DEDICATION

To the soul of my dear Father
To my tender Mother
To my beloved Husband and Son

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A RESEARCH BACKGROUND

The researcher, who graduated with a special interest in the landscape architecture and great expectations to increase the knowledge acquired as an undergraduate, chose the topic "urban landscape" for it's being a new arising field. The term "urban landscape" is now being frequently used with various interpretations. The researcher adopts the definition of the term "urban landscape" from the University of British Colombia (UBC). There, the James Taylor chair in Landscape and Livable Environments, produced several publications having the title of that term. Their publications illustrated the urban environment that people lead in their daily life. They dealt with the "urban landscape" as a mere snap shots (situations) of the urban physical environment. Their books illustrated various urban landscapes in Northern America and Canada (Condon *et al.,*1999).

Further more, the "sustainable development" is an issue of great importance in all humanities fields where it is a necessity if the posterity is to take their just and fair share in their communities. For this reason, the research will devote chapter one for the introduction to the sustainability and sustainable urban neighbourhoods.

The research title "Sustainable Urban Landscapes in Neighbourhoods" has been chosen with special attention and the following paragraph specifies on the meaning of every word.

From the comprehension of the various definitions of sustainability (chapter one, p:19-22), the research refers to the term "Sustainable" as the ability of the neighbourhood to minimize its negative impact on the surrounding environment. The term "Urban" defines the location of interest as being in cities and not rural settings which affects its physical aspects and character. Further more, it is the settings of urban design which is the specific specialty that the researcher graduated with. "Landscapes" as snap shots (situations) of the urban physical environment we live in.

Finally a "Neighbourhood" is used to refer to any urban residential area with well defined edges.

B RESEARCH PROBLEM

The research deals with sustainability as a process rather than a destination. "*Sustainability is a process; sustainable development is the product*" (Edwards *et al.,* 2000: p.20). The research will refer to sustainable development as "HEALTH" and unsustainable development as "ILLNESS".

Current approaches, like that adopted by the United Nations and many of the institutions interested in the topic of "sustainable development" tried to reach out to "HEALTH" through viewing the problems of our communities; from shortage of energy, pollution, poverty, unemployment, and trying to find out solutions to those problems. They sought the way of treating illness to reach health by means of set of principles. Those principles are known as "Sustainability Principles". Nowadays the ultimate goal to the sought "HEALTH" in our communities has been thought of by means of those principles and the prevention of deterioration of health to illness by means of set of indicators.

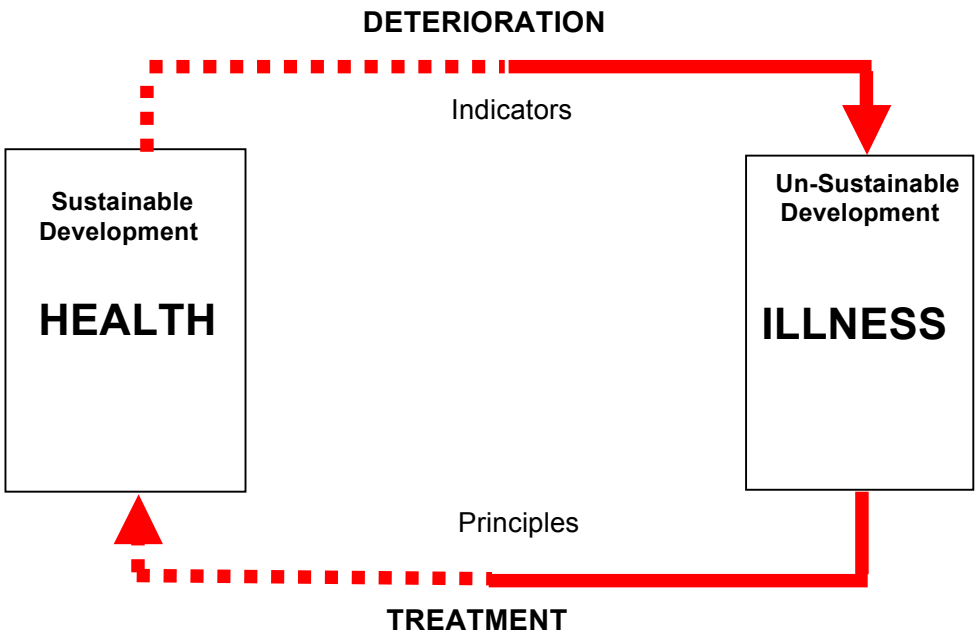


Fig i: Methodology of CURRENT APPROACH in treating illness and preventing deterioration of health

The problem that faces the current approach is the failure of those principles to ensure the treatment of illness and prevention of the deterioration of health.

This is because of the difficulty to reach the target " sustainable development" (sometimes called the impossible or the utopian destination). Consequently, there is a missing model of the target sought.

Additionally, the various definition of the term " sustainable development" turned the target to be anonymous and the principles of sustainability are diverse and not focused to meet at one point and so hit the target.

C RESEARCH OBJECTIVES

There is an urgent need for neighborhoods and communities to be rethought of and reconfigured, if they are to be sustained for the posterity. As the gap widens between the development and the aim sought which is the "sustainability of urban landscapes", it has been inevitable to try to find an approach by which sustainable urban landscapes could be reached.

This research attempts to make one step forward in the sustainable urban landscape issue through providing:

1- A better understanding of the sustainability issue in general and specially the sustainable urban neighbourhood.
2- Drawing a schematic picture of the sustainable urban neighbourhood.
3- Proposing a tentative approach to help achieve sustainable urban neighborhoods.

D RESEARCH STRUCTURE

The research is organized in four major parts. These are: The Research Argument , Natural Resources and Sustainability, Built Environment and Sustainability and Conclusions.

The Contents of each part are as follows:

Part One, **Research Argument** , includes an Introduction. This part aims at presenting the main argument and discussion of both the current and the proposed approach.

- The introduction states the research problem. The objectives that the research is trying to reach and the research methodology .

- Chapter one, The Sustainability Chapter which brings a closer look at sustainability and discuss its definition, dimensions, objectives and literature review.

Part Two, **Natural Resources and Sustainability**, is divided into three chapters:

- Chapter Two, Water in Sustainable Urban Landscapes, shows how water could be used in the neighbourhood infrastructure, and housing consumption in a way promoting sustainability.
- Chapter Three, Air in Sustainable Urban Landscapes, presents principles to fight pollution and the renewable energy resources that could be used in neighbourhoods .
- Chapter Four, Green-structure in Sustainable Urban Landscapes, describes the use of green-spaces and plant material in neighbourhoods to manifest sustainable urban landscapes.

Part Three, **Built Environment and Sustainability**, is divided into two chapters:

- Chapter five, Movement Network in Sustainable Urban Landscapes, illustrates how neighbourhoods could overcome the automobile dependence and encourage livability and energy efficient modes of transportation.
- Chapter six, Land Use in Sustainable Urban Landscapes, illustrates strategies to promote sustainability through dealing with land resource more efficiently.

Part Four, the final part, is the **Conclusion**

- Chapter seven, conclusion and Further research , concludes the research, and manifests the validity of the hypothesis adopted throughout the research.

This chapter also examines the applicability of the proposed approach in urban neighbourhoods in Egypt and arises many points of discussion for further research.

From Chapter Two to Chapter Six the design of the chapter will depend on one structure to analyze the transformation of the resources into urban landscapes in neighbourhoods.

The aim of this analysis is to test if the sustainability principles promotes the healthy cell characteristics or not.

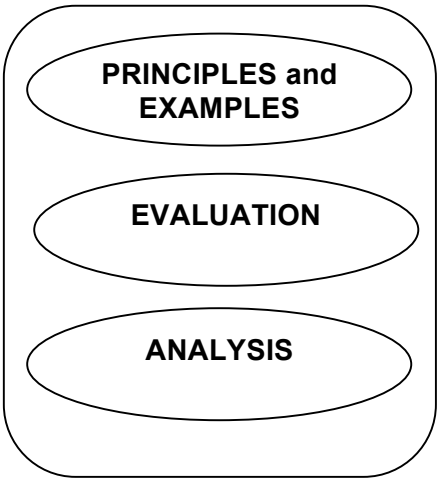


Fig. ii diagram showing the structure of chapters form 2 to 6.

The first part of every chapter presents the sustainability principles that deals with the resource discussed in this chapter from the urban design point of view and presents examples to show how those principles could be illustrated into urban landscapes.

The second part evaluates those principles from the three sustainability aspects (economic, ecologic and social).

The third part, or the analysis, tests the relevance between the current approach and the proposed one.

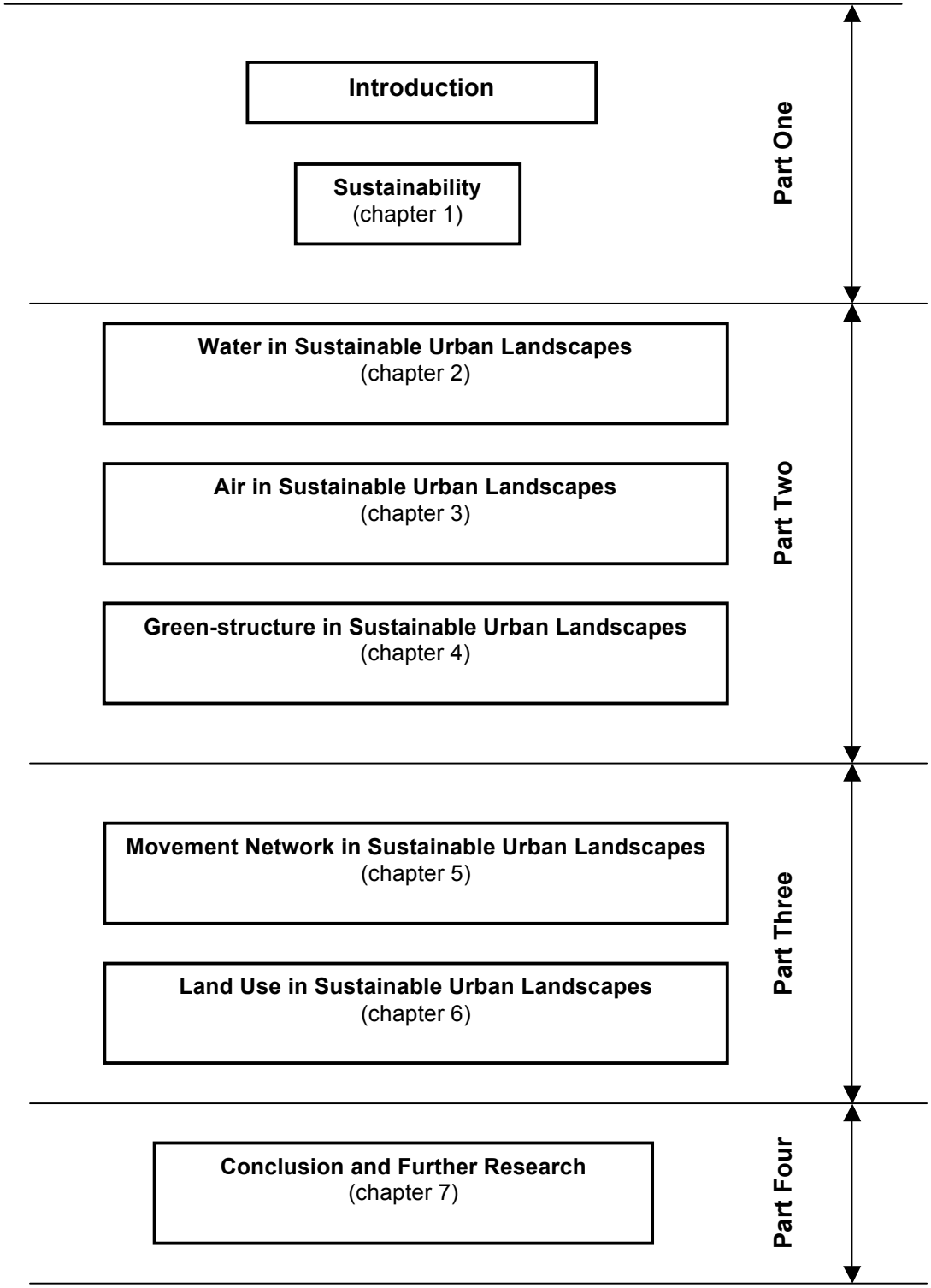


Fig. iii: diagram showing different parts of the research and the chapters they contain.

E RESEACH HYPOTHESIS

Biologically it is well known that the human cell has various functions, some of which are: assembling proteins, transport materials, energy capture and release, protein building, waste disposal, passing information, food formation and even movement. (atlas of science literacy, 2002). In maintaining its general health to perform its usual functions, the cell depends on some characteristics, which are: regeneration, self-sufficiency, self-correction and dynamic adaptation to the environment. (Mader,2001, Ross,2002).

Further more, biologically, it's known that the health of the contents composing the cell depends on the degree of their self-sufficiency, self-correction, regeneration and their dynamic adaptation to the environments. The researcher adopts those characteristics from the human cell and examines their existence in the neighbourhood ,thus tries to examine the correctness of the following saying:

"THE HEALTH OF THE NEIGHBOURHOOD DEPENDS ON THE DEGREE OF ITS SELF-SUFFICIENCY, SELF-CORRECTIVNESS, REGENERATION AND ITS DYNAMIC ADAPTION TO THE ENVIRONMENT".

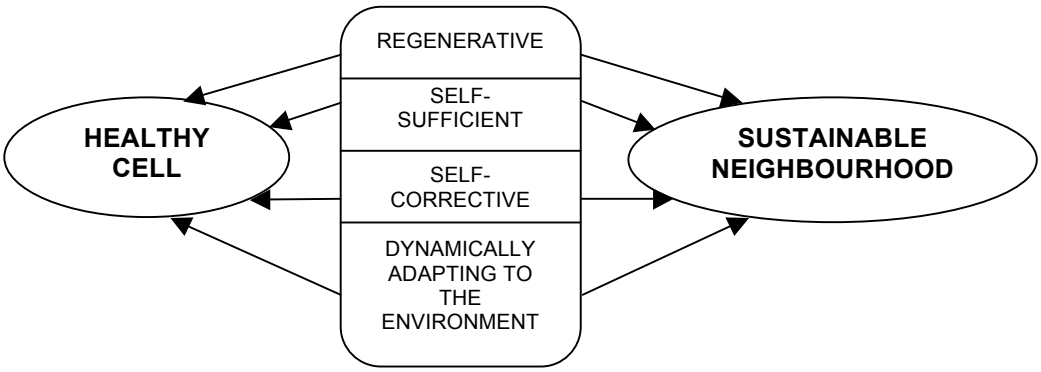


Fig.iv :Examination of existence of characteristics of Healthy Human Cell in the Sustainable Neighbourhood

Previous analogies were made between the human cell and the neighbourhood, The research depends on those urban-biological analogies, trying to develop them to correspond to the neighbourhood as the planning unit, just as the human cell is the unit forming the human body.

The research will list some of them and will take them as a start point from which an approach could be derived to try to assess sustainable urban landscapes in neighbourhoods.

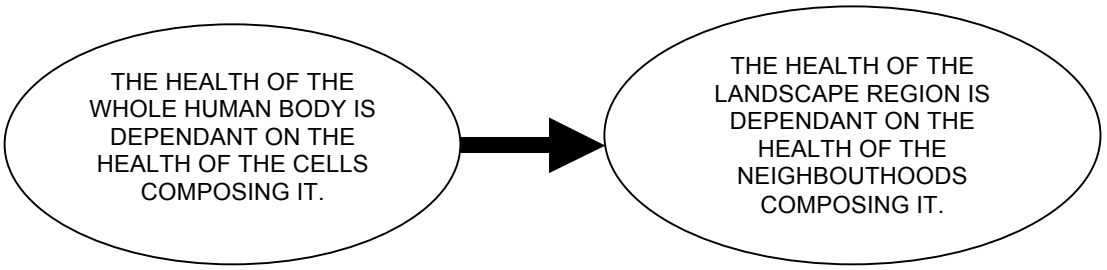


Fig.v: analogy between the healthy cell and the neighbourhood
Source: Condon et al., (1999)

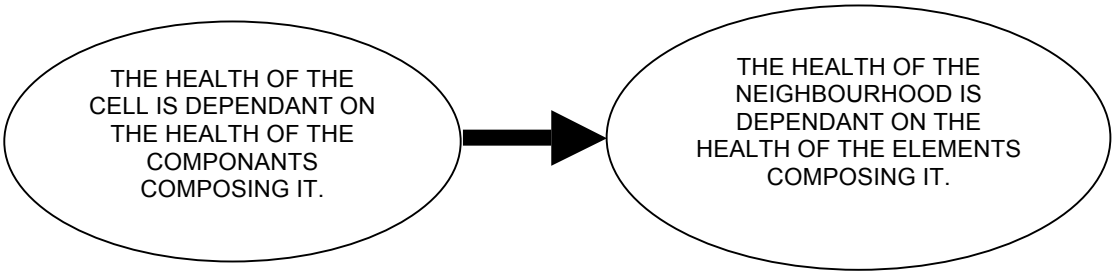


Fig.vi: analogy between the healthy cell and the neighbourhood
Source: logically derived from the previous comparison (composed by the author)

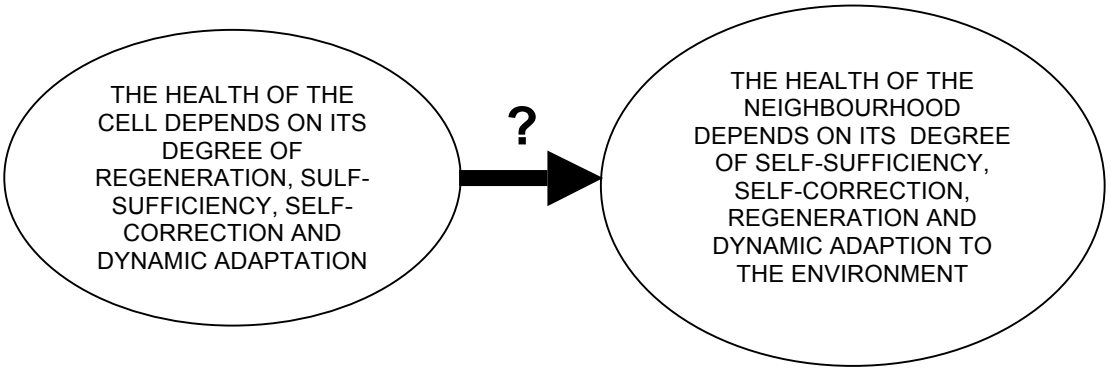


Fig.vii: proposed hypothetical analogy between the healthy cell and the neighbourhood
Source of first part of argument: Mader,2001, Ross,2002

F Research Methodology

Every development sought is a mere transformation of resources. In a neighbourhood, both natural and man-made resources are transformed into an end product which is, in this case, "the urban landscape".

