., 1990, Environment and Behavior seris: public spaces, Francis and Hester, London

Stephenson, N., 2003, Theoretical Psychology, Captus Press Inc, Ontario

Tandy, C. R.V., 1967, The Isovist Method of Landscape Survey, cited in by Harris, L. R. ,

Jenkin, M. R. M., 2001, Vision in 3D Environments,Cambridge University Press, p311

Tibbalds, F., 1992 , Making People-Friendly Town: improving the public environment in towns and Cities, Logman, Harlow

Thiel, P., (1961) A Sequence-Experience Notation For Architectural and Urban paces. Town Planning Review 32 p.33-52

Thiel, P., 1970, "Notes on the Description, Scaling, Notation, and Scoring of some Perceptual and Cognitive Attributes of the Physical environment in Proshansky, H. M., Ittelson, W. H., and Rivlin, L. G., 1970, Environmental Psychology: Man And His physical Setting, Holt, Rinehart and Winston, New York, 593-619

Thomas, R., 1996 : Les Conduites Piétonnières des non-Voyants en milieu urbain , memoir DEA , Cresson, Grenoble

Thwaites, K., Porta, S.,Romice , O.and Graves, M.,2003, Urban Sustainability : Through Environmental design, Span Press, USA

Tuan, Y.F.,1977, Space and Place: The Perspective of the experience, the University of Minnesota Press, Minneapolis, MN

Turner, A., Penn, A., 1999, Making Isovists Syntactic, proceedings of the second symposium of space syntax, Brasilia, April 1999

Turner A., 2001, "From Isovist To Visibility Graphs: a Methodology For The Analysis of Architectural Space", Environment and Planning B,28, 103-121

Turner A., 2003, "Analysing The Visual Dynamics Of Spatial Morphology", Environment and Planning B: Planning and Design, 30, 657-676.

Unwin, R., 1909, Town Planning in Practice An Introduction to the Art of Designing Cities and Suburbs, T. Fisher Unwin, London

Walsh,W.B., Pricr, R. H., and Craik, K, 2000, Person-Environment Psychology: New directions and perspectives, Lawrence Erlbaum Associates, Inc., NJ

Washburn, L. S, Brain evolution and Human Survival, in Kaplan, S. and Kaplan, R. 1987, Humanscape: Environments for People, Ulrich's Books, Inc, Ann Arbor, Michigan.

Whyte, W. H., 1980, The Social Space of Small Urban Spaces, The conservation foundation, Washington D.C.

Whyte, W. H., 1988, City: Rediscovering The Center, University of Pennsylvania

Wohlwill, J.F & Weisman, G.D., 1981, The Physical Environment and Behavior, The University of Minnesota Press

Zevi, B., (1974) The modern Language of Architecture, Washington University Press.

Zucker, P., 1970, Towns and Squares from the Agora to the Village Green, The MIT Press

APPENDICES

APPENDICES

Appendix 1 - List of analysis software programs that are used in the research field of space syntax, in historical order:

Axman The original developed by Nick Sheep Dalton of UCL to perform axial line analysis on computers running Mac OS, currently used in more than 50 countries. This spawned many offshoots such as Pesh (for the analysis of convex space networks) and SpaceBox (for the analysis of 'all-line' axial maps).

Spatialist Developed at Georgia Institute of Technology to implement theoretical innovations principally introduced by John Peponis, this software is plugs into the Microstation CAD package to analyse networks of automatically generated 'e-spaces' and 's-spaces'.

Axwoman, written by Bin Jiang while at UCL, is a tool to perform axial analysis as a plug-in to ESRI products.

Depthmap Developed by Alasdair Turner of UCL, this software was first developed to generate isovists and perform visibility graph analysis of building systems on computers running Windows, but now includes the automatic generation of axial line networks and analysis of axial line networks and road segment line networks at anything up to the level of the USA or Europe.

OmniVista Developed by Nick Sheep Dalton and Ruth Conroy Dalton to perform a range of isovist measures on Mac OS computers.

Fathom, a commercial implementation of visibility graph analysis written by the Intelligent Space Partnership.

Mindwalk Developed by Lucas Figueiredo, This software performs spatial analysis over standard axial maps and new continuity maps. It is written in Java and runs on several platforms. Also known as **xSpace**, Mindwalk has been used as a research and teaching tool at several institutions since 2002 and now it is being distributed worldwide for academic and non-commercial purposes.

Isovist Analyst by Sanjay Rana while at UCL, this program creates isovists from building plans as a plug-in to ESRI products.

