

The Impact of Sustainability Values on Neighborhood Public Space intelligibility

Mustafa Aziz Mohammad Amen

Abstract— Residential parts construct a significant portion in cities. Usually, neighborhood works as a central component of any cities. This study concentrates on using the concept of **sustainability values** as a method to comprehend the intelligibility of the Neighborhood public space. In another way, it is an attempt to find out if the sustainability values have any impact on the space intelligibility. Typically, Neighborhoods composed of two primary activities, residential, and non-residential. All activities related somehow with different criteria. In a pre-Sustainability era, those principles played a crucial role in modeling the neighborhood layout. Sometimes, activities allocation had a negative effect on the final product. Classic attitudes produced a rupture between the neighborhood center and the peripheral parts. That high centrality typically led to a kind of discontinuity between the various parts of the neighborhood from one side and creating some separated illegible spaces from the other side. By introducing sustainability values, many functional criteria modified to be as much as compatible with it. The study adopted some criteria from U.S Green Building Council (USGBC) mechanisms to understand and clarify the changes of the neighborhood form. Criteria like **Walkable Street, Compact, Mixed-Use Neighborhood, and Mixed-income diverse community** used to study the differentiation and flexibility of the sustainability factors, with its direct effects on creating a sustainable neighborhood. The research believes that the sustainable neighborhood has to be spatially intelligible and has a relative coherence between its components. The research adopts the comparison analysis method between the different Sustainable factors and intelligibility factors as it defined in space syntax methodology to understand the relationship between the Sustainable factors and its role in the intelligibility of the urban public space. All of the data from USGBC analyzed and then those data used in a comparative method to get the conclusion.

Index Terms— Neighborhood, Sustainability, Public Space, Residential, Green Building, Intelligibility

1 INTRODUCTION

It is worth to know why there is a global focus on sustainability issue with particular attention to its impacts on the city planning. "The International Panel on Climate Change, an offshoot of the World Meteorological Organization and the United Nations Environment Program showed that the average temperatures worldwide will increase by 2.5 degrees Celsius (4.5 degrees Fahrenheit) by 2100 lying and coastal cities will be particularly hard hit by this trend, due to anticipated changes in sea levels as polar ice thaws"¹. Accordingly, most of the countries did their work to understand what the procedure to reduce the global warming.

The Sustainability is a broad discipline that gives visions into most aspects of the human world from business to knowledge to the environment and the social disciplines. Sustainability draws on politics, economics, philosophy and social sciences as well as the hard sciences. Cities grew fundamentally in the last years, Pollutions, Congestions, and many other issues have played a significant role in increasing the emission of the CO₂ in the world, and those harmful factors played a crucial role in creating a real disaster unless there are real attitudes to reduce the adverse effects.

Sustainable city planning could reduce the negative environmental, economic and social impacts of the city, So that is a very critical issue to understand how to build residential area to reduce negative impacts on the cities. Each part of the cities could do its role, from this point of view Neighborhood has been selected as a chief focus of the research to be analyzed and manipulated.

1.1 DEFINITION OF THE SUSTAINABILITY CONCEPT.

Sustainability is a way of observing a community or society in a largest possible context, in both time and space. The concept of sustainability centered on the principle that people and their society composed of economic, social, and environmental systems that are in balance interaction, and that must be in balance or consistency. The balance is the main issue for the future society, aside from social and economic factors, increasingly rising energy expenditures over the years expedite the efforts towards sustainability. According to Michael Bauer, the energy saving is a critical issue for the European countries depends on the imported energy. He affirmed that by saying "energy saving measures have become essential in this day and age. A further reason for the conscientious handling of resources is a heavy dependency on energy import. The European Union currently imports more than 60% of its energy"². Buildings, in general, has a big share of energy expenditure and participate in another way in increasing pollution of the environment and producing environmental destruction, Matthew E. Kahn said that the "Urban population growth is a key driver of environmental degradation. As more people crowd into cities, the problems of urban air pollution, water pollution, and solid waste production all grow worse. New migrants do not simply increase the scale of economic activity; they also tax and sometimes overwhelm basic infrastructure services. As a result urban sustainability, as measured by both the ecological footprint and public health approaches, de-

¹ Kahn, Matthew E (2006). Green cities: urban growth and the environment. Brookings Institution's Press. Washington. P 133.

² Bauer, Michael., Mosle, Peter., & Schwarz, Michael. (2010) Green Buildings: a guidebook for sustainable Architecture. Springer. P10.

clines.”³. Accordingly, there is a goal to be achieved by Architect, designers, and planners that to reduce those negative issues related to building and city planning.

1.2 DEFINITION OF THE NEIGHBORHOOD CONCEPT

Neighborhoods are the main cell of creating cities; attached neighborhoods become the base for creating cities. When Neighborhood combines within a hierarchical system, it generates some bigger parts that could be called quarter or Sector. This concept of neighborhood is affirmed by USGBC as they believe that “A neighborhood can be considered the planning unit of a town. The charter of the Congress for the New Urbanism characterizes this unit as compact, pedestrian-friendly, and mixed-use”⁴. Neighborhoods, as laid out in LEED-ND, is in contrast to sprawl development patterns, which create pod like clusters that disconnected from surrounding areas.

Cynthia Girling also defined the Neighborhoods as “those broadly legible, if not precisely definable, areas of cities in which people say they live, work, learn, or play. It is also the scale at which new areas of many cities planned. Within this definition, neighborhoods may vary substantially in physical size, shape, population, density, or character. Several may link together to form a larger, interdependent group of neighborhoods.”⁵. Here another characteristic has been added to the definition that is the legibility of the place within neighborhoods.

According to Cliff Moughtin, there is a possibility for neighborhoods to emerge unconsciously or naturally and that is evident from his statement when he said “neighborhood is formed naturally from the daily occupations of people, the distance it is convenient to walk, to daily shopping, and a child to walk to school. He should not have a long walk, and he should not have to cross the main traffic road. The planning of a neighborhood starts from that.”⁶ From all those definitions we could say that Neighborhoods are the main unit to build cities. It has its characteristic that range from compact, pedestrian-friendly, mixed-use, Legibility. This research accepts this definition as granted and looking for to find the consistency of these values.

1.3 NEIGHBORHOOD LAND USE.

Neighborhood composed of several parts; here we will clarify those parts with how much area or the total percentage for each one inside the neighborhood.

³ Kahn, Matthew E (2006). Green cities: urban growth and the environment. Brookings Institution’s Press. Washington P 93.

⁴ U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc.P XVI.

⁵ Girling, Cynthia. Kellett, Ronald. (2005). Skinny Street and Green Neighborhood, Design for Environment and Community. Island Press. P 11.

⁶ Ibid P 28

1.3.1 NON-RESIDENTIAL

This part relates to sectors that are not for housing units. As a commercial, civic and Industrial Uses. There is no fixed number about what is the percentage of this area comparing to the other parts of the city. Grilling Cynthia studies on some American and Canada shows that the percentage could be 26% for some large neighborhood with 12000 dwellings. Alternatively, could be just 6% of some other⁷. There is no obvious factor showing the percentage of these areas in the planning standards. Instead, it is more related to laws and legislation of each city and country.

1.3.2 RESIDENTIAL AREA

The residential area is the part of Housing. It is worth to mention that this part contains all types of residential units like attached, detached, and stacked dwellings. According to USGBC these area has specific percentages depend on the several factors that relate to the sustainability issues. This point will be clarified in the sustainable neighborhood factors later.