Urban design defines the process which transforms the resources (natural and man-made) to urban landscapes (realistic urban picture where people live in) in neighbourhoods. It should employ the principles that make the resources in the neighbourhood move towards sustainable development. Each principle when applied would represent a sustainable landscape in the urban neighborhood.

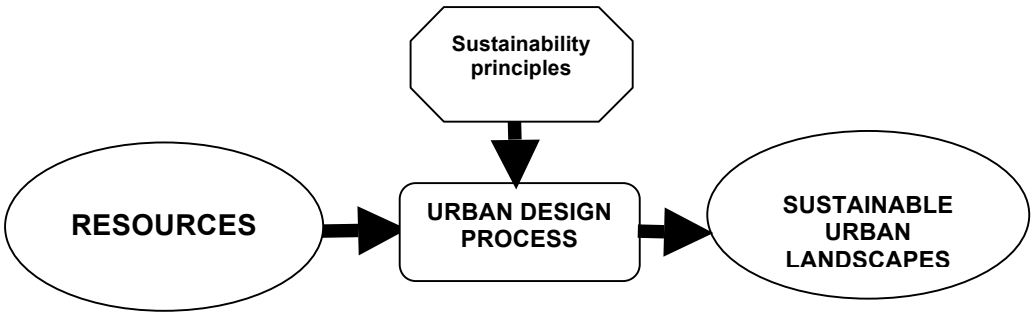


Fig.viii: Diagram showing how sustainable urban landscapes are produced through sustainable urban design process.

From the above argument, this research will deal with the term sustainable urban landscapes as follows:

THE SUSTAINABLE URBAN LANDSCAPE IS A PRODUCT OF A SUSTAINABLE URBAN DESIGN THAT TRANSFORMS RESOURCES INTO A DEVELOPED LIVING ENVIRONMENT WITH MINIMUM STRESSES ON THE SURROUNDING ENVIRONMENTS AND WHICH ENHANCES THE HUMAN LIFE, SOCIALLY, ECONOMICLY AND ECOLOGICALY.

As there are some problems facing the current approach, a need for a new one arises to substitute for the missing model and help in moving the neighbourhood more efficiently towards the sustainable development.

The proposed approach attempts to help the prevention of deterioration of the sustainable development and increase channeling the principles of sustainability to move the neighbourhood more efficiently to the "HEALTH". This is done by the substitution of the missing model of a healthy sustainable urban neighbourhood by the Human cell and analyzing the characteristics that help it to maintain its health on regular basis.

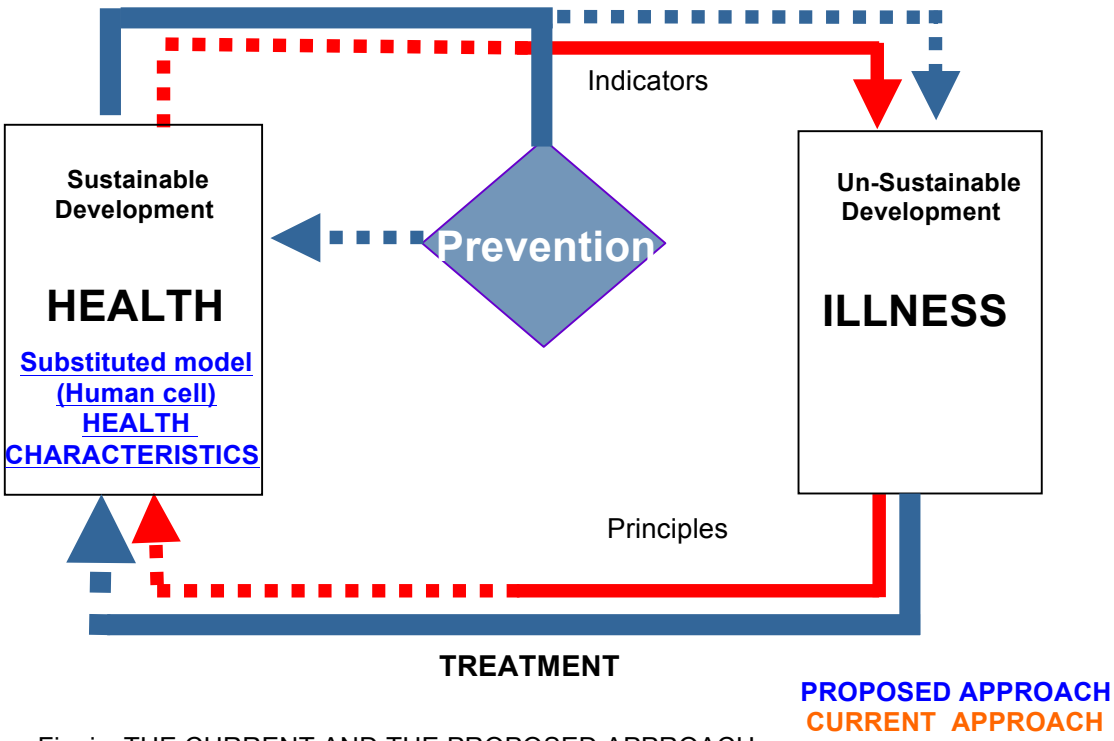


Fig. ix: THE CURRENT AND THE PROPOSED APPROACH

From critical review of literature, the research proposes the above needed approach. It adopts a cross sectional study to test the credibility of the proposed approach through the following steps:

Fig.x: the research argument discusses both approaches the current and the proposed

Fig.x shows the first part of the research which discusses the current approach and its problems and the need for a new approach and what this approach offers.

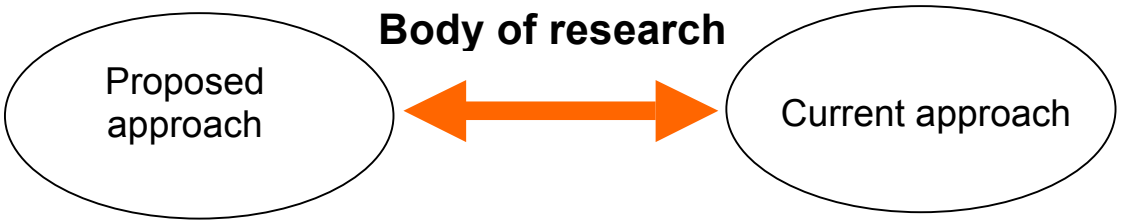


Fig.xi: testing the relevance between the proposed approach and the current one.

Fig.xi shows the second and third part the research which tests the relevance between the two approaches and the similarities and differences between them.

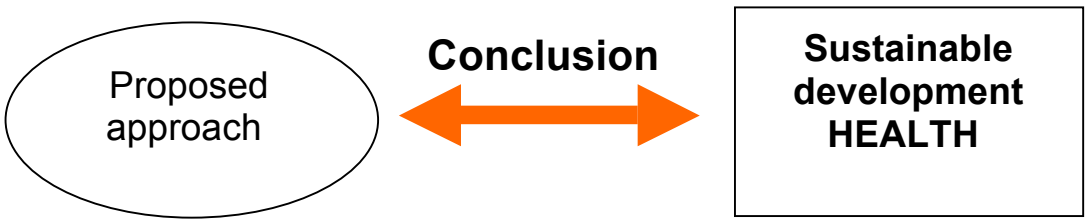


Fig.xii: testing the relevance between the proposed approach and the end product or the sustainable development .

Fig.xii shows the fourth part of the research which tests the relevance between the proposed approach and the end product

Theoretical Approaches Directing the Research Methodology

On the general theoretical level there are some concepts which helped in directing the research. The most important one of these concepts is the General System Theory (GST), which was coined by Bertalanffy (1971). Although Bertalanffy is a Biologist, his theory reflects on almost all aspects of life.
In brief, GST tries to bring different disciplines and theories together to build a more comprehensive body of knowledge. It reacts against a loss of this wholeness that is often associated with the ever-increasing specialization in modern sciences. After surveying different specializations, the notion of bringing them together was supported by a striking phenomenon. This phenomena is defined as, according to Bertalanffy, "independently of each other, similar problems and concepts have evolved on in widely different fields" (1971:29). GST seeks the formulation and derivation of those rules governing "systems in general", whatever the nature of there components and the relation between these components .

The research depends on previous comparisons showing relationships between the human body and the urban region and extends those comparisons to develop some mutual characteristics to promote health in both of them.

One of those comparisons is that of the James Taylor chair in landscape and livable environments in British Colombia University, which states the general similarity between the human cell and the landscape region as follows:

> *"The individual site and even the individual house and yard, are to the landscape region what the cell is to the human body.*
>
> *Just as the health of the human body is dependent on the health of the individual cells in it, so too is the urban region dependent on the health of the individual sites that comprise it*."
>
> Condon *et al*., (1999 : 9)

The similarity stated above was further extended by Newman et al., (1999) as they discussed how both settlements and human body function. They stated how they both undergo metabolism to deal with their resources and wastes.

They viewed metabolism as a biological way of looking at the resource inputs and waste outputs of settlements. Fig.xiii shows how this metabolism concept illustrates the dynamics and livability in these settlements.

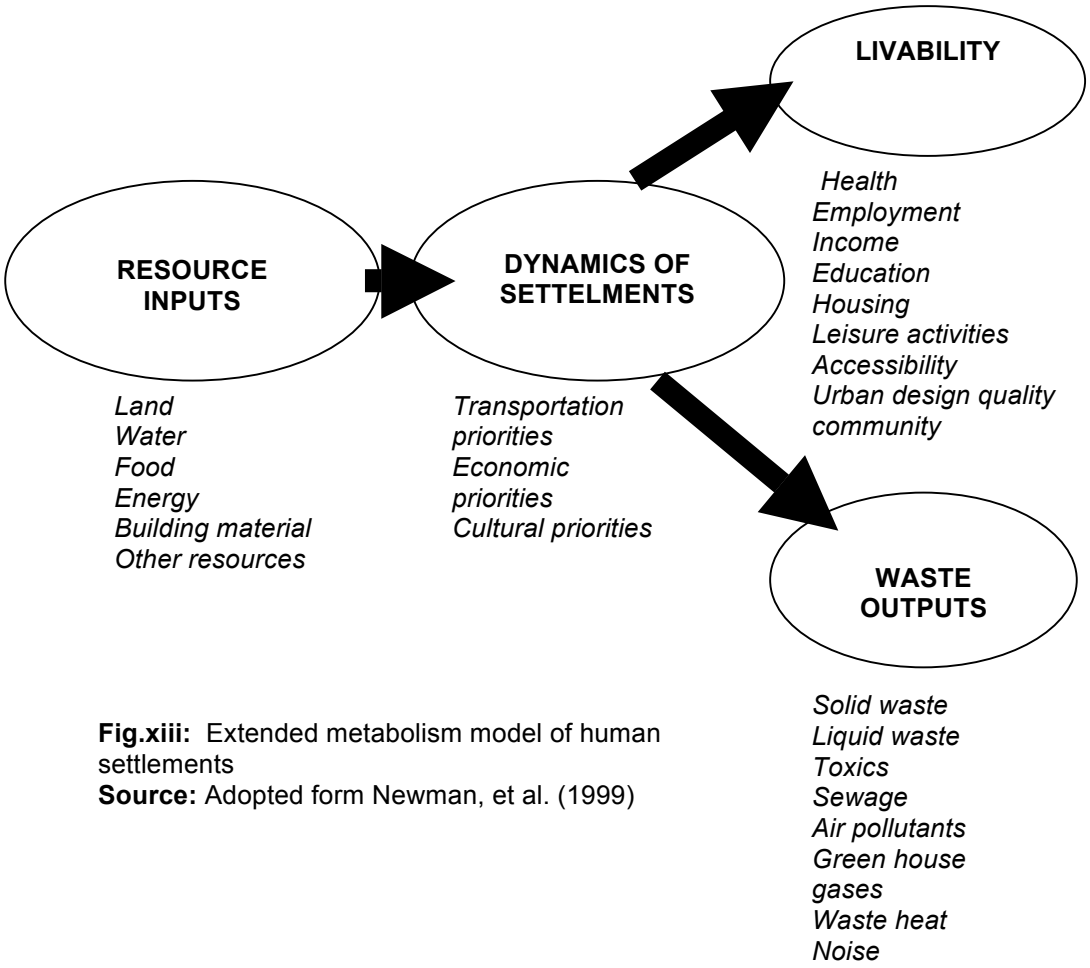


Fig.xiii: Extended metabolism model of human settlements
Source: Adopted form Newman, et al. (1999)

In this model it is possible to specify the physical and biological basis of the neighbourhood, as well as its human basis. The physical and biological processes of converting resources into useful products and wastes are like the human body's metabolic processes or those of an ecosystem. They are based on the laws of thermodynamics which show that anything that comes into a biological system must pass through and that the amount of waste is therefore dependant on the amount of resources required.

A study made by Moody W. (2000), reinforces the similarity between human bodies and neighbourhoods and states that they are both regenerative. He described this similarity as follows:

> *"Natural, healthy systems have no problem creating food from waste. Our bodies do it all the time. Organisms stay healthy by consuming only what they need to maintain balance and by casting out only what is needed for nourishment by other systems*
>
> *Our buildings and our neighbourhoods would be structured to utilize the abundance of the region, to recycle their own wastes or generate food for other parts of the ecology, and to nurture the inhabitants, not only for shelter, but for delight, and for spiritual rejuvenation*."
>
> Moody , (2000)

A paper published by Torrens *et al.,* (2000), at the University College London, accentuated the relationship between the human body and the neighbourhood, focusing on the neighbourhood as the planning unit of urban systems developing it into a cellular-based modeling of urban systems called Cellular Automata (CA). They defined the structure of the CA as follows:

"A CA is thus composed of four principle elements: a lattice, a state-space, neighbourhoods defined by the lattice, and transition rules." Torrens *et al.,* (2000)

Recently it has been extremely impressive how cellular automata (CA) modeling of urban systems grew popular in the field of urban planning and design. CA is a simplified representation of a phenomenon that operate in the physical world employed to help in the understanding of how the dynamics of those systems function .There has been a recent enthusiasm for their application to urban studies. CA models have been employed in the exploration of a diverse range of urban phenomena, from traffic simulation and regional-scale urbanization to land-use dynamics, polycentricism, historical urbanization, and urban development.

G The Characteristics of the Healthy Human Cell in an Urban Context

Although there is a similarity between the cell as the biological unit of the human body and the neighbourhood as the planning unit of the region, the four healthy characteristics adopted from the human cell have different reflections and interpretations in the urban context. Below is an explanation of how those four characteristics are going to be used further in this research.

The Regenerative Neighbourhood

A regenerative community is a one in which the concept of waste is totally eliminated. The inhabitants are consciously aware of their inter-relationship with natural systems. Moody W. (2000), highlighted the following characteristics for a regenerative neighbourhood:

- Uses existing resources for mutual benefit: Every development, design and implementation strategy serves multiple functions
- Adds resources without depleting others: A place becomes more than it was before it was touched by Man
- Eliminates the concept of waste: All waste in one system is used as food (resource) in another system.

To restore balance to the world, the concept of waste must be eliminated. What is considered to be “waste” in one system must be considered as resource in another.

Another idea which promotes the idea of Regeneration is the "Urban mines". This idea is so much in favor of recycling and reuse. The urban mines sustainable growth park was established in 1995 and named after Jane Jacobs ' idea that the waste of the cities would be the mines of the future (Rudlin, D. *et al.,*1999). Its aim is to circulate waste as secondary raw

Fig. xiv: regenerative process
Source: Rudlin, D. *et al.,*1999).

materials back in to the local economy. In addition to this, its aim is to promote economic regeneration, local employment and to develop new markets for recycled products. The urban mines project suggests that a million tones of waste will produce 500 jobs if it is recycled, compared to 150 jobs if it is incinerated and just 50 if it is dumped in a landfill site (Rudlin, D*. et al.,*1999).

The community needs to consider the development of locally appropriate means of reducing the total amount of household waste, for instance, through encouraging the voluntary implementation of home composting of the biodegradable component of household waste.

The Self-Sufficient Neighbourhood

A self-sufficient neighbourhood is like a miniature of utopia. It could never be achieved 100%, but relatively it could be evaluated that this neighbourhood is more self-sufficient than another. A self-sufficient neighbourhood is a one which satisfies the needs of the residents, socially, economically and ecologically

Through a study made by the U.S Department of Transportation on San Francisco Bay Area, California, the goals for building healthy and self-sufficient communities were stated as follows:

> *-All children succeed in school and are prepared for lifelong learning.*
> *-Families of all kinds are strengthened, preserved and flourish.*
> *-People acquire and retain jobs and achieve economic independence.*
> *-The cycle of violence is ended.*
> *-The frail, disabled and chronically-ill are ensured independence and dignity.*
> *-Inequality and discrimination are eliminated.*
> *-People achieve and maintain optimum mental and physical health.*
> *-Individuals and neighborhoods are prepared to respond to emergencies and disasters.*
> *-People play an active role in community life.*
> *-All people have access to affordable and safe housing.*
> *-All people enjoy the benefits of clean air, clean water and a healthy and sustainable environment.*
>
> (Bay Area Partnership,1998)

From the above goals, the self-sufficient neighbourhood seems to be too perfect to be true, but the closer a neighbourhood is to those points, the closer it is to self-sufficiency.

To some pioneers like Robert and Brenda Vale, 1975, sustainability implies self-sufficiency at small scale development. They have developed individual homes and small groups of houses that are entirely self-sufficient, producing their own energy, recycling waste and collecting and treating water. "See appendix A". However this complexity is nothing compared to the issues raised by addressing the sustainability of a whole neighbourhood. A neighbourhood is far from a collection of buildings, rather it can be seen as a series of interacting systems-systems for living, working and playing- crystallized into built forms.

There is no way that we can cut the neighbourhood from its surroundings by estimating that it could be 100% self-sufficient, for this will force us to deal with neighbourhoods as isolated islands.

The Self-Corrective Neighbourhood

Promoting human and community development needs a process that depends on community-based programs. This process is commonly known as "self-correction". Two vital self-corrective mechanisms could be used with all community-based programs. These are **monitoring** and **evaluation** (Community-Based Program Development ,2002).

Although these terms are often used together, the processes they refer to actually have different meanings and purposes. Generally, monitoring has to do with keeping track of something, while evaluation implies some sort of judgment about something's worth. Fully implementing community-based program plan requires both of these tools (Community-Based Program Development ,2002).