Ajanachara. Open source software developed by Gerald Franz at the Max Planck Institute for Biological Cybernetics to perform visibility graph analysis of 3D Studio Max and VRML models.

Webmap Also developed by Nick Sheep Dalton at UCL, this software is free to use (although it requires registration), and allows users to analyse axial maps through a web browser interface.

Confeego Developed by the commercial company Space Syntax Limited, but available free for academic use, this software plugs directly into MapInfo to analyse line axial networks.

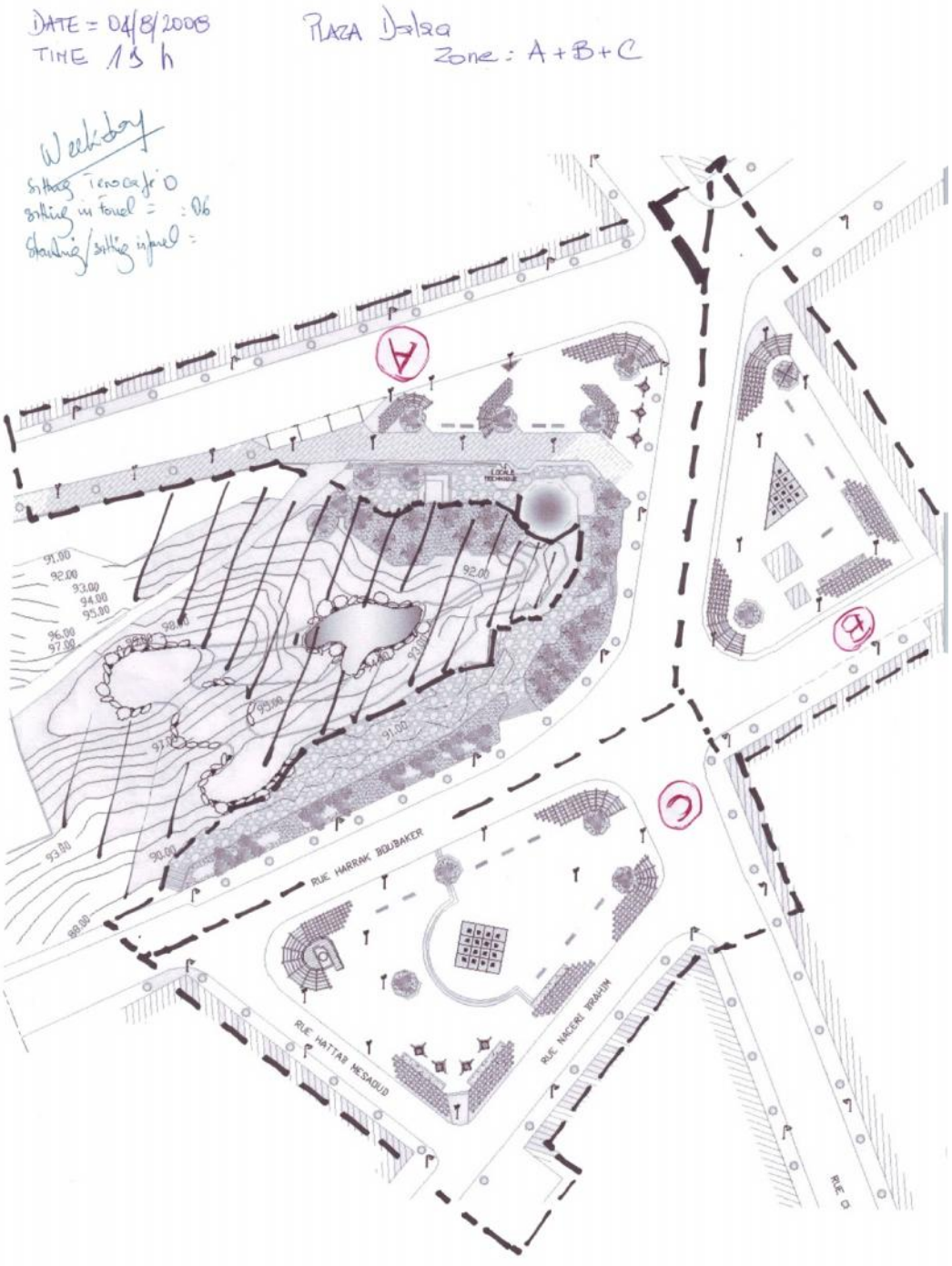
AJAX by Mike Batty of UCL, performs both traditional axial network analysis (Batty calls this the *primal* analysis), and point-based visibility analysis introduced by Bin Jiang (which Batty calls the *dual* analysis). In a recent paper, Batty shows the elegant mathematical relationship between the two

analyses.