1.3.3 PUBLIC SPACE TYPES.

A common criticism of many populated areas is that the “housing and its layout are monotonous and dull because house builders often utilize standard house types repeatedly along a road has been planned using the rigid standards referred to above that leads to create segregated area representing the commercial and cultural activities leaving the other part of the layout out of action. “The result is ‘anywhere’ housing—as the same developer could build the same houses along the same form of road anywhere else.”⁸ Space has its role in creating urban form.

At the broadest level, the urban designer is helping to design the inner envelope where is the solid walls of Buildings. The final layout of neighborhood design will get affected by the urban space that provides variety and diversity inside the neighborhood. There are many classifications for neighborhood spaces. According to Mike Biddulph, the concept of space could be classified according to accessibility or the ability to reach that area in the different daytime (Table1). Accordingly, he divided the urban public space to four types⁹. The conclusion shows that that two of the spaces has more accessibility and connectivity with the other part of the layout. Spaces are critical as it plays a significant role in the intelligibility of the layout later. For the sake of the Sustainable neighborhood, there must be an increment in the number of the public and semi-public spaces within the design. The increment of the private spaces would create segregated island inside the neighborhood that reduces the whole understanding of the layout.

⁷ U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc.

⁸ Biddulph, Mike (2007). Introduction to Residential Layout. Elsevier Limited. P6.

⁹ Ibid.

Space Type	Accessibility from Public	Public/Private Control	Public Activities
Public Space	Yes	Very Low	Yes
Semi-Public Space	Limited	Low	Possible but limited
Semi Private Space	NO	Controlled/Private	No
Private Space	NO	Full Controlled/Private	No

Table 1 Shows the space type according to accessibility, activists, and control (done by the researcher)

Graham Tower insisted on the priority of the public space in creating a sustainable neighborhood “There should be a coherent pattern of streets and public spaces which is permeable to pedestrians and provides access to facilities and amenities. It should aim to accommodate personalization and respect privacy. At the same time, safety and security should be a high priority.”¹⁰ The public space will be more important for the sustainable neighborhood as it is focusing on the increment of the urban density. Therefore “The public spaces that are so important when housing densities are high and that many take for granted—play areas, green areas, shade-giving trees, spaces that encourage a public social life—are usually deficient or absent as well”¹¹.

In designing or working in any communities large or small, usually there is a focus on the public spaces streets, squares, parks, and so forth – and design them in considerable detail, because these spaces are the core of any community, the original armature of public life¹².

2. Sustainability effects on cities.

Statistics show that the “population roughly doubled between 1940 and 2000, the housing stock tripled.”¹³ Housing and residential area take a significant share of that part. Cynthia Girling shows that the population increment in the cities is almost one third is lower than the housing increment, “While the population roughly doubled between 1940 and 2000, the housing stock tripled. In 1940, there were just over 37 million homes in the United States. Over the next sixty years, population slightly more than doubled (214 percent) while average household size shrank by about a third, The combination of increasing population and decreasing household size significantly accelerated demand For new housing units.”¹⁴ Accordingly, the world housing demands are supposed to be doubled within next years. It is clear that will be an increasing demand for the homes all over the world. Certainly, housing growths the built-up area of cities, with all its complementary infrastructure issues (fig 1)¹⁵.

¹⁰Towers, Graham. (2005). An Introduction to Urban Housing Design :AT HOME IN THE CITY. Architecture Press.P 72

¹¹ Garau,Pietro .(2005). A Home in the City. Earthscan. P15

¹² Walters,David.Luise Brown, Linda. (2004). Design First :Design-based planning for communities. Architecturall Press.

¹³ Girling, Cynthia. Kellett, Ronald. (2005). Skinny Street and Green Neighborhood, Design for Environment and Community. Island Press. P 1.

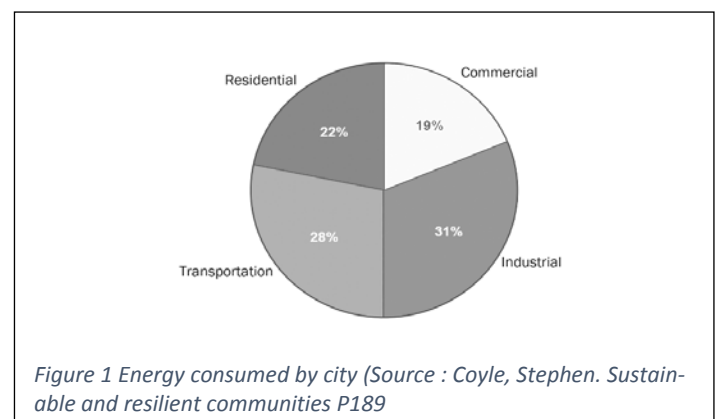
¹⁴ Girling, Cynthia. Kellett, Ronald. (2005). Skinny Street and Green Neighborhood, Design for Environment and Community. Island Press. P1.

¹⁵ Coyle, Stephen. (2011). Sustainable and resilient communities, a

If other economic factors increase the social standards that will eventually need more area per family and upsurge the plot area per family. The total increment will be much bigger and unpredicted. The global attitudes strains and demands will force the reduction of the energy consumption emancipation from the residential area; there are many ways and attitudes to achieve a sustainable society that it has some differentiation between society and other. Vehicle transferred mile (VMT), and increasing life quality might participate in encompassing the sustainability in the future cities.

Recognizing a proper method of dealing with the essence and size of the problem is the main factor in reducing the negative impact of the social, environmental, and social factors. In a sustainable society, communities have easy transportation ranges, with the option to use other media like a bike or using public transit to reach the other part of the neighborhood. Pedestrian networks connecting to centers, schools, hospitals, and parks support a mix of uses and destinations that create demand for transit service beyond normal commute peaks. In a sustainable Place, transit is integrated into communities, with high-quality building materials, and low-impact and easily accessible alignments.

Changes in the way we build, renovate, plan, and operate our communities can have tremendous impacts on local and national energy consumption. There is an increasingly recognized process in energy and community policy. Stephen Coyle confirmed that there is “a nascent shift toward more sustainable land use practices, changes in community design and transportation infrastructure to promote walkable neighborhoods and mass-transportation, dramatic improvements in building efficiency,”¹⁶ it is a global responsibility to think of those factors that could affect the world. Each profession has its share of that process as architecture, and urban design has to do their share on their whole process.



Comprehensive Action Plan for Towns, Cities, and Regions. John Wiley & Sons. P 189

¹⁶ Coyle, Stephen. (2011). Sustainable and resilient communities, a Comprehensive Action Plan for Towns, Cities, and Regions. John Wiley & Sons. P 190

3. Historical Review

3.1 Before 1850 Pre-Industrial era.

Since ancient times, towns and cities all over the world spatially divided into districts or neighborhoods. Some of the old cities reveal evidence of social neighborhoods as Lewis Mumford noticed. Mumford said, "neighborhoods, in some primitive, inchoate fashion exist wherever human beings congregate, in permanent family dwellings; and many of the functions of the city tend to be distributed naturally—that is, without any theoretical preoccupation or political direction—into neighborhoods."17.