Dynamical Adaptation to the Environment

The neighborhood needs dynamic urban planning that meets the changing needs of its residents over time, and faces challenges of future generations needs as well.

Sustainability requires adaptability of the structure. To elaborate on this, housing types need to change in order to avoid the need for families to move. Sustainable communities are efficient communities where families invest long periods of time in

their neighborhood. Jobs as well are liable to change over time, and if office building are not ready to adapt to these changes, it will be very uneconomic to built new ones to adapt to the new requirements. Spaces that are flexible to adapt more than one activity.

So neighbourhoods which dynamically adapt to the environment are those which serve the changing needs of the residents, without imposing any stresses on the environment or compromising the needs of the future.

Introduction

To go through the urban landscape issue from a sustainable point of view, it is inevitable to state a clear vision of the term “Sustainability”.

There has been a strong conflict in interpreting the term “Sustainability”. Those who support it face a lot of accusations as those who are hiding behind an undefined, vast meaning word that can hold a lot, and still misses a lot, vague, yet full to the brim of meaning and morals. On the other hand, those who support it, stated definitions, means and principles to clarify and manifest the strength and depth of this term in humanity's lives.

1-1 Definitions of Sustainability

According to Oxford dictionary the definition of the term "Sustainability" is :" *keep in existence"* which is a term acquainted with God's creation of the world we are living in. The earth and it's surrounding atmosphere are created to be sustainable ever since their creation date, or else, life on this planet would have terminated long ago. The amount of rain that falls on earth is constant every year and the amount of water evaporating from aquatic surfaces is also the same. The Sun would continue to send it's energy to the earth and the wind would continue to blow.

Though earth is affected by so may outer forces from other planets and galaxies, human beings are the most influential factor affecting and threatening the sustainability of earth.

The problem lies in the negative influence of human beings daily life on the environments surrounding them which causes disturbance in nature's balance.

There has been so many interpretations, definitions, thoughts and meaning to the term "Sustainability". It would be a very hard job to try to collect all that has been said around the issue of sustainability, and sustainable development. "See appendix B"

The research chose to depend on the classical definitions of "Sustainability" and "Sustainable development" that was provided by the “ World Commission on

Environment and Development (also known as the Brundtland commission) “in 1987;

> *“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.*
>
> *"Sustainability is about the maintenance of the health of the biosphere and the husbanding of key resources of air, water, land and minerals."*
>
> *"Sustainable development is therefore about maintaining and enhancing the quality of human life-social, economic and environmental-while living within the carrying capacity of supporting eco-systems and the resource base."*
>
> *"This means living on the earth's income rather than eroding it’s capital. It means keeping the consumption of renewable natural resources within the limits of their replenishment. It means handing down to successive generations not only man-made wealth, but also natural wealth, such as clean and adequate water supplies, good arable land, a wealth of wildlife and ample forests."*
>
> Barton H. *et al.,* (1995: 1)

The literature that dealt with sustainable settlements, sustainable housing, or sustainable cities, never stated that these settlements, housing or cities are sustainable with the meaning of "ever lasting existence", but they mean that these settlements, housing, or cities in their existence don't threaten the surrounding environments.

The concept of sustainability is the management of natural resources in a manner that is consistent with the preservation of the reproductive capacity. Another way to think of sustainability is as the carrying capacity of the earth for the human species.

A community’s carrying capacity refers to the rate that resources are used in relationship to the rate at which they are renewed. Barton H. *et al.,* 1995. A broad concern for communities is to avoid consuming resources faster than they can be restored. For example, a sustainable community that receives most of its drinking water from a nearby stream will be concerned with the pollutants that may be present in the water as well as the consistency of the water levels of that stream from year to year. Sustainable communities generally become reliant on

renewable resources and make educated decisions on what resources to consume.

Simply what its meant by sustainable communities, in this research, are those communities in which human beings could lead their daily life in a way that doesn't form any kind of stress on the surrounding environments, including all its resources (natural and man-made) . fig.1-1 shows some of these stresses developed from human settlements**.**

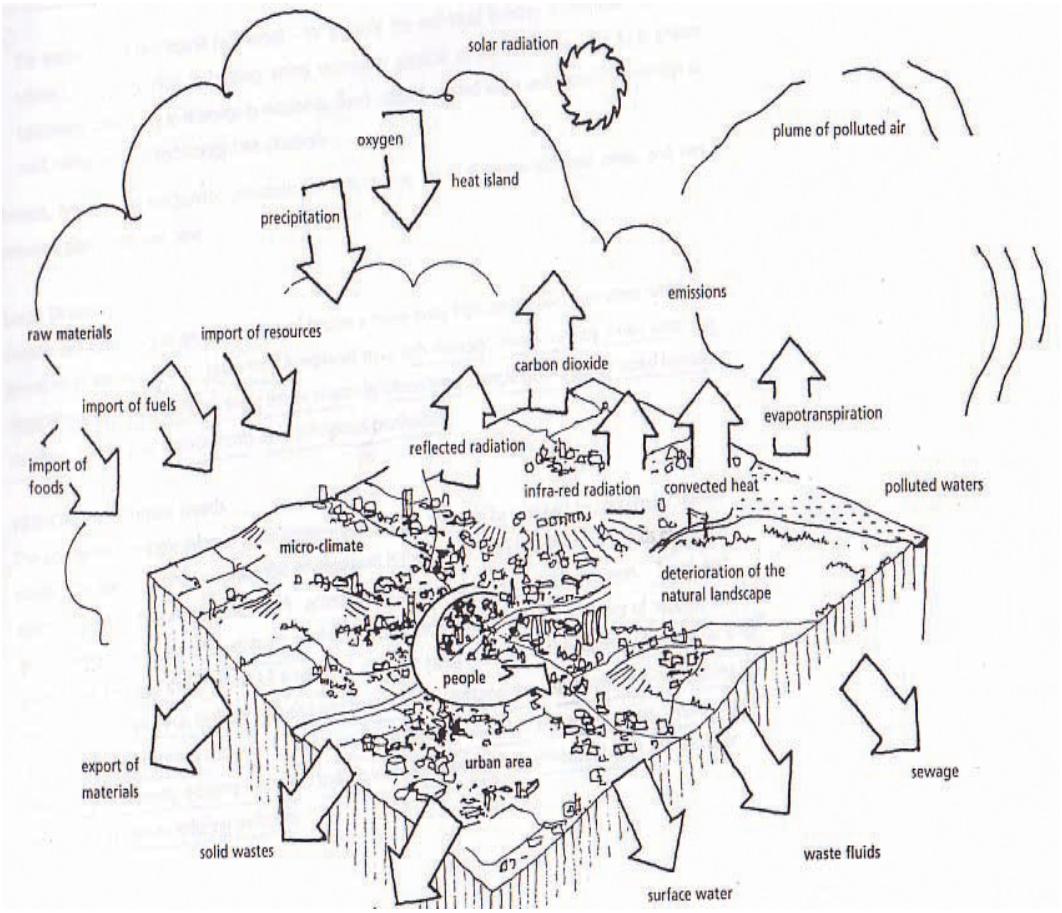


Fig. 1-1: stresses from human settlements on the surrounding natural environment
Source: Barton H. *et al.,* (1995)

Consequently, researchers are trying to picture the community which would go along friendly with the environment. In this they are trying to develop techniques

and principles of urban design that when applied would contribute to sustainable urban landscapes.

But techniques and principles are all liable to changes over time, according to the daily development in technologies and life styles of human beings. A small example for these changes is the World Wide Web "internet". When the world gathered to put the basis of sustainability in the earth summit at Rio 1992, the world had not known the internet then. That was only 11 years from now, so principles that were put then, are now far behind us. The internet as a communication system has absolutely contributed to great saving of fuel needed for transportation, where people could easily send their work form home, thus affecting the number of daily trips, consequently affecting air quality and pollution, automatically affecting sustainability.

Therefore, there is an urge to put a system that could go along updating itself with every day's changes to ensure the continuity of sustainability process." See introduction p:3"

1-2 Sustainability Indicators

Indicators can be used to design, monitor, and maintain a sustainable community. An indicator is a measure that can be used by residents and public officials to monitor trends and evaluate the overall health of a community. Traditional indicators of community well-being are different from sustainable community indicators in that the former only show changes in one aspect of the community. Traditional indicators measure change in one part of a community as if it was entirely independent from the other parts (Hart 1999). An example of a traditional indicator is the median wage earned in a given location. This indicator provides information regarding the economic status of an area, but ignores connections with the other aspects of the community.

Alternately, a sustainable community indicator can be defined as an indicator that provides information regarding the status of the overall well-being of the community with enough time for people to act if necessary. These indicators show the interconnections between changes in the economy, the environment, and

society. These indicators provide information about the present as well as the long-term health of a community.

1-2-1 The Value of Indicators

There are a number of factors that influence the quality and efficiency of an indicator. First, for an indicator to be effective, it must be relevant. This means that the indicator must be able to provide valid information about the subject under consideration. Second, an effective indicator should be easy to understand. People should be able to make sense of the information that is derived. Third, an effective indicator should be reliable. People should be able to trust that what the indicator shows is in fact true and honest. Finally, an effective indicator should give relevant information in a timely manner. If the indicator that is being used shows that a change is needed, then it should provide that information while there is still time to act (Hart 1999).

To summarize the issue of indicators, sustainable community indicators are specific type of indicators that can be used to measure changes and determine the effectiveness of given processes. They show connections between the environmental, economic, and social aspects of communities. Sustainable community indicators can be used to determine overall communal health as well as a community's sustainability. " appendix C".

Each city is of course best able to define the indicators that matter most to it. Seattle, for example , has defined twenty different indicators , including the diversity of local economy, the number of pedestrian –friendly streets, the percentage of youth participants in community services and the quantity of wild salmon returning to urban stream (Newman, et al. 1999).

1-3 Sustainable development objectives

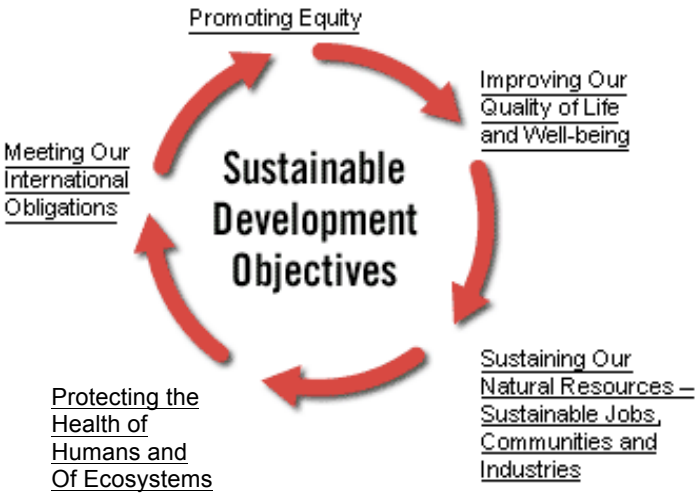


Fig. 1-2: sustainable development objectives
Source: Research and development highlights, (1996)

Promoting equity:

Equity is a fundamental goal of sustainable development. Sustainable development reflects a desire to consider the impacts that our current decisions could have on future generations, called *intergenerational equity* (Research and development highlights, 1996).

Improving our quality of life and well-being:

Improving wealth creation by the diversity of local entrepreneurial opportunities, recycling the financial resources locally and promoting urban regeneration and renewal. This is altogether in great relationship with improving the safety and security of the community and enhancing its freedom of choice and increasing the decision-making (Research and development highlights, 1996).

Sustaining our natural recourses , communities and industries:

Enhancing the environmental quality and promoting the wildlife and safeguarding the natural resources.

Protecting the health of humans and of ecosystems:

Public health is not just a matter of hospitals and health centers: amongst other influences , the planning and design of a community has a vital role. Combating heart disease, respiratory problems, and mental illness for example relies on factors such as healthy exercise, air and water quality, fresh food and local social networks, all of which are dependant on the health of the environment as a whole (Research and development highlights, 1996).

Meeting our international obligations:

To get to catch up with the international family of healthy communities and meet the standards of their environmental safety and social equity, together with the promotion of our own community's prosperity (Research and development highlights, 1996).

1-4 Aspects of sustainable development

Sustainable development has three aspects: economic, social, and environmental. Effective planning for sustainable future could only be achieved through collaboration of experts from different disciplines including environmental science, technology, economical science, social science, political science and ethics. "appendix D"

Social Aspect

> *"The social dimension of sustainability encompasses the political, the cultural and all people-centred issues, except the economic. It entails ensuring that the basic conditions for human life to flourish exist within society".*
>
> (Jetzt und Morgen, 2002)

These include:

Food, shelter and clothing. Health care, Education, Social interaction, sense of belonging and spiritual enrichment. These conditions cannot be met without a healthy and sustainable natural environment and economy.

Ecologic aspect:

Ecological footprint of settlements in terms of resource use and pollution rates is great and it continues to grow in certain respects and ought to be diminished. Waste production and recycling, water consumption and pollution, air quality and energy use, wildlife and biodiversity are all issued related to the ecologic sustainability of any settlement (Newman, et al. 1999).

Economic aspect:

Issues related to that aspect are those of the Economic growth and economic diversity. Employment rates, individual income, transportation expenditures, and personal consumption are all essential to form the economic sustainability of any settlement. The economic aspect of sustainability needs local political commitment and effective partnership community, public and private sector (Newman, et al. 1999).

1-5 Literature Review of Sustainable Development

Progress on developing the concepts of sustainable development has been rapid since the 1980s. Generally, the environment became an international issue in 1972, with the UN Conference on the Human Environment, held in Stockholm. In the following years, some progress was made on the scientific and technical environmental issues while only limited results were achieved in making the environment part of the national development plans and decision making (Newman, et al. 1999).

When the UN set up the World Commission on the Environment and Development in 1987, environmental preservation was clearly becoming a matter of survival for everyone. Led by Norwegian Prime Minister Gro Harlem Brundtland, the commission concluded that to meet the needs of the present without compromising the ability of the future generation to meet their own needs, environmental protection and economic growth would have to be tackled as one issue (Abou El-Seoud et al, 2000).

As a result of the Brundtland report, the UN General Assembly convened the UN Conference on Environment and Development (UNCED). The conference known as the Earth Summit took place in Rio de Janeiro in June of 1992. It was a turning point in the international negotiations on issues of environment and development. The primary goal of the summit was to find an equitable balance between the economic, social and environmental needs of present and future generations and to lay the foundations for a global partnership between developed and developing countries as well as between governments and sectors of civil society based on common understanding of shared needs and interests.

The summit brought together policy makers, diplomats, scientists, media personnel and NGO representatives from 179 countries in a massive effort to reconcile the impact of human socio-economic activities on the environment and vice versa. Leaders at the summit built upon the framework of Brundtland Report to create agreements and conventions on critical environmental issues. Three major agreements were adopted: Agenda 21—a global plan of action to promote sustainable development for the 21 st century; the Rio Declaration on Environment and Development—a set of principles defining the rights and obligations of states; and a Statement of forest principles—to guide more sustainable management of the world's forests. In addition, two legally binding conventions: the Conventions on Climate Change and the Convention on Biological Diversity. Together these agreements covered every aspect of sustainable development deemed to be relevant. A significant institutional outcome of UNCED was the establishment of the Commission on Sustainable development (CSD) in December 1992, to ensure effective follow-up of UNCED; and to monitor and report on implementation of the Earth Summit agreements at the local, national, regional, and international levels. It was agreed that a five-year review of Earth Summit progress would be made (Abou El-Seoud et al, 2000).

Five years after the earth summit the UN commission on Sustainable Development held its fifth session on April 1997- also known as Rio +5. The review process demonstrated that in general progress on implementing

sustainable development plans has been slow. It is clear that the policy progress is far more advanced in some areas than others. Some are still at the stage of defining problems and agreeing on necessary responses. Others have moved to the stage of target setting and deployment of new policy instruments to achieve change. In a few cases, intervention has already brought measurable results (Abou El-Seoud et al, 2000).

Several success stories have been reported in Rio+5, which show that sustainable development does work and many more success are possible if the level of commitment is maintained in the future.
At the local level, there has been a positive trend in the number of cities around the world which have formulated and are implementing local agenda 21. Currently almost 2,000 local governments from 49 countries are pursing local agenda 21 action plans through official planning processes in partnership with the voluntary and private sectors in their communities (Abou El-Seoud et al, 2000).

The world looked forward to the World Summit on sustainable development (also know as Rio+10), which was held in June 2002 in Johannesburg, South Africa. It brought together tens of thousands of participants, including heads of State and Government, national delegates and leaders from non-governmental organizations (NGOs), businesses and other major groups to focus the world's attention and direct action toward meeting difficult challenges, including improving people's lives and conserving our natural resources in a world that is growing in population, with ever-increasing demands for food, water, shelter, sanitation, energy, health services and economic security.

A vision of sustainable development that had emerged in the discussions there grounded in the large number of local projects, community initiatives that have successfully combined the social, economic and environmental imperatives into a coherent whole. It is a vision based on the potential of new technologies to promote decentralized developments that work with rather than against the local environment.

Accordingly the level of the neighbourhood as the planning unit could have a great effect on the sustainable development of a whole region. In fact the urban neighbourhood is the one of greatest significance as it is the unit of the focal concern of this age, which is the city.

To move a whole city towards sustainability, the research selected the planning unit which is the cell or the neighbourhood.

The following part will discuss the sustainable urban neighbourhood and its definitions and the principles that emerged to help promote the communities towards sustainable development.

1-6 Sustainable Urban Neighbourhoods:

A sustainable community can mean different things to different people. To a business owner, it may be a community that has an economy that encourages business to flourish. To parents, it may mean a safe environment in which to raise a family. Each person in a community has a stake in ensuring that the air and water are clean. The main goal of a sustainable community is to meet its basic needs in a way that can be continued for the future . A sustainable community must be envisioned by and maintained by its residents.

The name " sustainable urban neighbourhood" has been chosen with care for being the research scope.

Sustainable refers to the ability of the neighbourhood to minimize its negative impact on the surrounding environment. Urban refers to the location of the area and to its physical character. Neighbourhood relates to the ecologic, social and economic sustainability of the area, the community ties which hold it together and its relation ship to the surrounding areas.

If the meaning of urban sustainability , are towns and cities which sustain themselves without any adverse impact on the wider natural system, then the sustainable urban neighbourhood is an impossible goal (Rudlin and Falk,1999).

It is widely recognized that the way that human settlements are planned has an important role in increasing the sustainability of human activities. It is then inevitable to ensure that those designed neighbourhood are less unsustainable and that they minimize their impact on the natural environment.