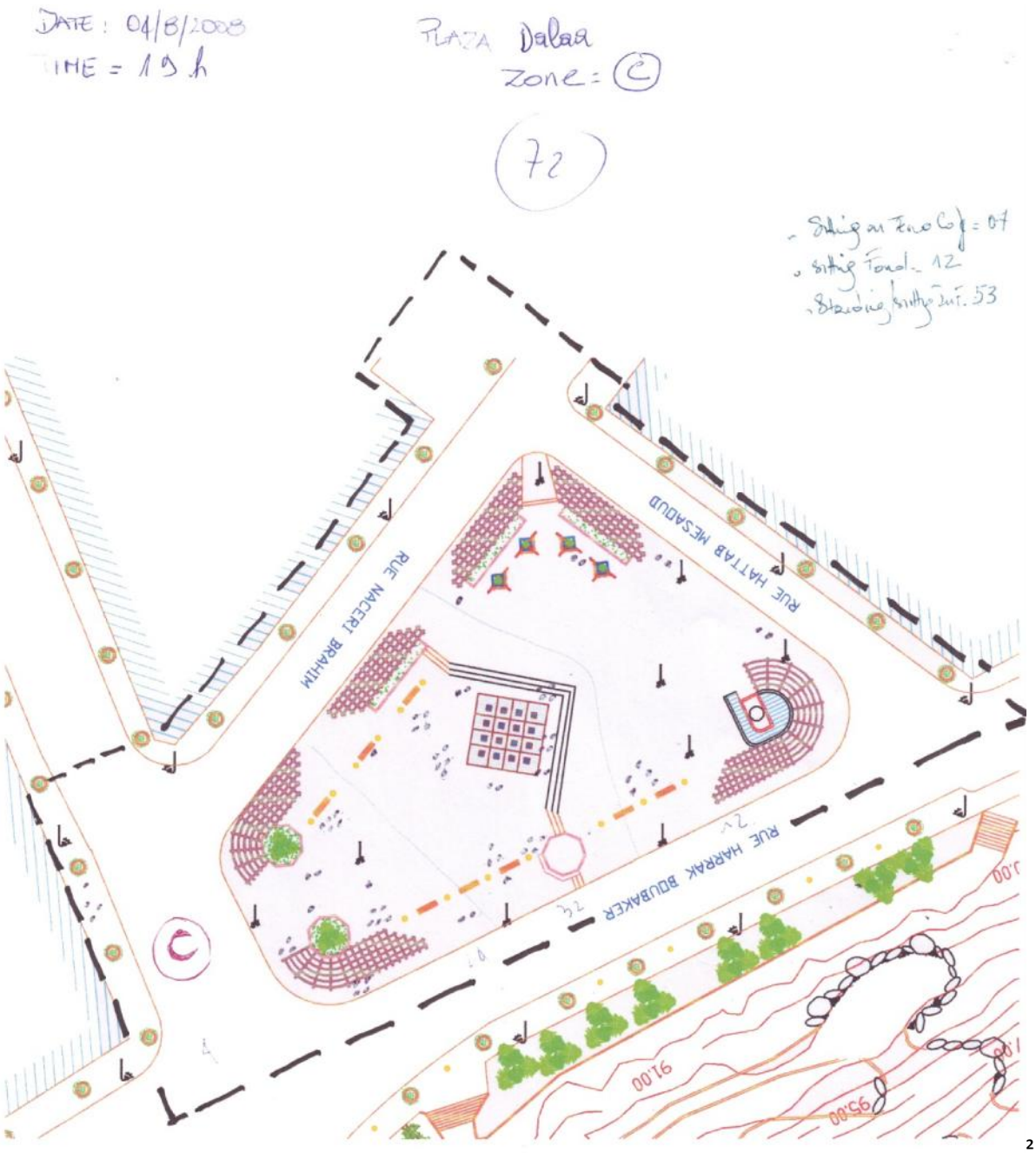
OverView plug-in to AutoCad by Christian Derix for Aedas Architects in collaboration with the Center for Evolutionary Computing in Architecture CECA. Allows architects to do quick visual integration mapping via isovist analysis on their projects. Contains also the possibility to analyse non-planar environments to take volumes and hilly sites into account.

AXess 1.0 by Jennifer Brisbane at the City University of New York. A context menu tool for ArcGIS 9.x that calculates connectivity, control, mean depth, global integration, and local integration for all nodes in an axial line layer.