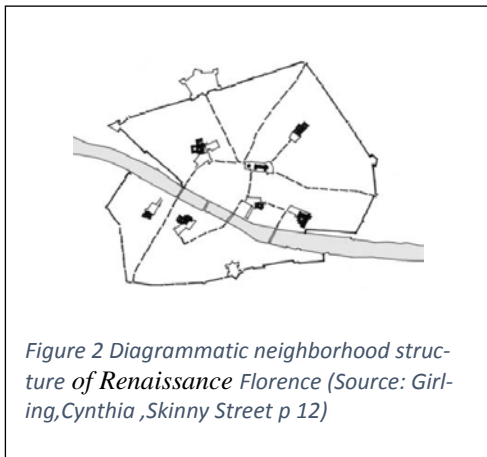


Figure 2 Diagrammatic neighborhood structure of Renaissance Florence (Source: Girling, Cynthia, *Skinny Street* p 12)

Normally there was a Center for Neighborhoods that also had edges or boundaries that distinguish one from another. The boundaries and edges could be different as Cynthia Girling said, "These edges can vary in type and character. Some may be hard and explicit (such as a wide, heavily trafficked street), whereas others may be soft and implicit such as a contrasting land use or common open space), allowing several neighborhoods to overlap or interconnect along a shared Edge"18.

Some of those boundaries may be hard and explicit (such as a wide, others may be soft, implicit and abstruse (such as a different land use or common open space), allowing several neighborhoods to join or interconnect along a communal edge (Figure 2). The neighborhood was a normal division in the pre-industrial city with its characteristics that had some diversity according to the different communities and traditions.

3.2 Industrial Era 1850

During the industrial era, many factors had generated negative impacts on cities. The skies above such major European and American were dark with smoke from heavy industrial plants. Kahn, Matthew in his *Green Cities* book said, "During the nineteenth and early twentieth centuries, the skies above such major cities as Chicago and Pittsburgh were dark with smoke from steel smelters and other heavy industrial plants. Today, Chicago and Pittsburgh are much cleaner than they were forty years ago, and even Los Angeles has experienced a dramatic reduction in smog levels despite rapid growth in population and"19.

17 U.S. Green Building Council. (2009). *Green Neighborhood Development*. U.S. Green Building Council Inc. P XVI.

18 Girling, Cynthia. Kellett, Ronald. (2005). *Skinny Street and Green Neighborhood, Design for Environment and Community*. Island Press. P 11.

19 Kahn, Matthew E (2006). *Green cities: urban growth and the envi-*

ronment. Brookings Institution's Press. Washington. P1

From the other side, people started to emigrate from a rural area to concentrate in cities. Changes in urban population growth worked as a basic key of dreadful environmental conditions. As more people moved into cities, the problems of urban air pollution, water pollution, and solid waste production all grow worse. It was a loss of environment according to Kahn, Matthew "These migrants often end up earning and consuming more, which can be a win for them but a loss for the environment."20

New migrants do not simply increased the city growth that implied an increase the scale of economic activity; they overwhelm basic infrastructure services. As a result, Cities become bigger and larger in size that could not bear the load. At the same time, factors like air pollution, water pollution, solid waste problems, Urbanization, and Consumption, made the Planners to think how to improve the way the town could grow toward more attractive, and more attractive, and more environmentally and economically pattern of development21. Some planners started to think about some criteria and standards to arrange the different sectors of the city, provided that they came to the point to organize the residential area into clusters of single-use buildings, the single-family residential pods, higher-density apartment complexes, retail strip centers and malls, offices, and industrial parks and campus-type school

sites fitted to the size of the local and regional thoroughfare system. Some planners and theorists like Raymond Unwin and Ebenezer Howard went forward to create what is more suitable for people to live so that they suggested garden cities22.

3.3 1929 Perry Concept and Green Neighborhood Movement.

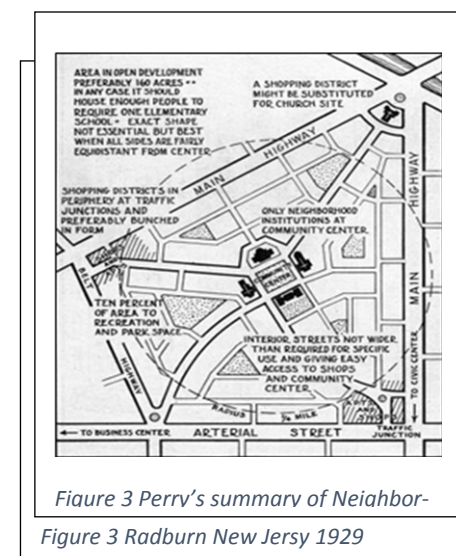


Figure 3 Perry's summary of Neighbourhood
Figure 3 Radburn New Jersey 1929

theories and concepts suggested before gorging the actual Green Neighborhood. A well-founded theoretical basis for neighborhood planning proposed by the American educator and social reformer Clarence Arthur Perry according to Perry's (view Fig 3) "A well-founded theoretical basis for neighborhood

planning came only later, proposed by the American educator

20 Ibid P106

21 Kahn, Matthew E (2006). *Green cities: urban growth and the environment*. Brookings Institution's Press. Washington P106

22 Gullivar, Katrina. (2014). *City scape in History*. P43

and social reformer Clarence Arthur Perry (1872–1944). Perry found the social sciences up to that point in the social cohesion and interaction of neighborhoods. “For a hypothetical neighborhood on 64 hectares, located about halfway between the center and periphery of a city with less than 100,000 residents, Perry designed catalog of formal and functional principles. Perry saw the precisely planned spatial coherence of such a residential unit and its size as the pivotal determinants for producing strong social cohesion and a feeling of community. A child’s route to the closest playground (no further than a quarter of a mile) and primary school (no more than Haifa mile) were considered crucial factors in determining the extent of a neighborhood.”²³

Perry started to think about the Planning a City Neighborhood from the Social Point of View. Perry condensed the findings of the social sciences up to that point in the social cohesion and interaction of neighborhoods in an urban context and thereby provided parameters for urban planning. Perry’s neighborhood and its and their spacious recreational spaces were grouped to form a city with a cellular structure. Radburn (Fig 4) was the real model for Perry’s work, Perry’s work led to national neighborhood planning standards. In the United States after World War II, “Perry’s work eventually led to national neighborhood planning standards published in the industry-wide technical bulletins of the U.S. Federal Housing Administration. After World War II, qualification for federal mortgage assistance was directly tied to these standards; thus, they explicitly influenced the development pattern of a generation of subdivisions throughout the United States in the 1950s and 1960s.”²⁴

3.4 Sustainable Neighborhood Movement

Oilman (1995) noted that “sustainable neighborhood, people can be close to where much of their food grown and their livelihoods. The physical and economic environment arranged so that quality time with family, friends, and community is possible. Leisure, recreational, and civic activities are within walking or short non-polluting commute distance.”²⁵ Arkin (1995) shows that “the “public interest purposes”’ eco-villages are such that they serve to:

- (a) Demonstrate low-impact, high-quality lifestyles;
- (b) Reduce the burden of government by increasing neighborhood self-reliance;
- (c) Reverse the negative environmental, social, and economic impacts of current growth and development practices;
- (d) Model sustainable patterns of development in the industrialized world, especially the United States, to encourage developing communities to bypass our unsustainable patterns;
- (e) showcase the talents and skills of those working toward a sustainable future.”²⁶The sustainable neighborhoods as it

²³ Gullivar, Katrina. (2014). City scape in History. Ashgate Publishing limited P46

²⁴ Girling, Cynthia. Kellett, Ronald. (2005). Skinny Street and Green Neighborhood, Design for Environment and Community. Island Press. P 12.