1-6-1 The Neighbourhood level

The term "Neighbourhood" has different definitions. According to Barton et al (2003) Neighbourhoods could be defined:

- *a- administratively: by ward and parish boundaries*
- *b- aesthetically: by distinctive character or age of development*
- *c- socially: by the perception of local residents*
- *d- functionally: by catchment areas for local services*
- *e- environmentally: as traffic-calmed areas where through traffic is excluded and the quality/safety of the living environment is paramount.*

Barton et al,.(2003: 20)

This research is concerned with the unit which forms the whole city, so it could depend on all previous definitions to describe the neighbourhood which the research is concerned about.

Concentrating on either the design of the individual building or the broad sweep of national and international policy misses most of the crucial issues of sustainability. The latter is too remote from actions required on the ground whilst the former has become a technical challenge. For this the neighbourhood is an appropriate level with which to work, large enough to address broader environmental issues, but small enough to affect people's lives and to focus minds of the practicality of implementation.

1-6-2 The General Principles of Sustainable urban Neighbourhood

The sustainability of the neighbourhood depends on the sustainability of it's resources. The research aims at discussing resources, whether natural or man-made in the neighbourhood. For each resource an integrated strategy is outlined and

Fig. 1-3: social goals can be achieved through resource sustainability
Source: Barton *et al.,* (2003)

issues of implementation discussed. Health and local quality of life and social goals can all be pursed through well-planned solutions to local resources.

Whilst it is clear the concept of urban sustainability is complex, there are a number of fundamental principles which apply to all sustainable development, be it a house or a neighbourhood (Rudlin and Falk,1999).

1- **Reduce inputs:** whilst the urban neighbourhood will never reduce its resources to the level which can be locally supplied, the reduction of inputs must be the starting point for any sustainable policy.

2- **Local resources:** making the maximum use of local resources such as the sun and the rain which falls on the roofs of the neighbourhood, and the food which can be grown in its gardens and allotments

3- **Waste minimization:** the neighbourhood must also minimize the amount of unrecycled or unrecycable waste exported form the area

4- **Making use of urban economies:** sustainability is also about the productive use of waste to reduce the consumption of natural resources. Urban areas as natural centers for trade have an important role to play in promoting more circular systems to resource consumption and waste production.

Conclusion

Progress towards sustainable development will not be achieved unless this goal receives attention at all political levels: Heads of Governments, Ministers of Finance and Economy, and Ministers of Environment and Social Affairs, Transport, Energy and Education. Moreover it requires a broad co-operative effort involving business, universities, labor and civil society organizations, reinforced by broad popular understanding and support drivers in environmental policies and regulations and incentives to technological development.

It is well clear at this point that managing to perceive a continuous progress in the sustainability process at the neighbourhood level, the local agenda21, and principles are not sufficient to ensure that.

There is an urgent need to an approach that could ensure the adaptability, correctness and continuity of emerging principles for sustainable neighbourhoods.

From here the research would present the healthy cell approach and test its credibility and its relationship with the principles of sustainability in dealing with the resources of the neighbourhood.

Introduction:

Much as the worth of a bank is determined by the number of dollars on hand and the strength of the currency, the worth of water resource depends on its quantity and quality. The ability to manage this bank is arguably the largest ecological challenge facing society. There are some sustainable principles through which this resource could be dealt with to increase its value.

This chapter discusses how to make water used in the neighborhood as a sustainable element in all aspects, ecological, economical and social through the presentation of sustainability principles and then evaluates those principles, and illustrates them through S.U.Ls in some case studies.

The chapter concludes with the relation between the sustainability principles and the healthy cell characteristics presented earlier in the introduction part.

The introduction of this chapter explores the effects of development on existing hydrological cycle and the importance of water to the environmental sustainability . It also identifies the sustainability objectives of water as a resource in neighbourhoods.

Development has many negative effects on the existing hydrological cycle. It disturbs the natural water cycle, fig.2-1, increases water run-off and decreases infiltration into the ground. The result can be that flooding occurs on waterways downstream, and natural underground reservoirs (aquifers) are no longer replenished. The quantity of water available for use is reduced. Quality suffers too, because run- off is often contaminated by pesticides, fertilizers, vehicle oils, etc, and the removal of impurities in the water by infiltration no longer happens to the same extent (Barton et al.,1995).

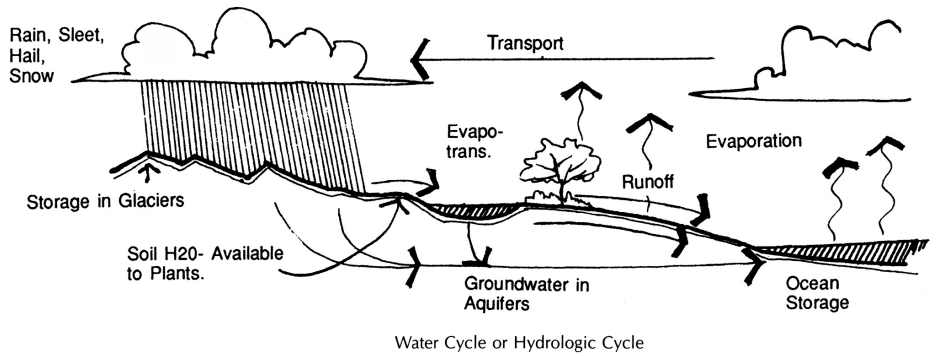


Fig. 2-1: water cycle
Source: John Motlock 2001

Water courses are of great importance to local environmental sustainability.
In developing a community environmental plan it is important to understand how the local surface and ground water systems work. Anne R. Beer and Catherine Higgins, 2000 summarized the importance of water courses to sustainability in two points:

- They are valuable habitats for a wide range of species and that the deterioration of water courses has endangered many native species.

- They are a major and often untapped recreational resource; improvements can boost the local economy by attracting outsiders as well as providing recreational opportunities for the local community.

The research would highlight the objectives of water sustainable urban design for best planning and management practices in order to identify the importance of sustainability principles presented later in this chapter.
Newman *et al.*(1999) classified the sustainability objectives in using water resources in neighbourhoods into four objectives;
Water balance objectives:

- Maintain appropriate aquifer levels and recharge and stream flow characteristics in accordance with assigned beneficial uses.
- Prevent flood damage in developed areas.

- Prevent excessive erosion of waterways, slopes and banks.

Water conservation objectives:

- Minimize the impact and use of public water.
- Promote the reuse of storm-water.
- Promote the reuse and recycling of effluent.
- Reduce irrigation requirements.
- Promote regulated self-supply.

Water quality objectives:

- Minimize water-borne sediment loadings.
- Protect existing riparian of fringe vegetation.
- Minimize the export of pollutants to surface or groundwater.
- Minimize the export and impact of pollution from sewage.

Environmental/ social objectives:

- Maintain water-related environmental values.
- Maintain water related recreational and cultural values.
- Implement any necessary, site specific water sensitive objective identified by the appropriate resource management.

After discussing the effects of development on the natural water cycle , the importance of water courses to local environmental sustainability and the objectives of sustainable water local management, the research would proceed to present the sustainability principles for local water management in neighbourhoods.

2-1 Principles for managing water in neighborhoods with sustainability aspects

Daily life is dependent on a reliable source of water, yet the way people live within urban areas is cause of much of the pollution which damages water supplies. It is therefore essential to find a means of cleaning contaminated water at or near the source of the pollution. Beer et al., (2000) identified the three ways by which contaminated water could be dealt with:

- expensively through 'technological solutions' (building state of the art sewage works), or
- more cheaply through 'natural solutions' using the natural self cleansing processes: reed beds, infiltration of surface water into the soil and its gradual percolation into the water table, and
- by ensuring that less foul water is produced from domestic and industrial as well as agricultural sources through behavior changes.

In planning to manage water more effectively and sustainably within any urban community there is a need to recognize that how the land is used and how the surface is managed by local people has a direct impact on factors such as water shortage, wastage, pollution and flooding. It is this direct link and the possibility of controlling it through local land management 'actions' which ensures a role for local communities in developing effective approaches to enhancing the local management of surface water flows, ground water infiltration and the upgrading of water quality in local streams, as well as ponds (Beer et al. 2000).

Management options for sustainable water systems are best applied for local scale. The reason for this lies in the nature of new water technologies, the nature of ecosystems, the nature of water/land integration in urban areas (Saldinger 1992). Therefore there is an urge to develop local solutions to water problems.

The main water problems which can be directly tackled through community environmental planning have been identified by Beer et al. (2000) and summarized into the following points:

- flooding - where this is due to the local topography and the local presence of extensive impermeable surfaces.

- pollution of the streams - where this due to the destruction of biota and the impeding of the natural processes of water purification caused by regular flash flooding.

- the lack of locations where the natural filtration and purification mechanisms of plants and other aquatic organisms can take place - water quality deteriorates even further when poor land and landscape management has led to the eradication of natural flood-land and associated habitats and species.

- the lack of opportunity to use water for recreation - where this has been due to neglecting the opportunities for fishing, water sports, bathing, walking and bird watching which naturally occur with the presence of clean surface water.

- the excessive use of tap water for non-drinking purposes - where this is due to a lack of a water collection system for roof water and reusable 'grey' water.

In the following section the research would present policies aiming to encourage sustainable local water management and solve the problems stated above with additional examples of some sustainable urban landscapes :

2-1-1- Make the best use of water sources in the neighbourhood

Water sources are classified in the following table by Barton *et al.* (2003) with recommendations of the best use of each kind, this is graphically illustrated in fig.2-2.

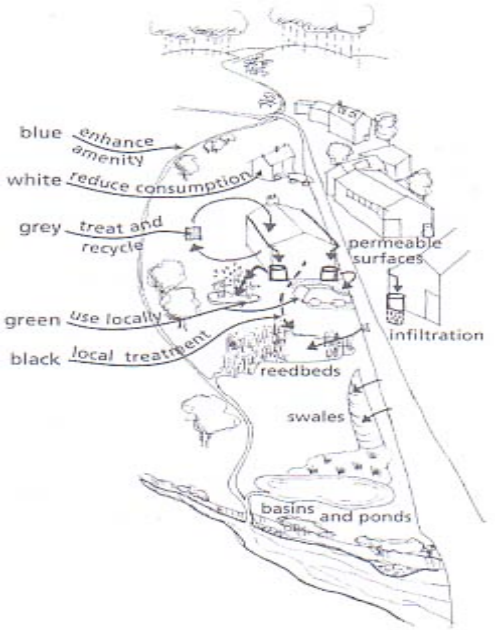


Fig. 2-2: water at the neighbourhood level
Source: Barton *et al.* (2003)

2-1-1-1 Water sources at the neighbourhood level

Water type	source	Options for use or discharge
Blue	Running or standing water	Use to enhance amenity and wildlife on site
White	Mains water	Drinking, body washing, cooking
Grey	Baths showers, washing machines	Treat then use for washing cars, watering gardens, flushing WCs. Dispose to reed bed or other local biological treatment
Green	Captured roof rain water	Washing cars, watering gardens, flushing WCs
Black	Flushing WCs, kitchen sinks	Dispose to mains sewer or local biological treatment

Table 2.1 : water types and options for uses

Source: Barton *et al.* (2003)

2-1-2- Ecological Infrastructure

The challenge is to invent an integrated infrastructure of bioremediation that alleviates the downstream consequences of increased urbanization, adds amenity and recreational value to the public realm, and saves money when compared to traditional infrastructure (Condon., 2002).

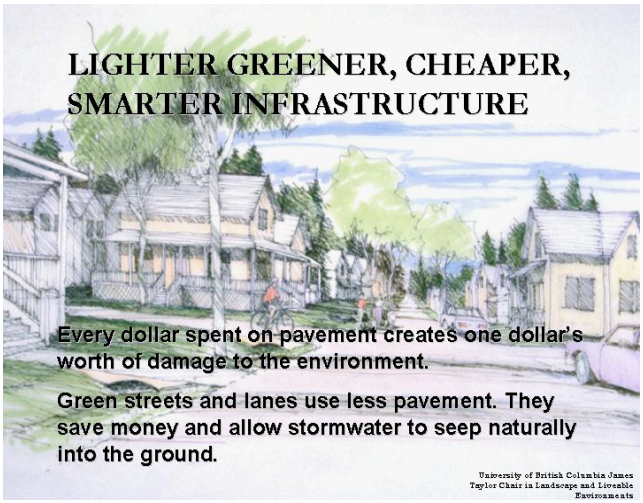


Fig 2-3: ecological infrastructure
Source: Condon (2002)

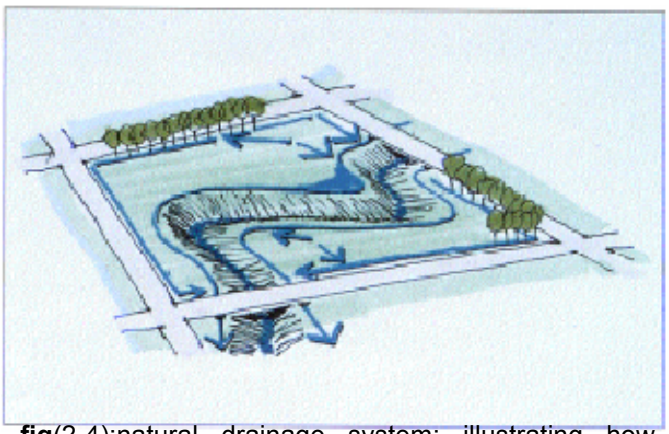
Presented below are some principles to help reach ecological infrastructure in neighbourhoods:

1- Propose new types of public infrastructure capable of bioremediation of urban pollution as close as possible to its source.(fig 2-3)

2- Integrate storm water Best Management Practices (BMP) into the fabric of the urban infrastructure. ” BMPs describes a range of structural and non-structural on-site options for alternative storm water management”.

3- Maximize any recreational and aesthetic possibilities that emerge as a result.
4- Maximize the impacts of infra-structure expenditures by building in recreational, multi nodal transportation, ecological enhancement, and bioremediation functions into the system, in ways that cost less than traditional single function infrastructure.

5- By understanding the watershed context of each development site, then storm water can be managed on site(fig 2-4), as opposed to being transported underground to the nearest body of water. Small and simple natural collection and treatment strategies located at the point where runoff initially meets the ground, repeated consistently over an entire project, will usually lead to the greatest water quality improvements for the least cost. The further the water is conveyed, the more expensive the system and maintenance requirements.



fig(2-4):natural drainage system: illustrating how water would be collected at street edges and brought overland to the edge of the stream. During a normal rainfall, storm water would be held at the top of the stream embankment until it could percolate down through the soil.
Source: Condon et al.1999

6- Parks, golf courses, cemeteries, lawns, 'dead' left over space, school grounds and communal open space are all suitable locations for retention ponds. Man-made water channels (shallow valley forms operating like ditches) can be introduced or improved and extended into a system which can channel water from the gardens as well as any open land to the retention ponds (appendix E). Storage in ponds allows the eventual development of valuable ecosystems and wildlife habitats. Plants, fish and other aquatic organisms can colonize; this helps to filter the water and maintain the stability of the habitat.

Condon., (2002) introduced two types of retention ponds to be considered:

Permanent storage ponds, which are appropriate where a continuous supply is available and where inflow and outflow and soils permit a stable condition.

Temporary storage ponds which are only full during and after storm events, and are allowed to dry out. This type is less suitable for development in recreation areas.

The example selected for the ecological infrastructure is the Brentwood site at the Brentwood district of Burnaby, Vancouver, Canada, to test the principles of sustainability on a 590-acre medium density urban landscape. The total area of the site is 590 acres.

The following examples are proposals by The James Taylor Chair in Landscape and Liveable Environments, to improve the sustainability of the area (Condon,1999).

fig. 2-5: illustrates a proposed strategy for surface water management. The neighborhood design addresses storm water management through sensitive grading. Major and minor vertical roads, and adjacent local collector streets are the primary channels for surface water flow and infiltration. The north-south streets collect water in surface channels where it can infiltrate before it

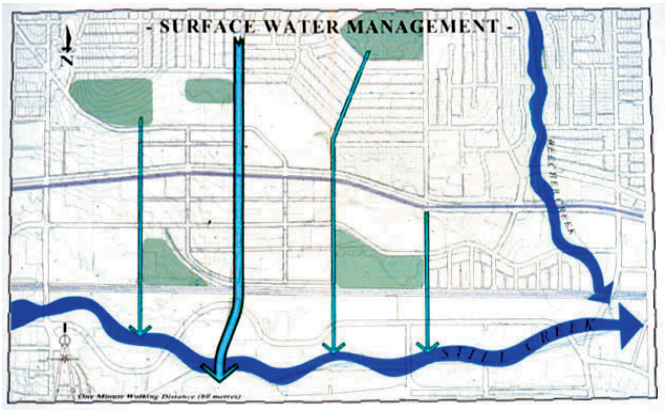


Fig. 2-5 surface water management: The slopped topography and surficial geology of the site are characteristics favorable to infiltration devices such as channels, buffers and wetlands. Smaller swales running along local roads feed into the primary channeling system, represented by the thick lines running along the major north-south arterial. City of Burnaby, Brentwood site, Vancouver, Canada
Source : Condon *et al,.*1999

enters retention areas and southern open water way. Large recreation areas (such as playing fields) double as infiltration basins.

fig. 2-6: shows the use of a retention pond system within a residential neighbourhood in the southeast portion of the site. Water is collected behind houses in channels along back lanes.