Appendix 2- Samples of the plans of the plazas handed out to the surveyors for people counting:



1/ Layout plan of the Dalaa Plaza, showing the major subdivisions of the plaza.



2/ plan of a subdivision of the Dalaa Plaza as handed out to and filled up (people counting –as dots) by surveyor.

Appendix 3- Some mathematical elucidations of some measurements of Depthmap's visibility graph analysis.(Alasdair Turner)

Clustering coefficient

Clustering coefficient, *gi*, is described in detail by Watts (1999) and has its origin in the analysis of small-world networks. Turner et al. found it useful for the detection of junction points in environments. Clustering coefficient is defined as the proportion of vertices which are actually connected within the neighbourhood of the current vertex, compared to the number that could possibly be connected, as shown in equation 2.

$$\gamma_i = \frac{|E(\Gamma_i)|}{k_i(k_i - 1)} \qquad (2)$$

where E(Gi) is the set of edges in the neighbourhood of vi and ki is the as previously calculated. This is implemented in Depthmap by the following algorithm for each vertex in the graph [Again note that as the set of edges E(Gi) is not recorded, the information must be recovered from the vertices in the neighbourhood, V(Gi)]

$\gamma_i = 0$
for v_j in $V(\Gamma_i)$
begin
    for v_k in $V(\Gamma_j)$
    begin
      if v_k in $V(\Gamma_i)$ then $\gamma_i = \gamma_i + 1$
    end
end
$\gamma_i = \gamma_i / k_i(k_i - 1)$

Control

Control for a location, which we will label ci, is defined by Hillier and Hanson (1984), and is calculated by summing the reciprocals of the neighbourhood sizes adjoining the vertex, as shown in equation 3. ci, is defined by Hillier and Hanson (1984), and is calculated by summing the reciprocals of the neighbourhood sizes adjoining the vertex, as shown in equation 3.

$$c_i = \sum_{v_j \in V(\Gamma_i)} \frac{1}{k_j} \qquad (3)$$

A simple algorithm can be used to calculate this value as follows:

$c_i = 0$

for v_j in $V(\Gamma_i)$

begin

$c_i = c_i + 1/k_j$

end

It should be noted that in VGA many of the immediately adjoining neighbourhoods will overlap, so that perhaps a better definition of VGA control would be the area of the current neighbourhood with respect to the total area of the immediately adjoining neighbourhood that is, rather than use the sum the size of all the adjoining neighbourhoods, use the size of the union of those adjoining neighbourhoods as shown in equation 4. The results of applying this method are shown in figure 6, although Depthmap is also capable of calculating control as defined by Hillier and Hanson.

$$c_i' = \frac{k_i}{|\bigcup V(\Gamma_j) : v_j \in V(\Gamma_i)|} \quad (4)$$

Mean Depth

The mean path length Li from a vertex is the average number of edge steps to reach any other vertex in the graph using the shortest number of steps possible in each case. This sort of graph measure has a long history stretching back as far as Wiener (1947), and is pertinent to visibility graph analysis due to the parallels with the use of integration in space syntax theory (Hillier et al., 1993), showing how visually connected a vertex is to all other vertices in the system. We calculate Li by constructing the set of point depths, as follows. The algorithm we use is not the most time efficient, as shortest paths are recalculated for each vertex, rather than being stored in a cache. However, the memory constraints on current personal computers mean that storing all the shortest paths in the system would rapidly use up the available memory. Hence, the algorithm that follows works in O(n2) time. It obtains point depths for all the vertices in the system from the current vertex, by adding ordered pairs of vertices and depths to the set P.

$P_i = \{v_i, 0\}$

$n = 0$

for $\{v_j, n\}$ in P_i

begin

for v_k in $V(\Gamma_j)$

begin

if $\{v_k, *\}$ not in P then add $\{v_k, n+1\}$ to P_i

end

if finished $\{*, n\}$ then $n = n + 1$

end

An asterisk, such as in the set pair {v1, *}, represents a wild card matching operation. For example, {v1, *} matches any of {v1, 1}, {v1, 2} or {v1, 4}.

Once the point depth set has been constructed, it is facile to calculate measures such as mean depth and integration. This measure would seem to be useful understanding movement of people within building environments, where it is difficult to apply traditional Space Syntax methods such as axial analyses at high resolutions. However, in urban environments, since we are measuring numbers of turns from location to location, VGA integration quickly approximates to axial integration (albeit with each line weighted by the street area), and due to speed considerations, it may not be as beneficial to use VGA integration in these situations.