²⁵ Hoff, Marie. (1998) Sustainable Community Development: Studies in Economic, Environmental, and cultural revitalization, Lewis Publisher, p86.

²⁶ Hoff, Marie. (1998) Sustainable Community Development: Studies in

presented by U.S. Green Building Council incline to show “high levels of walkability, a sense of place, social cohesion,”²⁷ stability and resiliency among changing economic and sociopolitical conditions. In summary a sustainable neighborhood include:

- “A discernible center
- Housing within a five-minute walk from the center
- A variety of dwelling types
- A variety of stores and commercial activity
- Flexible backyard “ancillary” buildings for working or living
- A school within walking distance
- Playgrounds near all dwellings
- Connected streets
- Narrow, shaded streets conducive to pedestrians and cyclists
- Buildings close to the street at a pedestrian scale
- Parking or Garages placed behind buildings and away from street frontages
- Prominent civic and public buildings
- A community decision process for maintenance, security, and neighborhood development.”²⁸
- Leed has submitted some criteria to achieve the sustainable

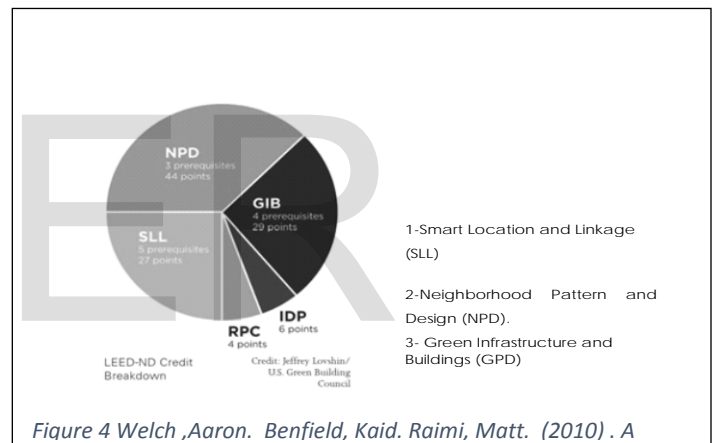


Figure 4 Welch ,Aaron. Benfield, Kaid. Raimi, Matt. (2010) . A

neighborhood, those criteria divided into three parts with a special grade for each part as below.

- 1-Smart Location and Linkage (SLL)
- 2-Neighborhood Pattern and Design (NPD).
- 3- Green Infrastructure and Buildings (GPD) 29

From(Fig 5) it is clear that according to the USGBN most credits in their final calculations and decisions go to the layout of the neighborhood or what they call it NDP.The research has taken that as grant and went further to manipulate it according to the intelligibility. The layout of the neighborhood will play the most important part of the neighborhood intelligibility as it finally will be the place that people would gather to work and interact with each other according to the urban space.

Economic, Environmental, and cultural revitalization, Lewis Publisher, p86.

²⁷ Welch, Aaron. Benfield, Kaid. Raimi, Matt. (2010). A Citizen’s Guide to LEED for Neighborhood Development: How to Tell if Development is Smart and Green”. U.S. Green Building Council Inc.P4

²⁸ Ibid.P4

²⁹ U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc.P XIV

4.1 WALKABILITY

Walkable Street are the basic foundations of projects that used to reduce carbon emission and polluted material by inventing a multi-model travel environment. Pedestrian-scaled Street has to be narrower than the street designed for automobile-Oriented. According to LEED-ND, the walkable street has to be designed with "adequate space for gathering people, plenty of visual interest, Mix use activities, and building enclosure"³⁰. Streets designed for pedestrian should offer protection from vehicles and has the good characteristics for walking. As a result, the walkable street is not just a neutral

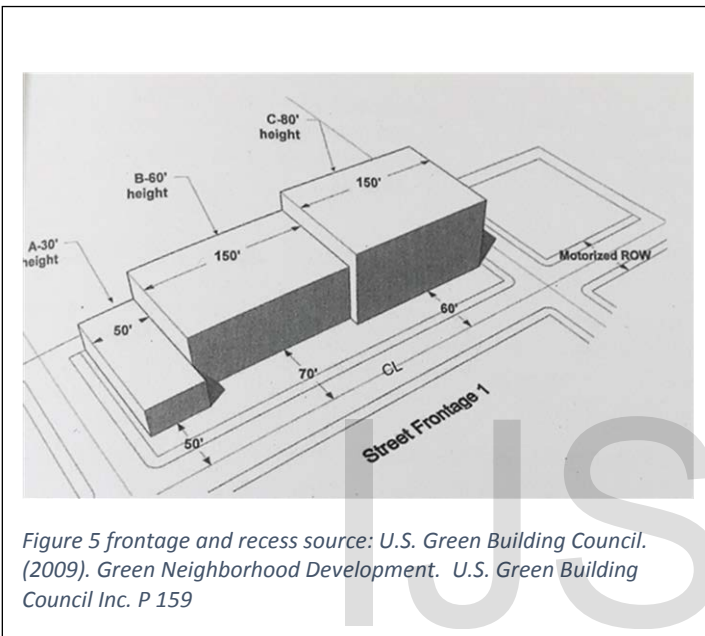


Figure 5 frontage and recess source: U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc. P 159

space with jus monotonous. This kind of street transforms the streetscape into public space amenities that can attract the resident to space.

To improve the walkability of the street, LEED-ND suggested to that all buildings must have the accessibility directly from the street that increase the interactions between the buildings and the Pedestrian. The previous factor increase interaction and the connection between the walkable street and building that lead to increasing of the connectivity of the walkable street more than the altered model of monotonous functions with back side entrance³¹.

Also, to that, there are some criteria regarding the dimension of the walkable street and the height of the street to be sure that the sense of enclosure created within the walkable street. "The prerequisite require that at least 15% of existing and new street frontage achieve minimum building high to street width ratio of 1:3. This ratio will affect the total scope of the street"³² fig (6) shows the dimension of buildings and frontage of different location inside the neighborhood³³. Besides that, 60% of the facades that face public space should be in glass and can

look through it clearly.

According to the above characteristics, the walkable street is perfectly connected to the other part of the layout and encourage more connections with neighbor sectors. However, the vital question remains related to the priority of the streets in the neighborhood and which one should have more walkability than the other? If something like that introduced then logically there should be more credits. By achieving the sustainable, walkable street, the project will get close to achieve highly connected parts together within the community. This factor can increase the connectivity and play a specific role in the intelligibility of the neighborhood. The purpose of this walkable street is to increase the feeling of safety, Security, and amenity as that all confirmed by Stephan Coyle when he clarify walkable street as a mean to "boast a diversity of necessary and desirable functions. The residential, employment, shopping and civic uses function integrated into mixed-use buildings and blocks. The location, scale, and design of squares, plazas, and parks reflect their importance and value as cultural, commercial, and natural resources. Boundaries between built and natural environments are clearly defined to protect both habitats?"³⁴ In brief, the walkable street is a public mean with public spaces works like nodes for interaction and invention within the walkable street. It should have a Scale and Form that human scale and spatial enclosure Buildings informed by the surrounding physical context, the adjacent landscapes, structures, local conditions, building traditions, and the microclimate.