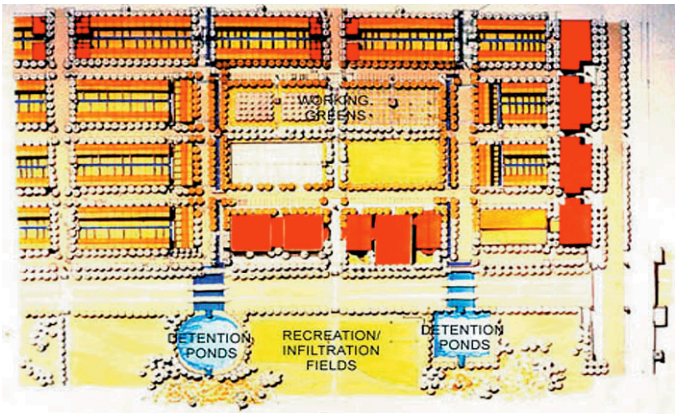


Fig. **2-6** retention pond system: Streets and rear lanes are considered as organizing structure for surface water management. Water channels flow into larger north south swales and provide irrigation for the central working greens. These greens would serve a number of social, ecological and recreational functions for the neighborhood and would act as filtration basins.City of Burnaby, proposed Brentwood site, Vancouver, Canada
Source: Condon et al.1999

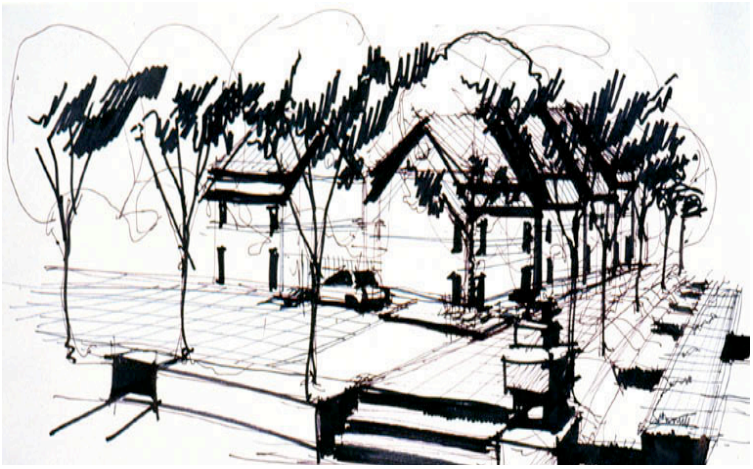
Street-side swales feed into infiltration beds that frame the community's working greens. As with the back lane swales, these and other swales incorporate infiltration devices and empty into a series of retention ponds at the edge of the open water way corridor. Properly designed retention and detention systems allow for fine sediment to settle and for wetland vegetation to absorb some of the dissolved nutrients in the stored runoff.

The shape and appearance of retention ponds varies according to the site context. Some have a "natural" appearance, while others may have a more urban appearance (such as the ones shown in the example). All can become important natural and recreational features in the surrounding open-space system.

Infiltration works best in soils with high to moderate percolation rates: deep, well-drained sand, gravel, or sandy loam with moderately fine to moderately coarse textures. Infiltration techniques are limited where soils have slow percolation rates (i.e., silty loam, or clay) where clogging may occur. High groundwater levels, steep slopes, or shallow bedrock also inhibit adequate infiltration.

An example for the surface drainage systems is:

Grassed channel also called swale, bio-retention swale, or grass swale discharge to receiving streams and are designed to meet runoff velocity targets under a variety of storm conditions. Generally, they keep water for up to ten minutes and are effective at removing some sediment and hydrocarbons. Fig. 2-7.The channels have broad bottoms and dense vegetation that seem to make them more like drainage channels. Grassed channels are applicable from low- to medium-density development and roads, have few environmental concerns, and are less expensive to construct than traditional curbs and gutters.



(**Fig 2-7)** grassed channel
perspective sketch of neighborhood drainage system. The drainage channel shown at left directly responds to the sloped topography of the site. Instead of a continuously sloping channel, a series of shallow rills that are underlain with a crushed, concrete drain, slow the movement of water. This allows coarse sediment to settle instead of being channeled directly to open water way.
Source: Condon, 1999.

2-1-3- Increase the area of permeable surface

The degree of imperviousness affects greatly the water cycle in the neighbourhood. (See appendix F). Beer et al. (2000) Indicated that wherever possible impermeable surfacing (tarmac, paving and buildings) should be altered into permeable surfaces (gravel, turf and structurally reinforced turf, 'grass-crete', treed and shrubbed areas, ..etc. The surface cover types which could be considered for change by a local community include: driveways, entrance areas, public spaces, courtyards, low capacity parking areas, some industrial areas (although due to the need to contain spillage of toxic material and liquids some of

these areas must remain impermeable), school yards and sports pitches. Open some river banks to re-create the old flood plains where appropriate and develop new ponding areas along the river to reduce downstream flooding.

2-1-5- Improve recreational access to water courses and local reservoirs

Water courses should not be inaccessible and hidden away (Condon, 1999). The full potential of the water courses needs to be fully realized through a series of local environmental improvements.

The pedestrian routes and public transportation should provide good accessibility to those open water courses and make it livable and enjoyable as much as possible (Condon, 1999). Fig. 2-8 shows how the designer integrated recreational amenity with storm water management and stream stewardship. Surface drainage patterns follow those of the grid structure and culminate in detention basins at street ends. These basins, together with playing fields are organizing units around which the larger open-space structure takes shape.

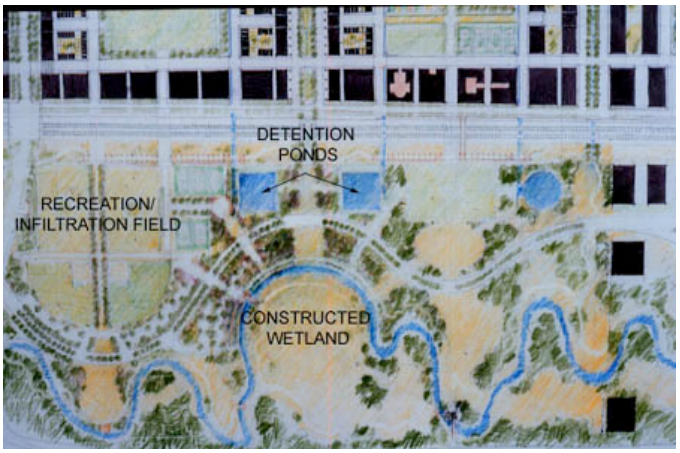


Fig. 2-8: recreation and drainage systems
Source: Condon 1999

2-1-6- Limit or eliminate the use of potable water for landscape irrigation.

-Use high efficiency irrigation technology, or, use captured rain or recycled site water to reduce potable water consumption for irrigation (Beer et al. 2000).

-Use only captured rain or recycled site water for reduction of potable water for site irrigation needs, or, do not install permanent landscape irrigation systems (Beer et al. 2000).

-Specify water-efficient, native or adapted, climate tolerant plantings. High efficiency irrigation technologies include micro irrigation, moisture sensors, or weather data based controllers. Feed irrigation systems with captured rainwater, gray water, or on-site treated wastewater (Beer et al. 2000).

2-1-7- Reduce generation of wastewater and potable water demand, while increasing local aquifer recharge.

-Reduce the use of municipally provided potable water for building sewage conveyance, OR, treat wastewater on site.
-Implement decentralized on-site wastewater treatment and reuse systems.
-Decrease the use of potable water for sewage conveyance by utilizing gray and/or black water systems. Non-potable reuse opportunities include, toilet flushing, landscape irrigation, etc. Provide advanced wastewater treatment after use by employing innovative, ecological, on-site technologies including constructed wetlands (Beer et al. 2000).

2-1-8- Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.
-Develop a water use baseline including all water consuming fixtures, equipment, and seasonal conditions
-Specify water conserving plumbing fixtures in combination with ultra high efficiency or dry fixture and control technologies. Specify high water efficiency equipment (dishwashers, laundry, cooling towers, ..etc). (LEED Green Building Rating System, 2000).

2-2 Evaluating Principles for Water Management in Neighbourhoods using Sustainability Aspects

2-2-1 Economical Aspect

Infrastructure components (including roads, storm drainage, and water/sewer service) make up an increasing prohibitive cost. Reducing imperviousness on a development site results in a reduced need for storm drainage, which in turn results in significant cost reduction. By promoting alternative stormwater management techniques that can take advantage of natural materials and processes, costs can be further reduced.

2-2-2 Social Aspect

Socially, ecological infrastructure enhances a community's topographic diversity and recreational opportunities. It connects people to nature by providing evidence of belonging to a larger natural cycle. In addition, wetland vegetation, grassed swales, and increases in green space enhance air quality and can often improve the visual aesthetics of community. Ecological infrastructure in urban areas implies a more naturalized, or "wild", landscape aesthetic. While considered by many to be an asset to a development, in terms of visual, recreational, and even financial value, such an aesthetic is often resisted by the public, planners, developers, and public works officials (Condon,2000).

2-2-3 Ecological Aspect

By using vegetation as a structural element, ecological infrastructure assists in improving the microclimate of developed areas. Effects such as increased shading, wind protection, cooling through evaporation and noise abatement provide better habitat for both human residents and wildlife. The proper selection of plant materials for an open drainage system can improve the infiltration potential of landscaped areas. When combined with effective planting design, open drainage can provide natural nesting and foraging areas for wildlife that, normally, would be displaced by development.

2-3 Analysis of the Relationship between Sustainability Principles for Water Management and the Healthy Cell Characteristics

In the above two sections in this chapter, principles for sustainable water management in neighbourhoods have been presented through the illustration of examples for sustainable urban landscapes and given the evidence through evaluations, that those principles do promote and increase the sustainability of the neighbourhood, ecologically, economically and socially.

Consequently, this section is devoted to examine how those principles correlate with the healthy cell characteristics proposed in the introduction.
The following analyses would present how applying sustainability principles to water management in neighbourhoods would manifest their relation to the healthy cell characteristics.

2-3-1 Regeneration

As mentioned earlier, a regenerative community is a one in which the concept of waste is eliminated.

The following part would match sustainable urban landscapes for water management in the neighbourhood with the regeneration character;

- Management of surface water flows, ground water infiltration and the upgrading of water quality in local streams, as well as ponds eliminates the concept of purification and treatment of water courses.
- The protection of natural, hydrological, and soil processes by prohibiting development along drainage patterns and water resources adds recreational recourses without depleting the drainage ways and affecting the equilibrium of the site.
- Constructed wetlands are incorporated into the site for bioremediation and recreation uses existing resources for mutual benefit

2-3-2 Self-Sufficiency

As stated earlier, a self-sufficient neighbourhood is a one which satisfies the needs of its residents, socially, economically and ecologically. Through the following analyses, we would get closer to examine the relationship between sustainability principles for water management in neighbouhoods and the features of the self-sufficient community as presented in the introduction.

By applying sustainability principles to water management in neighbourhoods;

- more people would enjoy the benefits of clean water, accessible recreational areas, fishing and boating if on site, and a healthy and sustainable environment.
- the ratio of water regeneration (percent of the consumed water to the recycled grey water) would increase.
- Maximization of recreational and aesthetic possibilities that emerge as a result of water courses
- fertile soil for agriculture would increase
- water efficiency within buildings would increase, to reduce the burden on municipal water supply and wastewater systems.

2-3-3 Self-Correction

As mentioned earlier, there are two vital self-corrective mechanisms could be used with all community-based programs. These are **Monitoring** and **Evaluation** The following part will present how sustainability principles need both monitoring and evaluation to keep on promoting water management in neighbourhoods towards sustainability.

- Monitor water consumption in the neighbourhood,

Evaluate the increase or decrease in water consumption and encouraging the residents through sustainability policies to reduce the water consumption in the neighbourhood.

- Monitor of water quality,

Evaluate the improvements in water quality due to purification programs , recycling grey water and black water treatment..

- Monitor degree of imperviousness,

Evaluate the increase in infiltration, contamination of water courses and the health of its riparian habitat

2-3-4 Dynamic Adaptation to the Environment

As stated earlier, neighbourhoods which dynamically adapts to the environment are those which serve the changing needs of its residents, without imposing any stresses on the environment or compromising the needs of the future. The following analyses would high light how sustainability principles of water management in neighbourhoods correlate with the dynamical adaptation to the environment.

- Allow water to flow normally through gravity channels as natural streams and protecting and respecting their edges.
- Using slopped topography and geology of the site as a part of infiltration devices such as channels, swales, buffers and wetlands.
- Respecting the land near the drainage way while developing the neighbourhood in a way of adapting to the environment.

Introduction

This chapter deals with air pollution, reducing and controlling emissions in neighbourhoods. The principles of reducing air pollution deals with the kind of energy used in transportation in neighbourhoods. So the research will highlight the alternative energy sources and strategies to reduce emissions. Then the evaluation of those principles and some case studies to illustrate those strategies and principles in urban landscapes that are easy to perceive.

The introduction would introduce the problems of air pollution and emissions. There are some problems related to air pollution and the traditional energy used in the human daily life. The research would mention some of them briefly to recognize those problems, before providing the sustainability principles which proposes solutions for them. Certain problems are considered to be global, regional, and some others are local. The research would deal with the solutions on the neighbourhood level.

Air pollution

This includes human health, environmental damage and avoidance actions (such as restrictions on sports and other personal physical activities during air pollution events) resulting from various air emissions produced by motor vehicles and other industrial activities. This research is interested mostly in the vehicle emissions as being the major and common producer of pollution in neighbourhoods.

Vehicles produce various harmful air emissions, as summarized in Table.3-1. Emissions vary in their source, harmful effects and their scale.

Most of them come from fuel production and engines and air conditioners. Air pollution is one of the most often cited external costs of vehicle use. Fig. 3-1.

Figure 5.10-1 Transport Contribution to Air Pollution[2]

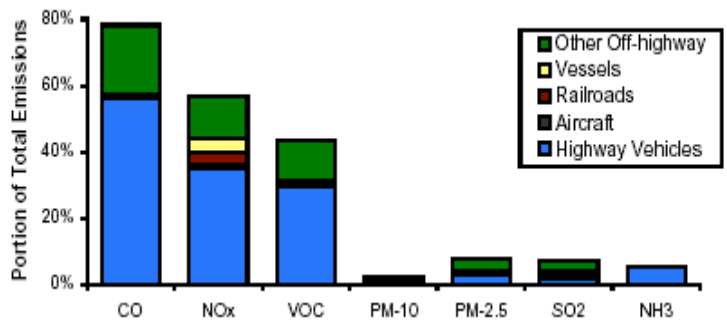


Fig. 3-1: chart showing transport contribution to air pollution
Source: TDM Encyclopedia(2002)

Emission	Description	Source	Harmful Effects	Scale
Carbon dioxide (CO_2)	A byproduct of combustion.	Fuel production and engines.	Climate change	Global
Carbon monoxide (CO)	A toxic gas which undermines blood's ability to carry oxygen.	Engine	Human health, Climate change	Very local
CFCs	Durable chemical harmful to the ozone layer and climate.	Older air conditioners.	Ozone depletion	Global
Fine particulates (PM_{10}; $PM_{2.5}$)	Inhaleable particles consisting of bits of fuel and carbon.	Diesel engines and other sources.	Human health, aesthetics.	Local and Regional
Hydrocarbons (HC)	Unburned fuel. Forms ozone.	Fuel production and engines.	Human health, ozone precursor.	Regional
Lead	Element used in older fuel additives.	Fuel additives and batteries.	Circulatory, reproductive and nervous system.	Local
Methane (CH_4)	A gas with significant greenhouse gas properties.	Fuel production and engines.	Climate change	Global
Nitrogen oxides (NOx)	Various compounds. Some are toxic, all contribute to ozone.	Engine	Human health, ozone precursor.	Local and Regional
Ozone (O_2)	Major urban air pollution problem resulting from NOx and VOCs combined in sunlight.	NOx and VOC	Human health, plants, aesthetics.	Regional
Road dust	Dust particles created by vehicle movement.	Vehicle use.	Human health, aesthetics.	Local
Sulfur oxides (SOx)	Lung irritant, and causes acid rain.	Diesel engines	Human health risks, acid rain	Local and Regional
Toxics (e.g. benzene)	VOCs that are toxic and carcinogenic.	Fuel production and engines.	Human health risks	Very local
Volatile organic hydrocarbons (VOCs).	A variety of organic compounds that form aerosols.	Fuel production and engines.	Human health, ozone precursor.	Local and Regional

Table 3-1: vehicle emissions
Source: TDM encyclopedia,2002

3-1 Principles for Improving air quality in neighborhoods with Sustainability aspects

Though individuals have a great share in tackling air pollution emissions, still there are some emissions that are nearly impossible for the average person to avoid creating. This section provides an overview of society-based actions that are being taken to reduce the effects of the pollution created. The four avenues through which air pollution is being dealt with are **alternative energy choices, , climatic criteria for designing neighbourhoods, emissions reduction, emissions control and enhancement of natural "sinks."** (AirHead.org and Center for Neighborhood Technology). Emissions control is a technological means to control pollution emissions, (see appendix G), while Natural sinks are not that effective forms of combating pollution locally, so they will be excluded form the scope of the research.

3-1-1 Alternative Energy

Burning fossil fuels to create electricity generally produces large amounts of emissions. As the skies grow more and more polluted, it is becoming necessary to find alternate, renewable energy sources that do not have such a negative impact upon the environment.

Renewable energy can be used to provide electricity, mechanical power, heat or fuel, certain renewable energy technologies are the fastest growing global energy sources, currently expanding at growth rates not seen since the early days of microcomputers. These sources are variable, such as , wind energy, water power, solar energy, biomass, geothermal energy, tidal and wave energy (Derek Taylor, 2000).

Renewable energy can be used in buildings in one or more of the following ways:

- it can be extracted elsewhere and delivered via the conventional delivery channels and networks.
- It can be extracted locally and used locally.
- It can be extracted at the site of the building(s).
- It can be extracted at the building or by the building envelope.

3-1-1-1 Wind Energy

Wind energy, unlike coal, natural gas, and oil--create no CO2, SO2, or NOx emissions. It depends on wind speed. The wind energy available varies on a seasonal basis, peaking in the winter month which matches well the variation in energy demand for communities. This is the reverse of solar energy which peaks in the summer month. Speeds are highest on hills, away from obstruction such as buildings because of turbulence. Wind turbines are available in a range of sizes from very small devices capable of producing a few watts to large turbines with rated outputs of over 1.5 MW. Most are installed in commercial wind power stations consisting of groups of turbines each rated at about 400KW or above. If the site is in a part of the country with sufficient high wind speeds, it would be possible to sell the excess electricity commercially to one of the regional electricity companies (Edwards *et al,* 2000).

An example for community wind farms is Awel Aman Tawe, upper Swansea Valley in the U.K. It is the first community owed and managed wind farm in the U.K, leading a project to develop a small wind farm a major community asset providing sustainable funding for local regeneration and a source of renewable energy to U.K customers. The project costs are £3 million, projected income of wind farm; £192,000- £383,000 per annum (Barton *et al.* 2003).

In normal circumstances it is not advisable to install a conventional wind turbine on a building structure. However researchers are now introducing a new family of wind energy convectors which use the building ,envelope as means of enhancing and extracting energy from winds blowing across their surfaces. These include the Aeolian Roofs and Aeolian towers, Aerosolar Power Towers and also the Aeolian Power Plane Turbines (Edwards *et al,* 2000). (appendix H)

3-1-1-2- Solar Energy

It has been used to provide useful energy for centuries, principally as a source of heat and light. Using solar energy for heat requires either solar collectors- a method known as active solar- or the integrated design of energy efficient buildings that trap solar gains passively- a method known as passive solar heating design (Taylor, 2000). Utilizing solar panels means a cut in the amount of electricity used and reductions in the amount of emissions released into the air. Fig. 3-2. A solar panel is composed of solar cells, which are made of silicon. These cells act as semiconductors, which convert sunlight into electricity. Solar electricity can also be produced by building large mirrors that attract sunlight to heat pipes within the mirror. The heated water then turns into steam, which is used to turn a turbine and produce electricity.