Point Depth Entropy

In addition to calculating measures such as mean depth, the point depth set Pi allows us to explore measures based on the frequency distribution of the depths. One such measure is the point depth entropy of a location, si, which we can express using Shannon s formula of uncertainty, as shown in equation 5. Entropy occurs in many fields, including informatics, and is proposed for use in Space Syntax by Hiller et al. (1987).

$$s_i = \sum_{d=1}^{d_{\max}} -p_d \log p_d$$

where dmax is the maximum depth from vertex v i and pd is the frequency of point depth *d* from the vertex. This is implemented algorithmically in Depthmap as follows:

$s_i = 0$

$d_{\max} = 0$

for $\{*, n\}$ in P_i

begin

    if $n > d_{\max}$ then $d_{\max} = n$

end

for n in 1 to $d_{\max}$

begin

    $p = \text{count}(\{*, n\}) \; / |P_i|$

    $s_i = s_i - p \log p$

end

Abstract

This thesis aims to explore why some plazas are preferred to others and also why some parts of the same plaza are busier and more preferred by people than others.

The investigation springs from the assumption that a good space is a used space and people's behavior, movement and use is directly related to the visuals fields created by the spatial configuration i.e. visibility. It is also assumed that the use of space is governed by two major factors: Its attractiveness in terms of movement, i.e. how easy for people to move in as its being to-movement and through-movement space; and the conduciveness of its visual properties for people's activities. This work aims to examine the correlation between the spatial use and isovist properties of plaza spaces with a case study from Algeria. The thesis first starts with a comparative study of four urban plazas within the city center district of Biskra, Algeria, in which the correlation between the number of static people in sitting and standing positions and the syntactic and isovist properties of each plaza is examined. Then focuses is put on each of these plazas to explore why within the same plaza some parts are busier and more preferred by people than others. Believing that a space may have many sub-settings and that its use is determined by the affordances of these sub-settings, the plaza has been subdivided into subspaces based on its physical properties. Each subspace has been investigated further to look for links between visibility and spatial use. Space syntax method and tools are used to investigate into the issue. The Depthmap program, developed by Alasdair Turner, has been used to observe the visibility properties while behavior mapping, i.e. people counting and spatial use mapping, has been used to observe in-situ the spatial use. The results indicated that spatial use is strongly related to visual considerations relevant to the type of activity and that people might undergo some discomfort for visibility matters.

Key words**:** Isovists, space Syntax, spatial experience, behavior, visibility, Plazas

ملخص

تتناول هذه الأطروحة كيفية استعمال المجال العمراني و بالتحديد الساحات الخارجية العامة حيث تطرقت إلى الإشكالية المتعلقة بكيفية الاستعمال الغير متوساءات من طرف الإنسان – ساحات عليها تدفق و استعمال كبير و أخرى قليلة الاستعمال حتى تكاد تكون مهجورة كما هو الحال بالنسباحة الواحة – مجالات مستعملة أكثر من أخرى.

للنظر في هذا الإشكال انطلقت هذه الأطروحة من الفرضية المتمثلة في أن استعمال المجال من طرف الإنسان مرتبط ارتباطا وطيدا بالعلاقات البصرية و حقل الرؤية (Visibility) المتوفرة في المجال. اعتمادا على النظرية التي تنص على أن تركيبة و مرفولجية المجال العمراني متغير بالنسبة للإنسان المتجول (المتحرك) مما يتأثر على سلوكيته و قراراته و ختياراته المتعلقة باستعمال المجال سواء للتحرك و التنقل أو القيام بأنشطة ثابتة (Static activities) (Bill Hillier).

للنظر في هذه المعضلة أخذت الأطروحة ساحات مدينة بسكرة كنموذج للدراسة. و تم استعمال صيغة التركيب الفراغي كمقاربة للدراسة – عمليا البحث ارتكز من جهة أولى على استعمال البرنامج الرقمي(Depthmap) الذي يسمح بتقييم رقمي لخصائص المجال و إنتاج خرائط بيانية، و من جهة أخرى تم الاعتماد على الملاحظة الميدانية (In Situ observation) لكيفية استعمال المجال و انجاز خرائط السلوكيات أو كيفيةال المجال (Behavior mapping). تم الاعتماد على تطابق كل الخرائط و الأرقام المستمدة من البرنامج الرقمي و الملاحظة الميدانية بهدف الكشف عن أية علاقة بين استعمال المجال و الجانب البصري تم هذا عن طريق المقارنة بين الساحات المختلفة و بين مختلف مناطق (Subspaces) الساحة الواحدة.