The differentiation of the building heights works to increase the sense of the enclosure within that node. In addition to that, it could help to support the feeling of more intimate by making the people of space has a special interaction with the activates inside the space that has achieved through introducing the open façade area that give the feelings of belonging and safety to space.

4.2 COMPACT DEVELOPMENT.

Compact development inspires the efficient use of the land footprint of the neighborhood layout. The Less impervious surface may free land for additional improvement; this factor introduced to increase the livability, walkability, and the transportation efficiency, Accordingly to reduce the vehicle mile traveled (VMT)³⁵. There are many criteria to implement this condition, so there is an enforcement to increase the density especially for the main transit while keeping integration with the surrounding communities.

³⁰ U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc.P 154

³¹ U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc.

³² Ibid P153

³³ Ibid P 159

³⁴ Coyle, Stephen. (2011). Sustainable and resilient communities, a Comprehensive Action Plan for Towns, Cities, and Regions. John Wiley & Sons. P 8

³⁵ Welch, Aaron. Benfield, Kaid. Raimi, Matt. (2010). A Citizen's Guide to LEED for Neighborhood Development: How to Tell if Development is Smart and Green". U.S. Green Building Council Inc .P8

To achieve that high density the layout should adopt attached housing or multifamily residential housing and limit the size

Residential Density (Du/Acre)	Non-Residential Density (FAR) ³⁶	Points
> 10 and ≤ 13	> 0.75 and ≤ 1.0	1
> 13 and ≤ 18	> 1.0 and ≤ 1.25	2
> 18 and ≤ 125	> 1.25 and ≤ 1.75	3
> 25 and ≤ 38	> 1.75 and ≤ 2.25	4
> 38 and ≤ 63	> 2.25 and ≤ 3.8	5
> 63	> 3.0	6

Table 4 U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc. P199

for a single family homes³⁷. According to (Table 4) the higher density is preferable by Leeds and gets the maximum points from the rating system. This factor also encourages the make a mixed use functions within the high-density area, shops, and restaurants to be built offices and apartments or multistory nonresidential building. The location of the high density³⁸ should be within the walkable main street or the center of the neighborhood. The high density of its functions diversity increase the connections between its part and the other part of the neighborhood, but the main connectivity will be in main transit that work as the main connecting node between the different part of the sustainable neighborhood.

4.3 MIXED-USE NEIGHBORHOOD CENTER.

Neighborhood center offers a public space for the people to gather and increase the intimate activity between them; the center may include activities that are in beyond daily use. The objective of this factor is to increase development that is within walking distance (Fig 7), all residents and visitors could walk to the diverse activities within this area, providing walkable access to the essential functions and basic services save many issues, people do not use their cars for daily shopping and needs. Additionally, daily physical walking has a good impact on the public health³⁹.

This factor, in general, will do well in reducing the vehicle miles Transportation (VMT) which has a direct impact on the pollution and the urban congestion, also to reduces greenhouses gas emission. Accordingly 50% of the residential dwellings should be within a ¼ mile from the diverse activities, to get the maximum of this factor LEED-ND suggested to have at least 19 different activities inside or within the neighborhood center⁴⁰. Its worth to mention that the educational activities are not the main factor top locate the neighborhood center, as

³⁶ FAR is the density of nonresidential land use exclusive of parking measured as the total nonresidential building floor area divided by the total buildable land area available for nonresidential structure.

³⁷ U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc. P167

³⁸ U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc. P165

³⁹ U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc. 206

⁴⁰ U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc. 203

it had established by Perry work. It is possible to create more than one center or divides the total activities within multiple centers. These with its different activities would work as a legible node connected to the walkable street that has more connection with the different parts. In his effort Sam Zimbabwe, LEED Director, Center for Transit-Oriented Development (CTOD) suggested that the neighborhood center contains a variety of housing and retail with multi-stories building up to 5 stories.⁴¹

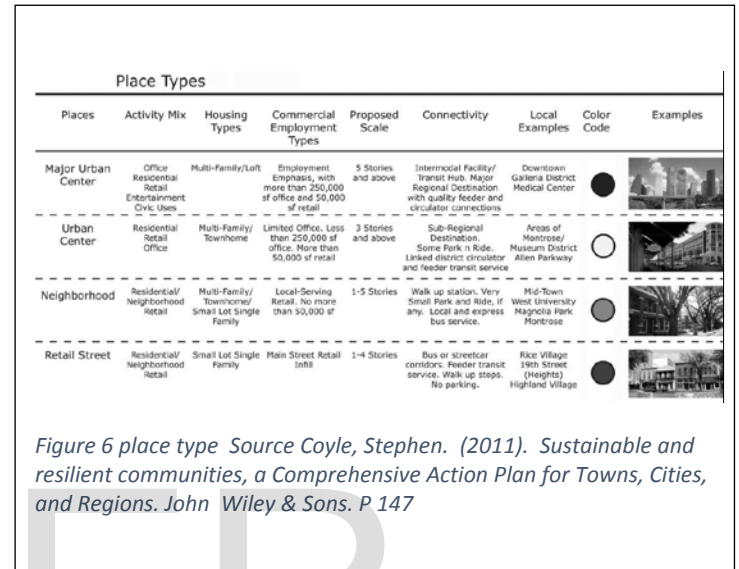


Figure 6 place type Source Coyle, Stephen. (2011). Sustainable and resilient communities, a Comprehensive Action Plan for Towns, Cities, and Regions. John Wiley & Sons. P 147

4.4 MIXED-USE NEIGHBORHOOD COMMUNITY.

Varied housing types and sizes are fundamentally reinforced to create completely equitable community serving to create a harmony between the different Parts of the society. This factor Include a proper variety of housing sizes and types in the different area in the neighborhood parts. The main objective is to create a diverse community with different families that have varieties in size and economic issues. There is a demand to mix the different housing designs according to this factor. It is worth to mention that this factor depends on the size of the unit that is more important than the framing the economic family income. The total diversity should range from 0.7 to 0.5 according to Simpson Diversity Index Score⁴². So the score would be calculated by the equation listed below

$$\text{Score} = 1 - \sum (n/N) \quad 43$$

Where n is the total number of the dwellings or type unit, N total number of dwelling in all categories. This factor has 7 points according to the LEEDs-ND, it could create homogeneous between the different parts of the neighborhood and other

⁴¹ Coyle, Stephen. (2011). Sustainable and resilient communities, a Comprehensive Action Plan for Towns, Cities, and Regions. John Wiley & Sons. P 147

⁴² U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc. 213

Simpson Diversity Index Score is a method to calculate the probability of any two randomly selected dwellings units will be of a different type.

⁴³ U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc. 213

adjacent communities. It has the effect on the communities itself rather than a direct effect on the layout itself. Accordingly this factor has a little effect on the neighborhood generating process itself

4.5 STREET NETWORK

The sustainable neighborhood must have a high level of internal connectivity to the community at big scale. All street and sidewalks should have connectivity available for public use and not gated. The gated street is not allowed in this type of neighborhood. The total streets road connections should be more than 400 connections per mile square. Projects must have through street or non-motorized right of way to at least every 400 feet. Streets have to connect internally and externally with the abutting neighborhood, additionally, no closed roads are permitted, Culs-de-Sac and similar design avoided in this type of layouts⁴⁴.