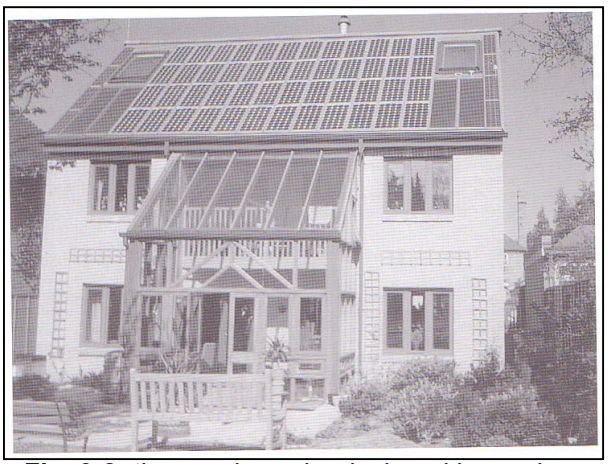


Fig. 3-2: the passive solar designed house has flat plate active solar collectors and photovoltaic modules of the roof.
Source: Derek Taylor, 2000

An example of the solar panels is the new neighbourhoods in Jerusalem. Fig. 3-3. The placing of solar heating panels on the roods of new apartment blocks,

showing the right energy conservation ethos and usage of technical installations (Thomas, 2002).

Fig. 3-3 : Jerusalem, Palestine , new neighbourhood with solar panels
Source: Thomas, 2002

3-1-1-3- Geothermal Energy

Geothermal energy uses the heat that comes from beneath the Earth's surface to create electricity. The internal heat of the Earth results mostly from the decay of radioactive nuclei that were incorporated into the planet's core when it was formed.46 Geothermal energy is created by harnessing either the dry steam, wet steam, or hot water that is generated underground. Each of these can be extracted from molten rock, magma, hot dry rock zones, or warm rock reservoir deposits. Geothermal producers essentially use elongated pipes that access the heat and water under the earth's core and bring it to the surface. Here, the hot water is transformed into steam, which powers generators and creates electricity with very little pollution. This is being done on a large scale in California, but it is also used for small-scale residential or commercial heating. The drawback to relying on geothermal energy is that the intense heat is not evenly distributed over the globe, so only certain areas can really take advantage of this methodology (Taylor, 2000).

An example of the geothermal aquifers are those in the U.K. at the depth of 1.5-2.0 Km in several areas of the U.K. In Southampton the local geothermal source has been successfully linked to the community heating network (Barton *et al.* 2003).

3-1-1-4- Hydroelectric Power

Moving water creates large amounts of energy. Using water to capture power is a clean source of energy. Large amounts of water can be used to push items, such as wheels or blades, which in turn can move generators to produce electricity. Norway actually obtains 99% of its electricity from waterpower. This method of creating electricity generates minimal air and water pollution. Additionally, these reservoirs of water can be used for irrigation, flood protection, and recreation (AirHead.org and Center for Neighborhood Technology, 2003).

If a proposed community is situated in close proximity to a fast moving stream or a river, then there is potential for water power exploitation. This will involve the installation of a water turbine coupled to a generator , but the type of turbine will depend on the head(the height between the dam and the turbine) available, the volumetric flow rate, and whether there is to be a dam or whether a river current turbine is to be used. Each water power installation requires a large amount of specially designed civil engineering works so there are no benefits from standardized mass production to keep the costs low. However, provided that there is sufficient water flowing through the system, it can be a very simple and straight forward means of generating electricity with no CO2 emissions (Taylor, 2000).

3-1-1-5- Nuclear Energy

In France, 79% of its energy comes from nuclear power. Nuclear reactors are actually promoted by a few environmentalists, because they are unaffected by the potential shortage of fossil fuels and they do not emit carbon dioxide, sulfur dioxide, or carbon monoxide into the atmosphere. But, most environmental advocates do not see nuclear power as a solution to our energy needs, because nuclear reactors and the radioactive waste they generate are incredibly hazardous to humans and other species (AirHead.org and Center for Neighborhood Technology, 2003).

3-1-1-6- Biomass

Biomass include fuels derived from organic municipal wasted and sewage, farm animal wastes, energy crops or crop and forestry residues. Unlike most other forms of renewable energy, biomass can be stored for use when required, provided sufficient space is available.

To contribute to the energy requirements of a housing project, a local source of a biomass will need to be easily available. This may mean allocating part of a development area to growing energy crops (which could also be used as parkland) or contracting local producers to grow energy crops. It may also mean that the waste from housing such as sewage and organic matter, is converted into a

usable fuel by biological treatment processing locally. On a large enough scale, domestic waste can be used for energy via combustion, or via processing into fuel. For many reasons it often makes more sense to utilize biomass into a neighbourhood or a district scale combined heat and power (CHP) unit (see appendix I) rather than in biomass boilers or wood stoves for individual houses. All energy crops require large areas of land allocated to their production (AirHead.org and Center for Neighborhood Technology,2003)

3-1-1-7- Fuel Cells

Most hydrogen is extracted from fossil fuels. Although, it can be obtained from water via *electrolysis*, great amounts of electricity are required to separate hydrogen from oxygen. Some fuel cells are designed to run on alcohol or natural gas, which they "reform," or extract hydrogen from. Reforming fossil fuels still causes an emission of carbon, but since fuel cells are often twice as efficient as conventional internal combustion engines it is a step in the right direction.

Fuel cells have great potential for a number of applications, from transportation, to remote locations in need of power, to seamless power supply for computer systems.

Emissions from a fuel cell system are lower than emissions from the combustion process because fuel cells rely on chemistry rather than burning. Fuel cells produce electricity and heat as long as fuel--natural gas, methane, or any hydrocarbon--is provided (Taylor, 2000).

3-1-2 Climatic Criteria for Designing Neighbourhoods

Five climatic factors influence the comfort and health of people in most urban environments; air temperature, humidity, solar radiation, wind and air pollution. While little can be done in designing nieghbourhoods to combat regional atmospheric conditions, such as those governed by the movement of air masses , measures can be taken to minimize thermal extremes and high levels of air pollution associated with micro climates within the neighbourhood.

Marsh, (1998) presented four basic types of climatic controls or changes through urban planning and design.

1- Reduce summer solar radiation by shading critical surfaces, for example, pedestrian walks, waiting areas, and busy streets. Fig.3-4 and by architectural means like wind traps, fig.3-5

Fig.3-4 :Blanes, Spain
Pedestrian path shaded with trees on both sides

This form of traditional resource efficient climate moderating device, evolved over centuries, overcomes the spread of air conditioner that are energy consuming and air polluting.

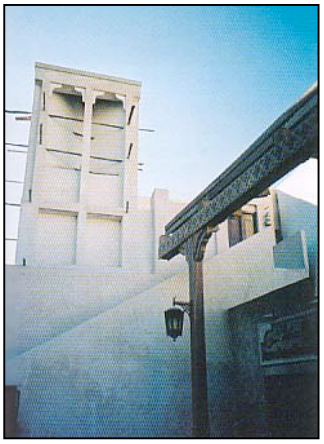


Fig. 3-5:wind traps
Dubai emirates
Source: Van Neikerk, 2002

2- Reduce the abundance of concrete and asphalt, and increase the amount of vegetation and open water.
3-Increase airflow at ground level to flush heats and polluted air away from the city.
4-Reduce pollution by decreasing emission rates, improving flushing rates and locating discharges rates, and locating discharge points to minimize impact on heavily populated sectors.

At the street scale, considerations should be given to the potential for thermal stress on people in waiting and walking spaces. In addition to high temperatures, intensive solar radiation, poor airflow, high humidity, and physical exertion also contribute so heat stress. Thus along pedestrian corridors with high solar exposures, poor air circulation, and long walking distances, the potential is great

for heat syndrome among walkers. To avoid this, shaded rest stops, with good ventilation should be provided at appropriate locations. The distribution and location of stops should be based on origin and destination patterns for different walkers, elderly and disables especially (Lead green building rating system, 2000).

3-1-3 Reducing emissions

Due to its principle role in producing pollution in urban areas, urban transportation emissions would be the scope of this part of the research. It explores strategies and principles used to reduce emissions form urban transportation in neighbourhoods,

Though it is hard to calculate the amount of pollution produced by transportation, a study done by Fisher,(2000), (appendix J) developed a model of GHG emissions from personal urban transportation given variations in neighbourhood characteristics, including community and housing design, socio-economic makeup, and locational factors. The results provide valuable insight into how communities can be designed and planned to reduce GHG emissions from passenger travel in urban areas. The spreadsheet tool produced by this study provides a useful instrument for planners and developers in estimating the GHG emissions implications of both neighbourhood design and the broader-scale urban structure considerations of infill development versus new development. The user inputs data on the characteristics of the neighbourhood and the tool forecasts the annual per-household GHG emissions from transportation.

This study resulted in the development of a model that is able to explain a substantial amount of the interaction between neighbourhood characteristics and vehicle use...

This study suggest that the “macro” urban structure is more important than the “micro” neighbourhood design in reducing GHG emissions from auto and transit travel by neighbourhood residents. That is, infill development to increase resident population in inner areas and inner suburbs is more effective than greenfield development in moderating the growth of GHG emissions. However,

neighbourhood design is also a significant determinant of emissions and can go a long way in improving the sustainability of neighbourhoods.
Below are some strategies used to reduce emissions

3-1-3-1-Land Use Management Strategies

The TDM encyclopedia (2002) stated that Land use management strategies such as Smart Growth (see chapter six), New Urbanism (see appendix K) and Location-Efficient Development can reduce per capita automobile use, transportation energy use and emissions by improving accessibility and Transportation Options. Land use reforms can provide a number of benefits where Increased land use density tends to reduce total per capita emissions (TDM encyclopedia 2002). The following land use factors can affect energy consumption and emissions :

- Density (the number of people and businesses in a given area) and Clustering (common destinations located close together) affects the distances that people must travel, and the potential of transit, walking and cycling. (see chapter six p:158, 159).

- Land use mix (the diversity of land uses in an area) affects trip distances and the feasibility of nonmotorized transportation. (see chapter six p:156,157).

- Major activity centers (locate employment, retail and public services close together in walkable commercial centers) increases the feasibility of transit use and allows people to make personal and business errands without driving.

- Parking management (flexible minimum parking requirements, shared parking, priced parking and regulations to encourage efficient use of parking facilities, see chapter five for more details) affects the relative price

and convenience of driving, and affects land use density, accessibility and walkability. (see chapter five, p: 136,137).

- Interconnected streets (a dense network of street that connect to each other, with relatively few dead ends) affects accessibility, including the amount of travel required to reach destinations and the relative speed and convenience of cycling and walking.

- Transit Oriented Development (locating high-density development around transit stations) makes transit relatively more convenient, and can be a catalyst for other land-use changes.

- Pedestrian Accessibility (walkability) and Traffic Calming (roadway design features that reduce traffic speeds) affect the relative speed, convenience and safety of nonmotorized transportation. (see chapter five, p:122-129)

3-1-3-2 Non-motorized Transportation Improvements and Encouragement

Shifts from automobile to nonmotorized transportation can be particularly effective at energy conservation and emission reductions by reducing short motor vehicle trips which have high per-mile fuel consumption and emission rates. As a result, each 1% shift of mileage from automobile to nonmotorized modes tends to reduce energy consumption and pollution emissions by 2-4% (TDM encyclopedia, 2002).

Walking and cycling improvements can help reduce total travel: a short walking or cycling trip replaces a much longer automobile trip.

3-1-3-3- Transit Improvements

Transit consumes less energy and produce less pollution per passenger-mile than automobile travel, and people who rely on transit tend to travel fewer passenger-

miles than motorists, so increased transit tends to reduce per capita energy consumption and pollution emissions.

A variety of strategies can encourage transit use, including increased service, more convenient and comfortable service, transit priority traffic management, lower fares, improved marketing, commuter incentives (such as employee transit benefits), improved pedestrian and bicycle access to transit stops, and Transit Oriented Development (TOD). (TDM encyclopedia, 2002).
Transit Oriented Development helps create multi-modal communities where residents and employees drive less overall .

3-1-3-4-Telework

Telework involves the use of telecommunications to substitute for physical travel. This includes telecommuting, distance learning, and various forms of electronic business and government activities. A portion of the reduced travel is often offset by additional vehicle trips teleworkers make to run errands, and because it allows employees to move further from their worksite, for example, choosing a home of job in a rural area or another city because they know that they only need to commute two or three days a week (TDM encyclopedia, 2002).

3-1-3-5- Speed Reductions

Traffic speeds reductions can reduce energy consumption and emissions. Lower speeds tend to reduce total vehicle mileage.

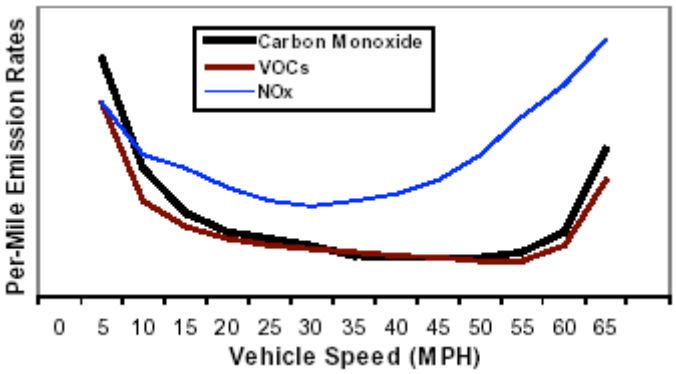


Fig.3-6: vehicle emissions by speed
Source: transportation research board (TRB), 1995.

Emission rates for most pollutants are higher when

engines are cold. Older vehicles that lack current emission control systems, and vehicles that are poorly tuned, tend to have high emissions rates. Emission rates tend to increase under stop-and-go conditions, and at very low and very high speeds, as illustrated in Fig. 3-6

Some researchers suggest that significant energy savings and emission reductions could be achieved by enforcing existing traffic speed limits (Suzuki, 1998).

3-1-3-6- Neighborhood Vehicles

These are small, low-speed vehicles, often powered by alternative fuels, suitable for local travel (Litman 1999). This type of vehicle can be encouraged by removing any barriers to their legal registration and use of public roads, favorable local transportation policies, roadway designs that accommodate such vehicles, and by direct support from transit agencies.

An example for efficient low energy vehicles was presented in India. Against the heavy air pollution from vehicles, the Indian state promotes the use of compressed natural gas (CNG) in transportation in the city with a population of 11 million largely dependant on motorized transport for mobility. The vehicles are either new retrofitted to provide cleaner emissions and easily visible in their distinctive livery. Fig. 3-7

Fig. 3-7 : efficient low energy vehicles Delhi, India, 2001
Source: Thomas, 2002

3-2 Evaluating Air management principles using Sustainability Aspects:

This section is divided into two, the first evaluating alternative resources and the second evaluating strategies to reduce emissions.

3-2-1Evaluating alternative resources: No matter how much renewable energy is used today, there will still be the same supply in the future. Therefore they are

sustainable for the posterity where there are no worries about the demands of tomorrow.

Economic aspect:

• Many countries do not have domestic supplies of coal or oil and must import much of their energy, but most countries do have access to some form of renewable energy which can be readily tapped.

• They can help transform rural economies into more viable communities for national development in most developing countries, by providing power for small-scale industries and job creation.

• For several countries that rely on imported fuels for power generation, there could be some significant savings by developing sustainable energy policies. Conservation and renewables also help a country's fuel supply diversity and security.

• If excess electricity from renewable sources is available, then it would be possible to sell the excess electricity commercially to one of the regional electricity companies.

Ecologic aspect:

• As a source of clean, non-polluting electricity they emit no air pollution or greenhouse gases and thereby have excellent appeal for greenhouse reduction/stabilization strategies.

Social aspect:

• Renewable energy as an perpetual source of energy, satisfies the needs of future generations and promises the society a better and secure tomorrow

3-2-2 Evaluating strategies to reduce emissions:

A Comprehensive Evaluation Framework considers a broader range of impacts, and so would favor that emission reduction strategies that provide additional benefits, such as consumer cost savings, road safety and congestion reductions (TDM, 2002). The following section would present evaluations to emission reduction strategies from sustainability aspects.

Economic aspect:

Strategies that tend to reduce travel mileage, speed, and emissions have long range economic benefits and saving on purifying polluted air, curing health deterioration, and environmental damages.

Ecologic aspect:

Emission reduction strategies can reduce pollution, enhance air quality and environmental health.

Social aspect:

Land use management strategies can reduce crashes, increase transportation choices, reduce sprawl and increase community livability. Speed limit enforcement can reduce crashes and sprawl neighbourhood vehicles are likely to increase consumer choice and community livability.

2-3 Analysis of the Relationship between Sustainability Principles for Air Management and the Healthy Cell Characteristics

In the above two sections in this chapter, principles for sustainable air management in neighbourhoods have been presented through the illustration of examples for sustainable urban landscapes and given the evidence through evaluations, that those principles do promote and increase the sustainability of the neighbourhood, ecologically, economically and socially.

Consequently, the research will provide an examination of the relationship between those principles and the healthy cell characteristics.

The following analyses would present how applying sustainability principles to air management in neighbourhoods would manifest their relation with the healthy cell characteristics.

2-3-1 Regeneration

A regenerative community is a one in which the concept of waste is eliminated.

The following part would match sustainable urban landscapes for air management in the neighbourhood with the above mentioned characteristics

-Organic municipal wasted and sewage, farm animal wastes, energy crops or crop and forestry residues, all could be regenerated to usable fuel by biological treatment processing locally through biomass to be reused as a clean energy source, which eliminates the concept of waste, and adds to the community resources.

-All sources of renewable energy adds to the community resources without depleting others except the nuclear energy.

2-3-2 Self Sufficiency

A self-sufficient neighbourhood is a one which satisfies the needs of its residents, socially, economically and ecologically. Through the following analyses, we would get closer to examine the relationship between sustainability principles for air management in neighbouhoods and the features of the self-sufficient community as presented earlier.

- Above all other benefits of self-sufficiency of any community is that all people of the community enjoy the benefits of clean air and a healthy environment.
- Using renewable energy sources helps the neighbourhood to supply its residents with the energy needed for housing uses.
- Renewable sources of energy help communities to be self-sufficient , clean energy suppliers and makes it export this excess energy to the neighbouring communities

- Relying on more local products reduces the pollution and emissions form freight transport, decreasing the dependency on imports.