The connection is highly recommended. It creates a intersected woven network that prevent isolated area inside the neighborhood, taking in account that all these roads adopt the previous conditions; there will be a high degree of space definition inside the neighborhood from the residents

4.6 ACCESS TO CIVIC AND PUBLIC SPACE

These points suggest to improve the physical and mental and social activity within the residents of the neighborhood by providing a variety of open spaces close to work and home. These public places provide a node for gathering, a place for contemplation and socializing. Examples of this kind of spaces are a pocket park and civic park as places for connecting people and increasing the interaction between the diverse parts of society.

5 INTELLIGIBILITY OR LEGIBILITY OF THE SUSTAINABLE NEIGHBORHOOD LAYOUT.

There are many definitions of the intelligibility. The Oxford English Dictionary define the intelligibility as the "the quality or character of being intelligible; capability of being understood; comprehensibility and the Capacity of understanding; intelligence"⁴⁵. From the other hand, the Merriam-Webster Dictionary defined it as "the apprehensible by the intellect only or the capable of being understood or comprehended"⁴⁶. From the other hand, Legibility is "That can be read. Of writing: Plain enough to be read; easily made out or deciphered. Of compositions: Accessible to readers (nonce-use), also, easy to read, readable"⁴⁷.

⁴⁴ U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc. 231

⁴⁵ Oxford English Dictionary Second Edition on CD-ROM (v. 4.0) Oxford University Press 2009

⁴⁶ Merriam Webster Dictionary, Merriam Webster Incorporated V3. 2003.

⁴⁷ Oxford English Dictionary Second Edition on CD-ROM (v. 4.0) Oxford

Linguistically, there is no big difference between two words, in contrary, the meanings are almost indicated to the same thing that is the ability to understand text, thing or the world all around us. However, for the sake of the research, we will use the word intelligibility that is more related to the spaces syntax methodology as it presented by Bill Hillier and his colleagues. So the intelligible is the ability to comprehend things that man come across.

Consequently, the concept is important when being applied to the urban design that have to be intelligible and people could understand the role of that space. To work as it is the place for communication as cited by Bryan Lawson, "What distinguishes all the other methods of communication from the live conversation is that the latter takes place in space. The very phrase 'face to face' implicitly makes reference to space. It tells us how people are arranged in space. They are not 'back to back' because they want to see each other's faces! This is very basic stuff"⁴⁸. It affirmed by many social scientists that whenever you find people collected together occupying some part of our world, there will also find rules governing their use of space⁴⁹

According to Kevin Lynch Legibility is essentially considered to be a physical and spatial quality of the surroundings as he said "Although clarity or legibility is by no means the only important property of a beautiful city, it is of special importance when considering environments at the urban scale of size, time, and complexity. To understand this, we must consider not just the city as a thing in itself, but the city being perceived by its inhabitants"⁵⁰. Here we find the concentration on the spatial layout for understanding the space, the layout and architectural elements plays an essential role to understand the space.

Much research demonstrates that cognitive map knowledge is more coherent in a structure where the perception of the spatial structure is relatively easy⁵¹. Spaces that connects to each other with a high degree of clarity help to understand the layout as a whole entity. Hillier mentioned that when he said "By creating spaces that link center to edge, but also creates a system that internally integrated, and intelligible. Thus, the paradox of centrality is overcome, at least from visibility and intelligibility"⁵². However, it is not clear that those type of layouts or pattern could work socially and could be understood intelligibly as public space. This is not the total deny of the layout role, but the interaction with society is an important role that research try to answer.

The easiness of reading things is crucial for understanding the essence of the world. In urban design, it is essential to understand or make our space intelligible, so the community felt secure, safe. Eventually, the arrangement of the architectural

University Press 2009

⁴⁸ Lawson, Bryan. (2001). The Language of the Space. Architectural Press .P2

⁴⁹ Ibid

⁵⁰ Lynch, Kevin. (1960). The image of the city. MIT press. p3

⁵¹ Thierry Ramadier and Gabriel Moser. (1998) social legibility, the cognitive map and urban Behavior. Journal of Environmental Psychology. Academic Press

⁵² Hillier, Bill. (2007). Space is the machine, A configurationally Theory of Architecture. Space syntax Press.P284.

space is fundamental to build good relationships with others⁵³. Bill Hillier affirmed many positive issues for ineligible space and the arrangement of space as he says “ We can use it to help generate feelings of excitement or calm. We can control the proximity of others. We can demonstrate our dominance or submission and our status in society. We can use it to bring people together or keep them apart. We can use it to convey complex collections of rules of acceptable behavior. We can also use it on occasion to signal our intention to break those rules”⁵⁴ “Intelligibility as Hillier said, “has something to do with the way in which a picture of the whole urban system can be built around from one part to another.”⁵⁵

Here there is a need to identify a proper methodology to understand the intelligibility and its effect on the societies. According to the Space Syntax Methodology, the “intelligibility is the correlation coefficient between connectivity and global integration. It helps to identify how easy it is for one in a local position to comprehend the global structure”⁵⁶. The intelligibility of a form can be measured by analyzing the relation between how a complex can be seen from its parts and what it is like in an overall pattern, that is, as a distribution of integration⁵⁷. As a result, there is a need to understand the how these factors plays its role in the intelligibility process.

In Brief, the intelligible space is the result of an interaction between the spatial layout and the people or users of those spaces accordingly, it is important to there be a direct interaction between them by creating some activities and action that increase the interaction therefore the total understanding of all surroundings on the whole context. Such contents tended to create a structure more or less on the scale of the layout and fabric as it grew; the effect is to maintain both the intelligibility and the functionality of the urban space, to maintain a strong relation between the different parts of the built-up area. To create those intelligible space, we need to understand both connectivity and integrity as it presents by space syntax methodology and its effects on the public space.

Accordingly, to Bill Hillier, there are two types of human behavior related to urban spaces and both has a prominent role in the intelligibility of space. These types are the Movement and occupation of space, as Hillier said: “Movement is primarily about the relations between spaces rather than the spaces themselves, in contrast to an occupation that makes use of the spaces themselves.”⁵⁸. Occupation uses the local assets of specific spaces, and that could be clarified through the connectivity of space, a movement the most global properties of the pattern of spaces and studied through the integration of space with other spaces.

⁵³ Hillier, Bill. Hanson, Julienne. (2009). the Social Logic of Space. Cambridge University Pres.

⁵⁴ Ibid.p3

⁵⁵ Hillier, Bill. (2007). Space is the Machine. Space Syntax 4 Huguenot Place. P94.

⁵⁶ Al-Sayed, Kinda. Turner, Alasdair. Hillier, Bill. Shinichi, Iida. Alan, Penn. (2014) Space Syntax Methodology. UCL Press.

⁵⁷ Hillier, Bill. (2007). Space is the machine, A configurationally Theory of Architecture. Space syntax Press. P 245.

⁵⁸ Ibid P248

5.1 CONNECTIVITY

Connectivity is a method to understand the direct relationship of space to the other spaces in any context that has affirmed by space syntax methodology as a “(degree) or measures of some immediate neighbors that are directly connected to space.”⁵⁹.

There are two ways to understand the connectivity of the urban space according to the space syntax methodology as it listed below.

1-Axial representation fig (8) when “reduces these spaces to

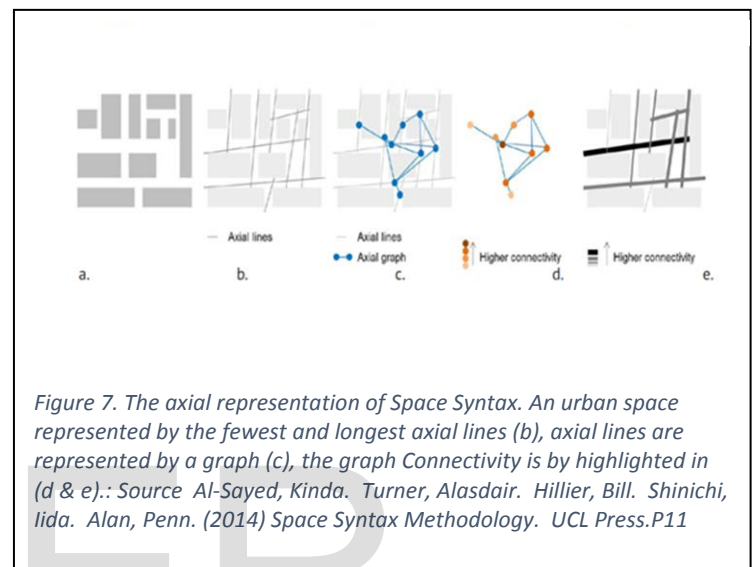


Figure 7. The axial representation of Space Syntax. An urban space represented by the fewest and longest axial lines (b), axial lines are represented by a graph (c), the graph Connectivity is by highlighted in (d & e).: Source Al-Sayed, Kinda. Turner, Alasdair. Hillier, Bill. Shinichi, Iida. Alan, Penn. (2014) Space Syntax Methodology. UCL Press.P11

the longest accessible lines that cover all convex spaces in a map, that is; the axial lines or “lines of sight” These elementary components and their adjacency relationships can be represented by a network (nodes or vertices of a morphological graph)”⁶⁰. Here all streets with all public spaces represent as lines to understand its direct connections with other spaces. The direct connections deiced the power of that space accordingly “Spatial adjacency is the fundamental relationship that characterizes how structures might be configured in a spatial layout”⁶¹.

2-A representational scheme of convex maps

In this method (fig 9) there is a focus on the space instead of the street. It “represents adjacency relationships by reducing the spatial complexity of a layout to the few and fittest convex spaces”⁶². Here the procedure include that the “Spaces that are immediately adjacent will have one step of depth in-between, spaces that have a minimum of one space Separating them will have two steps of depth in-between, and so on. In other words, depth of two spaces is defined as the least number of syntactic steps –or shortest topological dis-

⁵⁹ Al-Sayed, Kinda. Turner, Alasdair. Hillier, Bill. Shinichi, Iida. Alan, Penn. (2014) Space Syntax Methodology. UCL Press.P15

⁶⁰ Al-Sayed, Kinda. Turner, Alasdair. Hillier, Bill. Shinichi, Iida. Alan, Penn. (2014) Space Syntax Methodology. UCL Press.P11.

⁶¹ Al-Sayed, Kinda. Turner, Alasdair. Hillier, Bill. Shinichi, Iida. Alan, Penn. (2014) Space Syntax Methodology. UCL Press. P 11.

⁶² Al-Sayed, Kinda. Turner, Alasdair. Hillier, Bill. Shinichi, Iida. Alan, Penn. (2014) Space Syntax Methodology. UCL Press. P. 12

tance- in a graph that are needed to move from one space to the other”⁶³.

It is clear from both definition and procedure of the connectivity depend on the same method. Connectivity depends on the direct connection of space to the other parts of the spaces in the context. The greater connection is creating more intelligible space according to the procedure. It needs connections to be direct and continuous (without interruptions) to achieve highly connected space. Any interruption or weakness in these connections will cause great damage on the intelligibility of the total layout of the built up area or the neighborhood. Accordingly we will discuss how much the LEED-ND sustainable factors has an effect on intelligibility factor. Most of the factors encourage and increase the degree of this factor as it listed below.

sustainable neighborhood to be more diverse in functions.

3. Connectivity: Mixed-Use Neighborhood Center

There is a direct effect of this factor on the neighborhood; it helps to create more attention and connections to the center. It is worth to say it is not the obligation to arrange all activities in one location to create the center of the neighborhood. Instead, the residential neighborhood could have more than one center, by doing that the connections factor will be distributed all around the neighborhood to work as highly intelligible space with great connections.

4. Connectivity: Mixed-Income Divers Community.

There is no direct effect of this factor on the connectivity of the neighborhood. However, it has an effect on the connection between the neighborhood and other residential.

5. Connectivity: Street Network

There is a direct effect of this factor on the connectivity of the neighborhood. However, it could join the walkability factor and work as one part.

6. Connectivity: Access to Civic and Public Space

There is a direct effect of this factor on the connectivity of the neighborhood. However, it could join with the mixed-use center factor and work as one part.

As a result of those six factors, three of them has a direct contribution on the connectivity those factors are walkability, Compact Development, Mixed Use Neighborhood. While one has an indirect contribution, that is the mixed use community. We believe that the two last factors is almost connected and could work with the other factor and could explain the neighborhood in a better way.

The result of this factor is according to Table 5

	Connectivity	
LEEDS-ND FACTORS	Direct	indirect
Walkable Street	Yes	
Compact Development	Yes	
Mixed-Use Neighborhood Center	Yes	
Mixed-Income Divers Community	NO	Yes
Street Network	-	
Access to civic and Public Space	-	
Table 5 Source: the Researcher		

5.1 INTEGRATION.

Integration measures the” is a measure of mean depth that is specifically adapted for architectural layouts.”⁶⁴ The global measure shows how deep or shallow space is about all other spaces. Spaces ranked from the most integrated to the most

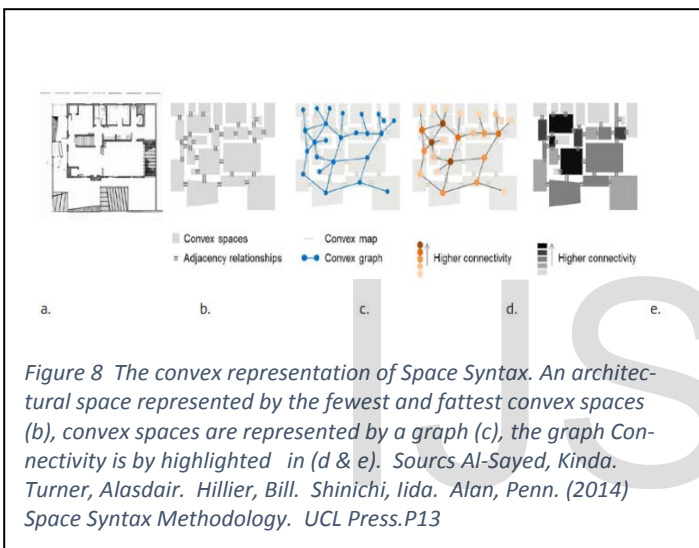


Figure 8 The convex representation of Space Syntax. An architectural space represented by the fewest and fattest convex spaces (b), convex spaces are represented by a graph (c), the graph Connectivity is by highlighted in (d & e). Sources Al-Sayed, Kinda. Turner, Alasdair. Hillier, Bill. Shinichi, Iida. Alan, Penn. (2014) Space Syntax Methodology. UCL Press.P13

1. d Connectivity: Walkable Street

There is a direct effect of this factor on the neighborhood, the walkability according to LEED-ND increases the connectivity by two ways. First it assures that the walkable street is connected to all another part in the neighborhood, there is no closed or dead end routes or paths. From another hand, it has internal spaces normally create by playing with recess and the diverse dimensions of the building height all around the walkable street that encourage and help to define the space limits. Those space work like node for connections especially when it has different activities for daily for inhabitants and visitors.