To measure the degree of self-sufficiency of air management in a neighbourhoud, the ratio of air pollution emitted in the neighbourhood to the maximum bearing capacity of the local environment should be recorded to identify when technological and expensive means of combating air pollution would be essential if air pollution exceeded this bearing capacity.

2-3-3 Self-Correction

There are two vital self-corrective mechanisms should be used with all community-based programs, these are **Monitoring** and **Evaluation.**
The following part would present how sustainability principles need both monitoring and evaluation to keep on promoting water management in neighbourhoods towards sustainability.

Monitor percentage of air pollution
Evaluate air quality and correcting its percentage to meet the levels of the bearing capacity of the neighbourhood.

Monitor the percentage of the dependency on renewable energy
Evaluate the current technologies and the efficiency of the current means of energy supply.

Monitor the emissions of vehicles and urban transport
Evaluate the current strategies to reduce emissions form urban transport.

2-3-4 Dynamic Adaptation to the Environment

Neighbourhoods which dynamically adapt to the environment are those which serve the changing needs of its residents, without imposing any stresses on the environment or compromising the needs of the future. The following analyses

would high light how sustainability principles of air management in neighbourhoods correlate with the dynamical adaptation to the environment**.**

- Natural sinks such as trees could be used intensively to reduce CO2 in the neighbourhood
- Passive and active solar designs in the neighbourhood adapts its built form to make the best use of the resources available in the neighbourhood
- Building integrated wind energy and capturing wind through wind farms are means of the dynamic adaptation to the environment
- Making the best of the local renewable energy source in the neighbourhood is a mean of the dynamical adaptation to the environment.

Introduction

This chapter highlights the main green-structure elements in the neighbourhood. It also discusses the sustainability principles for each element and how they could be illustrated in the sustainable urban landscape context it tackles the evaluation of those principles from sustainability aspects as well. The chapter concludes with the relationship between those principles and the healthy cell characteristics explained earlier in the introduction. The following paragraph gives an idea about each element and its importance in the green-structure.

Green-structure

The Green-structure is a subject that is inevitable to discuss, however, in brief, the Green-structure has a direct and great effect on the green-spaces and corridors in a neighbourhood.

The word Green-structure is used in this chapter to encompass the linking of green-spaces with corridors and to signify that the spaces involved have the potential to support "nature " through the plant material they include. Fig. 4-1 shows how the research views the relationship between those three elements, and each of them would be further dealt with individually.

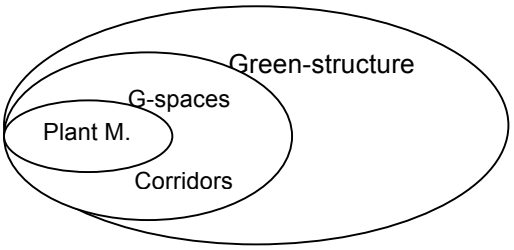


Fig.4-1: relationship between green-structure elements

The concept of green-structure recognizes the interaction that must exist between all green-spaces if biodiversity (appendix L) is to be preserved and enhanced. There is a noticeable lack of planning theory in relation to the overall role of structure; instead only specific greenspaces with specific attributes have been considered as worth the attention (i.e. public parks, historic urban gardens, recreational open spaces and ecologically valuable sites). This has led to the

"island" approach to both parks and nature areas - each element is seen in isolation, a factor that has been disastrous for many natural habitats in urban areas. However, only in the Scandinavian countries, and in Germany and Holland has this understanding begun to be translated into developing Green-structure planning as part of the official city planning system. Green-structure Planning is proposed as a mechanism which could deal with how a community's green-spaces might be planned in a spatial sense, and then how they might best be designed, managed and maintained for the benefit of the local population (Beer *et al.,* 2000).

Sustainable Green-structure in Neighbourhoods

The green-structure plan of any neighbourhood encompasses many different kinds of spaces - varying from public, semi-public and private spaces - , growing various kinds of plant materials within each of them and the corridors linking all of those spaces together.

In light of our increased understanding of the need to act sustainably in our interaction with the natural and physical environment, "Green-structure Planning" has become essential in the planning of towns which has landscape plans based on a thorough study of the local natural and physical environment. The result is that the built-up areas of new towns strongly reflects the local topography - keeping well clear of the valleys - the floodable land as well as preserved the most valuable natural habitats within the designated area boundaries incorporating them where possible into the linked green-spaces system which is another by-product of almost all the landscape plans produced for any new settlements (Beer *et al.,* (2000).

An example of good green-structure planning is a proposal presented by Richard Rogers for the redevelopment of the western district of Shanghai which will be known as Lu Jai Zui.

An important element in the proposal is a large central park at the focus of the project. Fig. 4-2. This will supplement the linear park that runs parallel with the Huang Pu. Proposed in the master plan by the municipality of Shanghais, these two open spaces represent the key element in the open space plan. Green-space will therefore be located at the heart and at the perimeter of the area.

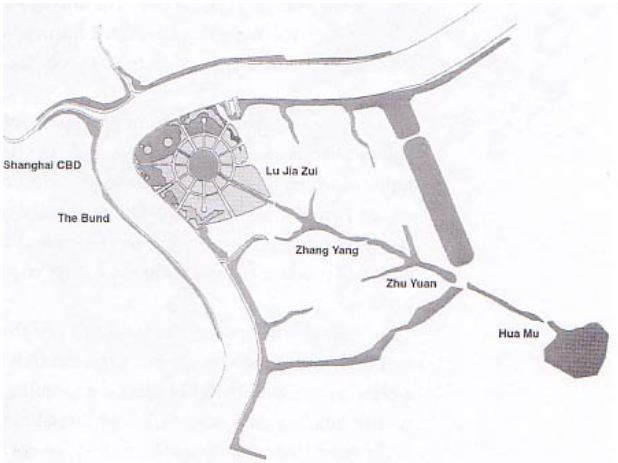


Fig.4-2:green-structure: Plan illustrating how the green plan for Lu Jai Zui links in with the proposal for open spaces in Pu Dong reinforcing the major circulation axis
Source: Steele,1997

All areas of Lu Jia Zui will therefore be within easy reach of open space.

The community and cultural facilities already planned by the municipality and additional facilities included in this proposal will be located around the edges of the central park. Fig. 4-3

The central and the linear park will be connected by a major link located at the base of the new television tower. Smaller neighborhood parks and squares will be located within each segment of the plan.

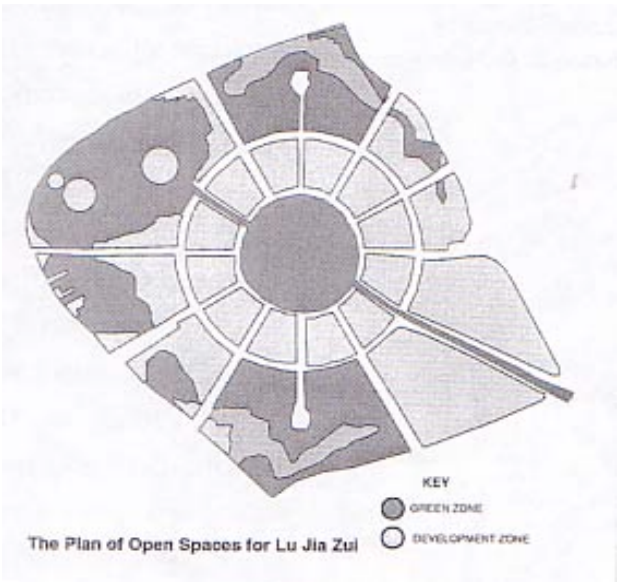


Fig.4-3: the plan of open spaces for Lu Jia Zui
Source: Steele,1997

Green-spaces

They are "places" - areas of land with mainly unsealed surfaces - these "places" carry human activity as well as plants, wildlife and water, and their presence influences quality of life, as well as local air and water quality (Beer *et al.,* 2000).

Green-spaces is the land which is composed of unsealed surface (not covered by buildings or paved surfaces) and so has the capability to support plants and therefore wildlife. Beer, (2000) stated the multi-functional benefits of green-spaces in a paper given at the Workshop on the Flemish Long-Term Vision of Nature Conservation in Urban and Suburban areas. These benefits are summarized in the following points:

• Through the flora and fauna they support, greenspaces are crucial to the survival of any level of biodiversity.
• Green-spaces have a measurable impact on local as well as city-wide air quality and can ameliorate the temperature within a community.
• By providing "natural" places through which water runs and within which it can be stored, greenspaces can have an impact on water quality and on the management of surface flows.
• Green-spaces provide settings for a wide range of human activity and, therefore, influence people's perception of their quality of life.
• Green-spaces have a profound influence on how local people and visitors experience a community and therefore on the social and economic life of a community.

During the past decade there has been an increased understanding in how green-spaces can be used in multi-functional ways to manage water, increase levels of biodiversity, improve air quality, reduce wind speed, grow biomass and even to grow fresh "organic" food. Developing this multi-functional use of green-spaces creates a much richer range of "experiences" for local inhabitants, including the possibility of more diverse local recreational activities.

Plant materials

They are valued natural resources. The research would clarify how this kind of resource should be dealt with in the urban landscapes of sustainable neighbourhoods. In brief, Motloch, (2001) summarized the value of this resource in the urban context and their influence over the surrounding natural and urban environment they exist in, as being the purely visual pleasures to be derived from looking at, providing contrasts of color, texture, and form in a built environment. Plant material introduces the shapes, colors and feelings of nature into the man made geometric patterns of roads and buildings.

On the site design scale, vegetation provides many sensual benefits. It provides enclosure and defines and articulated space. Vegetation can screen, enframe, or serve as a background for elements in the environment. It can also contribute color to the landscape. Vegetation can provide shelter from fierce winds, or through delicate movement accentuate even the softest breeze. Plant materials can influence microclimate and human comfort (Motloch, 2001).

The use of plant material in landscaping the urban environment must be taken with great care to make the best ecological, economical and social use of the plant materials, and reduce stress on the surrounding environment.

4-1 Principles for planning Green-spaces in Neighbourhoods with Sustainability Aspects

Good quality local green-space enhances the quality of life and the sustainability of the local land uses in many ways, for instance, through increasing the range of local recreational opportunity, which in turn reduces the need for car usage in leisure time. Good quality green-space also enhances the visual environment, creates educational opportunities for children, allows the development of efficient local water management schemes and grows biomass for use locally.

A strategy which aims to **regenerate** green-spaces, with the aim of realizing their full potential for enhancing local biodiversity, as well as enhancing the quality of

local people's lives, can give local community groups a focal point - so playing a major part in enhancing the quality of life.

Beer,(2000), indicated several policies for green-space in order to fulfill its full potential in relation to community sustainable planning:

-The availability of greenspace and open space near every home for use, in particular, by the elderly, disabled, young children and young adults

-Adequate footpaths and cycle routes and links between greenspaces. These can be provided in the form of green corridors with associated refuges for wildlife within the urban area. Safe usable paths with plenty of seating throughout the study area's greenspaces are needed, in particular, where people have to walk up and down hills on their way to their homes, the shops, schools and workplace.

-Recreational uses which reflect the local 'carrying capacity' of that greenspace and its habitats. For example, an area with a fragile habitat or supporting relatively rare wildlife should not be designed so as to encourage overexcited activities.

-The stimulation of local interest by using greenspace for educational purposes and encouraging community involvement.

-The need for integration and collaboration to deal with green-space issues on the local level: There is always the possibility that a community could, through its own efforts, work with a local authority and appropriate experts to redesign its local green-spaces so that they are more supportive of the whole range of recreational activities in which all age groups would like to participate.

-Sustainable waste management and local land use: Urban biodegradable waste can be recycled in local parks and other spaces owned by the local authority. As there is profit in waste, a local community can even consider engaging a private company to take care of composting the garden and park waste at a central plant. A local business might even be developed based on the sale of compost.

The research would go further in the following part to discuss the sustainability principles for the green-spaces in more details. The research would present sustainability principles for public spaces, semi-public spaces, semi-private spaces and private spaces.

4-1-1 Public Green-spaces

The research would present parks as an example of the neighbourhood public green-space.

Parks need to be thought of in terms of being an integral part of the community. In fact they should be considered the primary organizing elements of our communities. In order to enhance both parks sustainability and the neighbourhood as a whole, Hall *et al,.,*(2001) proposed some principles for designing parks in particular:

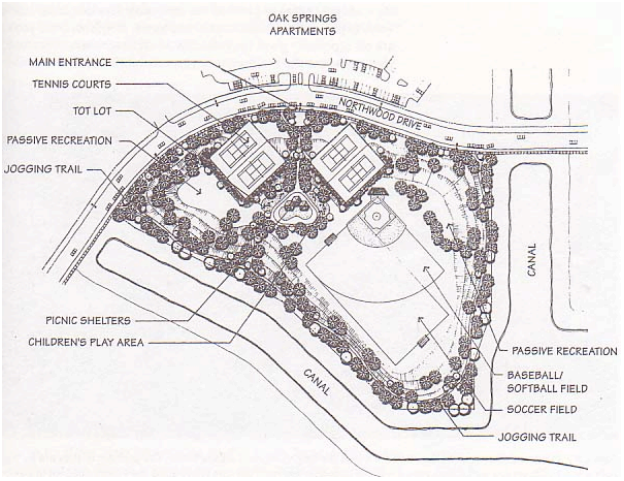


Fig.4-4 : neighbourhood park: activity areas for organized sports and other form of leisure and recreational activities that should be present in a neighbourhood park
Source: Hall *et al,.,*2001

• Everyone should have equal access to parks. All ages and segments of society should be served in as many ways as possible on all sites. Old, young, male, female, rich, poor, active and passive should all have something that appeals to them in every park settings. Fig.4-4.

• A park should be with walking distance of every resident. Neighbourhoods should be designed with a park or a series mini-parks linked together by walking path.

• Parks should be in a convenient centralized location and be bordered on at least two sides by public streets. This allows homes to be fronted on the park, helping to monitor activities occurring there.

• Parks should be prominently places so that we are aware of them through out the day in our normal routine. fig. 4-5. The pleasure to be gained form viewing

parks even while driving at 45 to 50 miles per hour far exceeds the amount of information or convenience to be gained by an equal amount of commercial space and signal.

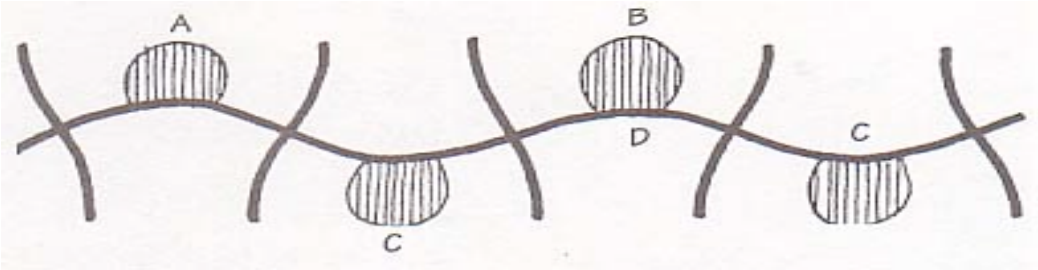


Fig.4-5: Location of parks : (A) potential locations of major parks or green spaces. (B) ideal locations is on major thoroughfares and preferably on the outside curve to serve as a focal point.(C) parks should be regularly spaced to create a sense of rhythm to the collector street by interrupting other continuous developments. (D) these locations serve the local neighbourhood while providing as aesthetic view along the collector streets
Source: Hall *et al.*, 2001.

• School sites are tremendous assets to the community and could be vastly more utilized that they are. They could operate longer during the day and become the location of numerous community functions, hosting activities such as neighbourhood meetings, distance learning, community based tutoring, sports camps, they could be recreation centers within the neighbourhood in the evenings and summers, eliminating the need for everyone to drive to the major recreation center across town. An example of the sustainable public spaces in neighbourhoods is the Easton central space, Ohio, USA. Fig. 4-6 illustrates how the central green-space of the neighbourhood can be the place where people gather for recreation, hanging out, and even open concert shows, which provides the community with that enjoyable atmosphere and strengthen social relationships.

Fig. 4-6: Easton central space, Ohio, USA
Source: Design Development Group, 2002

4-1-2- Semi-Pubic green-spaces

They are spaces serving a group of people in an intimate scale, the following part would present different kinds of semi-public spaces. The research would discuss shared external spaces, play spaces with each home path and shares court concept.

4-1-2-1-Shared external spaces

A small area of external space can be directly related to each housing group, dedicated to shared activities and uses. fig. 4-7. The range and nature of activities and uses can be determined and managed by the residents of each housing group (Barton *et al .,* 1995).

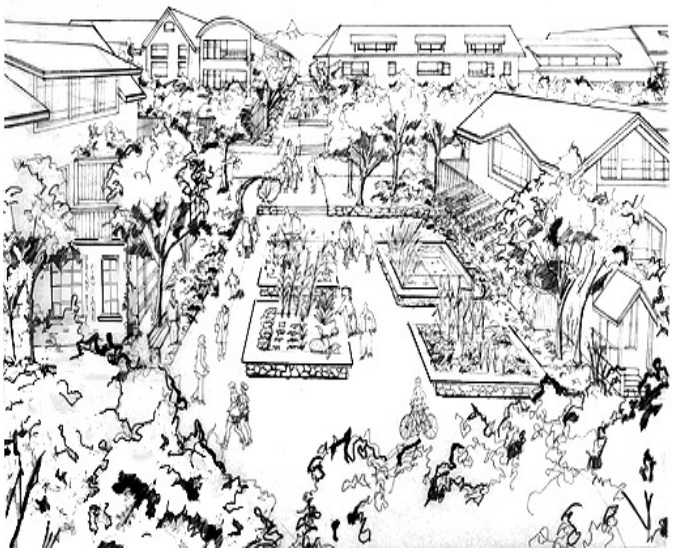


Fig. 4-7:shared external spaces: In this perspective sketch, houses have front doors that open onto local streets and are arranged around a central community green. Open spaces such as this (and the mid-block pedestrian through-ways that link them), are important social, ecological, and formal components of the wider neighbourhood fabric. Here a close-knit arrangement of related uses, including housing, day care, and open space, support a diverse community. Within this small area, opportunities for encountering one's neighbours and passers-by are increased. Concepts of sustainability and self-sufficiency are addressed through food production, recycling, and water management.

Source: Condon *et al.,* 1999

The distribution of open spaces relating directly to small housing groups may result in a more economical use of space, of higher quality, with better maintenance, than the specification of a single large area of “public open space”. There is a range of activities and uses, which require accommodation, not often recognized in the planning of conventional housing schemes: allotments, play areas, areas for communal events and celebrations, overspill parking (caravans, visitors, boats…), nature conservation areas, etc.