2. Connectivity: Compact Development

There is a direct effect of this factor on the neighborhood; Compact development plays its role by reducing the walkable distance between nodes and increase the connectivity of the spaces together within the context. From another side, it helps to create more connect points inside the area when it forces the

⁶³ Ibid P.13

⁶⁴ Al-Sayed, Kinda. Turner, Alasdair. Hillier, Bill. Shinichi, Iida. Alan, Penn. (2014) Space Syntax Methodology. UCL Press.P13

segregated. Integration is usually indicative To how many people are likely to be in space and is thought to correspond to rates of social encounter and retail activities. It is sometimes helpful to illuminate higher values in a system (i.e. the highest 10% values) to illuminate the integration core in a city.

The integration core might take different shapes (a spine, a deformed wheel, diffused, and concentrated)⁶⁵.Therefore, the most integrated space will have more connected line to its and has more extension. Bill Hillier affirmed when he said, "More centrality for larger spaces means more integration, more extended lines from larger spaces means more integration, more continuity of larger spaces means more integration and more linearity of larger spaces means more integration."⁶⁶.

This will prevent the segregation "segregation in a complex is created almost entirely by the sequencing of spaces"⁶⁷.

From fig (10) we could find that the most sequenced space create less integrated and more segregated although space has the same layout and design. The mean⁶⁸ distance is same for all layouts. That is Because increasing (I) values depends on the sequences space connected in any ring of public spaces. The increment of space did not increase the integration. Instead, it causes more segregation of space according to the increment of the i-Value. From (fig 11) shows the integrated space of an architectural team to identify the most integrated spaces to the weakest one.

Here it clear that to create an integrated public spaces. All

spaces have to connect in a way that prevent sequences that have one entrance and one exit to the neighbor

spaces. Most of the spaces should have short links from one side and has more connections to the other spaces to protect itself from the segregation that cause fatigue to the urban public space and create the feeling of illegibility that harm the resident from one side and isolate the specs from the other side. Therefore, we need to understand the way that space connects to the other spaces the context; that connection will encourage the resident and visitors to use the space and fell safe and amusable or as a place for entertainment or gathering to increase people meeting in the public spaces. Therefore, sustainability factor wherever exists, it has to be compatible and take this point in the advance account.

1. Integration: Walkable Street

This is the main spine of the neighborhood. According to LEED-ND, all the other parts should have a way to connect to this space directly. One condition of the walkability is connections to the clusters and has a clear intersection each 400 ft.⁶⁹ from another hand, this factor will reduce the private space as it increases public space for people to gather and connect with each other.

2. Integration: Compact Development.

This factor reduces the distance between cluster that make the connection between the secondary spaces and the main space easier. The compact design increases the density that somehow increase the number of the people who are using the space.

3. Integration: Mixed-Use Neighborhood Center

This factor supported and created by creating more pull factor inside space, according to that more connection will create that support the integration of space.

4. Integration: Mixed-Income Divers Community

This factor increases the pulling power for space; it has a direct effect on creating more integration between the different spaces of the sustainable neighborhood.

5. Integration: Street Network

The important thing here that LEED-ND prevents cul-de-sac road, it is not allowed to do so as it increase the disintegration and create a dead space inside neighborhoods. The other point is the limitation of the road dimension; it is not permitted to create roads more than 400 ft without intersection or opening to the other parts of the neighborhood.

6. Integration: Access to Civic and Public Space

This factor is more related to the walkability and street network; accordingly it would achieve its goal when those two points solve the layout.

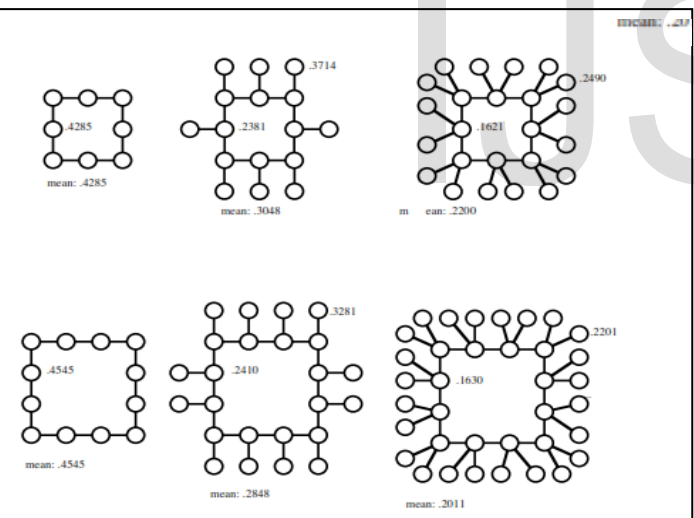


Figure 9 space Integration and layout Source Hillier, Bill. (2007). Space is the machine, A configurationally Theory of Architecture. Space syntax Press. P 252

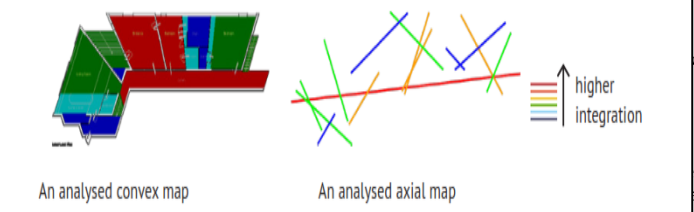


Figure 10 An example of how convex and axial representations are mapped on House at Creek Vean, Al-Sayed, Kinda. Turner, Alasdair. Hillier, Bill. Shinichi, Iida. Alan, Penn. (2014) Space Syntax Methodology. UCL Press.P11

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	Integration	
LEEDS-ND FACTORS	Direct	indirect

⁶⁹ U.S. Green Building Council. (2009). Green Neighborhood Development. U.S. Green Building Council Inc.

Walkable Street	Yes	
Compact Development	Yes	
Mixed-Use Neighborhood Center	Yes	
Mixed-Income Divers Community	NO	Yes
Street Network	Yes	
Access to civic and Public Space	Yes	
Table 6 Source: the Researcher		

4. Conclusions

According to this research we, as it clear in (Table 6), found that some factors of LEEDS-ND sustainable factors have a direct effect on the intelligibility of the neighborhood as it increase the factors of Connectivity and Integration as they are both have a direct impact on creating intelligible space. Accordingly we believe that most of those factors increase the legibility of space according to the space syntax methodology. It is possible to increase the intelligibility by adopting the maximum criteria. For the sake of the research we have uses binary representation to show the final result in the table below.

Intelligibility	Connectivity		Integration	
	Direct	indirect	Direct	indirect
LEEDS-ND FAC-TORS				
Walkable Street	Yes		Yes	
Compact Development	Yes		Yes	
Mixed-Use Neighborhood Center	Yes		Yes	
Mixed-Income Divers Community	NO	Yes	NO	Yes
Street Network	-		Yes	
Access to civic and Public Space	-		Yes	
Table 7 Source: the Researcher				

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