4-1-2-2 Play Space within each home-patch

in 1993, The national playing field association recommended a "local area for play" (LAP) for children up to 6. Barton *et al .,* (2003). This is a small area of open space sited within one minute's walking time of every home. As the fig.4-8 suggests, this play space may be part of the street scene but should be safeguarded form traffic, green in character and overlooked by dwellings (Barton *et al .,* 2003).

Fig. 4-8: local area of play
Source: Barton *et al .,* 2003

An example for the playing area within the home patch is in Cleveland, Ohio, USA: Fig. 4-29 The American model, kid's play equipment, often designed and built by the parents

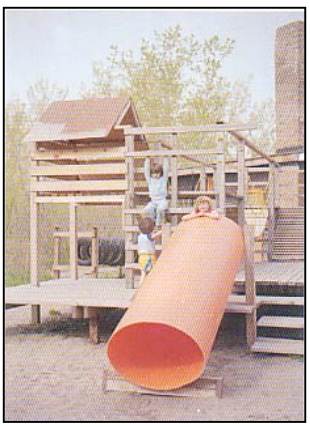


Fig. 4-9: Cleveland, Ohio, USA
Source: Derek Thomas, 2002

4-1-2-3 Shared Court

Fig. 4-9 shows the spatial organization of housing around shared court which provides privacy and security in the residential zones forming a shield against unwanted public intervention into the privacy (Thomas, 2002).

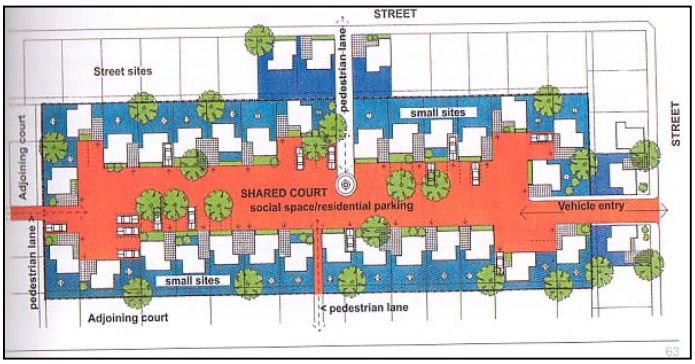


Fig. 4-10: court module where pedestrians take priority over motor cars.
Source: Thomas, 2002

4-1-3 Private Green-spaces

Private green-spaces are those spaces serving very limited number of people, like family members or people living at the same building. For this the research would present two types of private green-spaces, the residential gardens and the roof gardens.

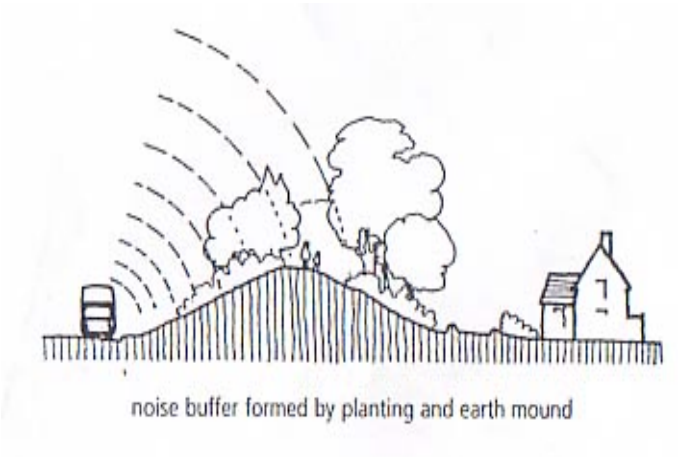


Fig. 4-11 : Vegetation on truck roads
Source: Barton *et al .,* 1995

4-1-3-1 -Residential Gardens

Each house should be designed to have a public and private side. The following part would present private spaces for residents of the neighbourhood. It would discuss front and rear gardens.

Front gardens:

There function is to provide a traditional zone between public and private spaces. On truck roads a 100m wide band with a bank of dense planting may protect houses against noise, dust etc. Barton *et al .,* (1995). Soft landscaping will generally absorb higher frequency sound and the internal planning of houses should provide a buffer zone. Fig. 4-11

On minor roads surveillance acts as a self-policing mechanism for an area. Opportunities for criminal activity can be minimized through and effective screen. Barton *et al .,* (1995). Fig. 4-12, shows several uses for the green screen, briefly they are;

- Conceals views into habitable rooms from the street and permits views from habitable rooms into the street
- Deters intruders from entering the premises and permits surveillance from neighbours of the house itself
- Conceals noise sources and reduces external sound reverberation
- Reduces glare from street lights and headlights, also sunlight and permits a view of the façade (the public face of the building).
- Enhances social relationship between residents.

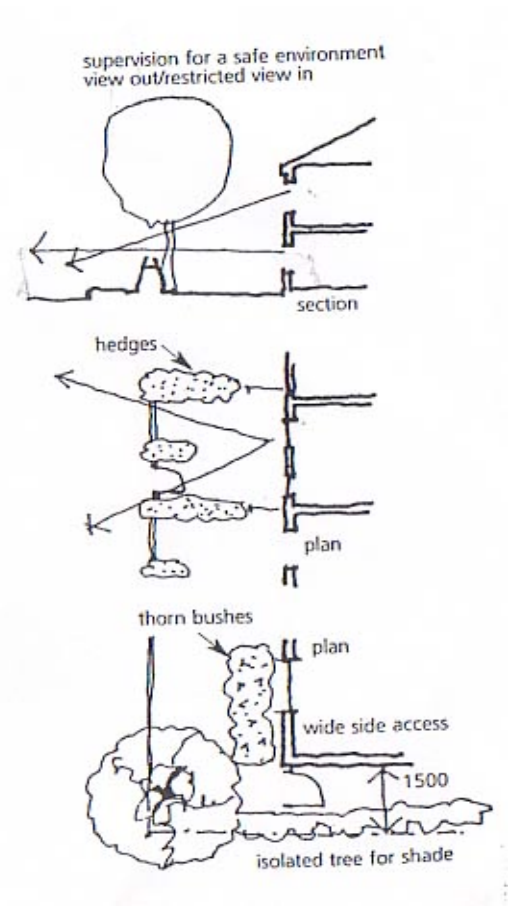


Fig. 4-12 : Vegetation on minor roads
Source: Barton *et al .,* 1995

Rear gardens

Rear gardens help the process of infiltration which promotes the natural infrastructure in the neighbourhood, and helps in the private activities of the residents, which may be playing grounds for the children or growing food for the elderly. The back to back rear gardens help increase the green open space for each house with a small hedge that serves as a barrier for privacy, and may be a pedestrian route in between the gardens. Developments should provide the opportunity for a proportion of residents to grow food, so there should be a variety of garden sizes available (Barton *et al .,* 1995).

4-1-3-2 Roof Gardens

Roof gardens are attracting greater public interests owing to the high densities and congestions associated with the neighbourhoods nowadays.

However, neighbourhoods contain large areas of roofs which are generally unused and often an eyesore. With careful design a useful garden oasis can be created in the heart of the neighbourhood. Fig. 4-13

Roof gardens can be used to provide additional insulation to buildings and buffer the roof membrane against climatic variation (Scrivens, 1990).

Fig.4-13: The gateway house at Basingstoke built in 1977, picture taken in 1986
Source: Scrivens, 1990

It is common to find that flat roofs require major renovation after as little as ten years, owing to environmental conditions to which they are exposed, including the effect to solar radiations and temperature extremes. Under a layer of moist soil the waterproofing is protected against these destructive influences and will remain in good condition for far longer than will an exposed roofs (Scrivens, 1990).

4-2 Principles for planning corridors of Neighbourhoods with Sustainability Aspects

In order to permit the potential movement of wildlife within developed areas and indeed to provide a sense of continuity between spaces " green corridors" of indigenous vegetation should be planted preferably with safe cross-overs where roads or other hazards interrupt the route. Streams and railway lines are potentially useful linear features in this respect. While the evidence that wildlife uses corridors for long distance travel in conclusive, the linear form is valuable because of the long boundaries or edge conditions which offer particularly rich habitat for a diversity of plant and wildlife (Barton *et al .,* 1995).

Roadside planting: If roadsides are given enough width and vegetation, they can indeed be considered green corridors for the neighbourhood.

Barton *et al .,* (1995), suggested that there are opportunities to make use of the road planting in a number of inter-related ways, fig. 4-14, such as:

- Composing of leaves
- Wildlife corridors and refuges
- Crash-barriers to vehicular movement
- Improved micro-climate (including wind shelter, removal of particulates, noise reduction)

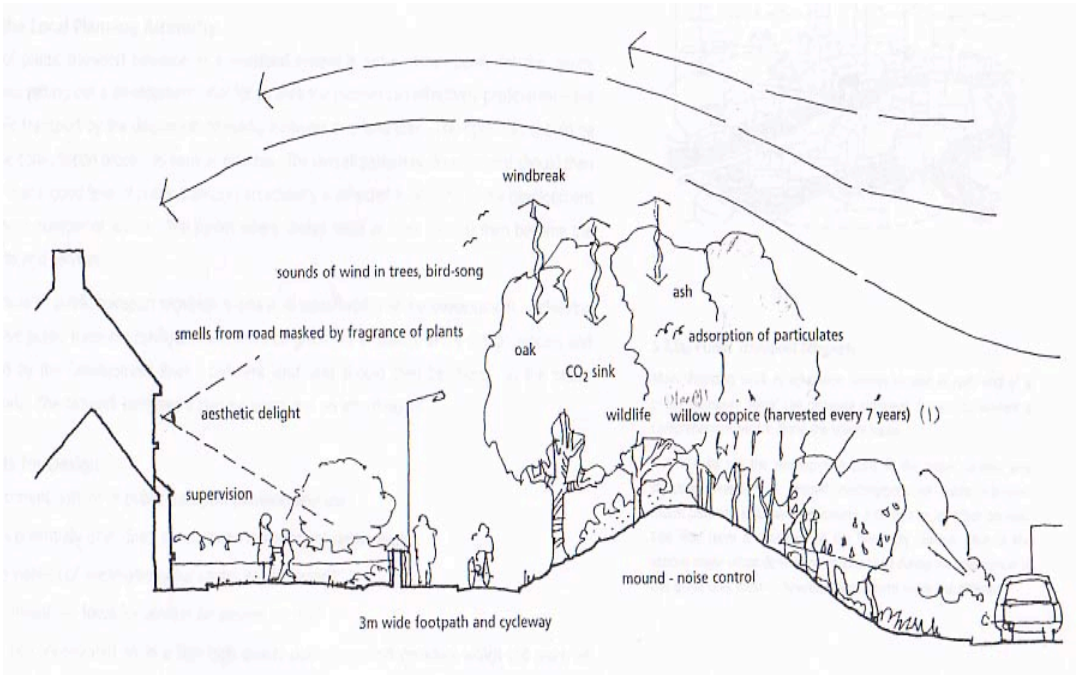


Fig. 4-14 : roadside planting benefits
Source: Barton *et al .,* 1995.

In urban areas, it is sometimes possible to design the road corridor as a linear landscape. This arrangement has the advantages of providing a pleasant environment for the motorist, enabling pedestrian and bicycle routes to be located away from the traffic in park like surroundings and at the same time distancing the vehicles from the dense urban areas with the accompanying benefits of relief form

noise, pollution and the sight of traffic. This work could be designed in such a way that the route would eventually be part of the network of greenways covering the whole neighbourhood area and connecting up the parks, squares, greens. The possibilities in planting such green ways are endless. They can be developed as ecological corridors within the neighbourhood (Mc Cluskey, 1979).

Natural plants grouping could be established and allowed to develop, providing an attractive habitat for wild animals and many species of birds as well as being an exciting foil to the adjacent urban areas, some land could be planted as wood land, others in the manner of a landscaped park, and so on. There are several ways of planting trees in relation to such road way. The best results are often obtained when the trees are spaced close enough for their canopies to meet along the rows and in some cases also across the roads (Mc Cluskey, 1979).

The provision of routs for pedestrian and cycles adjacent to that of the road will often be required. The options open will depend on the width of planting strip or parkway provided. It may be possible to provide pedestrian and cycle paths which also following the same direction of the road are not kept parallel, but, at some distance when their way through a landscape area.
If the tree spacing is sufficiently close the spatial volume allocated to the pedestrian will be as clearly defined as the space contained by an arcade or a corridor inside a building. Such an arrangement gives the pedestrian a strong sense of refuge from the element and the traffic.

4-3 Principles for using Plant Material in Neighbourhoods with Sustainability Aspects

Plant materials are used in landscaping for their various fuctions. the main fuctions of plant materials which increases the sustainability of spaces are liste below, as well as the principles of sustianability for using plant materials in both public and private spaces.

4-3-1 Spatial functions for plant material for the sustainability of spaces:

Plants contribute not only to the visual quality of man's environment, but also to the physical quality, and have relevant design features such as form, color and texture that can be used by designers to increase the sustainability of the space.

The functional characteristics of the plant material includes the capacity to articulate space, to provide screens, to control soil erosion , control traffic, provide shade, ameliorate wind and to achieve privacy (Avis *et al*, 1990).

Space Articulation:

" *Any element, natural or man-made, which is able to form a floor, wall or ceiling, may be used to articulate space*." (Robinette,1972: p.16). In fig. 4-15 , plants proof to have the ability of fulfilling this function.

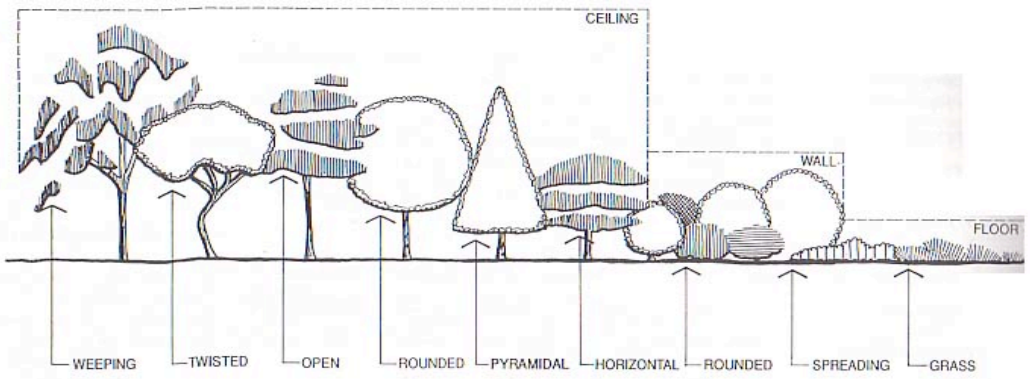


Fig. 4-15: characteristic plant forms able to form floor, wall or ceiling
Source: Avis *et al*, 1990

Screening:

A common need in landscape design is for plants that will provide a screen to block out the view of nay unattractive feature, or enhance one's privacy.

Screen plants may be required to form either a solid visual barrier or an open screen. Open screens are often necessary to allow the penetration of light.

Erosion control: in the natural environment, vegetation holds the shape of the land. Plant roots hold the soil in place and the leaves and branches form a cover on the ground that creates a barrier to air movement. Fig. 4-16 The top soil provides the most important nutrients for plant growth . therefore it is essential to retain this soil for landscape works with plants.

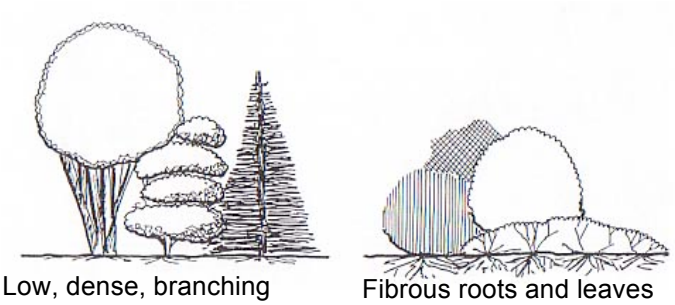


Fig. 4-16: plant characteristics that effectively control erosion
Source: Avis *et al*, 1990

Traffic control

This important use for plant material assists in the defining the patterns of direction to prevent dangerous random pedestrian and vehicle movement through an area and to help in calming the traffic and giving privilege for the pedestrians and cyclists over vehicles. The effectiveness of the barrier that the plant material provides relies on the characteristics of the plants used, the height and spacing of plants and the width of the planting. Pedestrians tend to avoid plants that cause discomfort when touched. In addition, plants are totally ineffective in controlling traffic if they are sparsely placed as this will allow movement through openings though them. Finally the width of the planting is important tot consider.

4-3-2- Plant material in Public spaces

In public spaces, plant materials are used to enhance the urban environment, purify air, increase amenity as a recreational and beautiful scenery.

Patterson, (1990) , specified more functional purposes, such as:

-to block out undesirable features; car parks, industrial areas

-to indicate change in use

-for emphasis and direction as in avenue planting for enclosure of seating areas, children's play area

-individual specimens or trees with special characteristics can be used for more formal ornamental purposes as living sculptural elements in squares (Fig. 4-17).

Fig. 4-17: plant material as ornament. Cairo, Maurice Lee
Source: Christopher Driver, 1990

Plants can be used to control the wind issuing from droughty gaps between buildings fig. 4-18

Organic materials can be employed for their architectural properties. Grass verges may form parts of the floor of the space containing the roads, the walls can be of trees and shrubs and the canopy form the ceiling. Plants may be employed as screens. Aesthetically they can be used for the creation of pattern and texture, for their sculptural shapes and as decorative walls (see fig. 4-20).

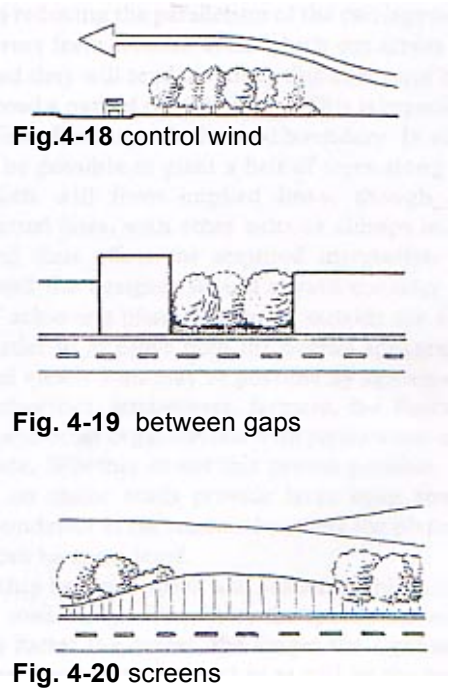


Fig.4-18 control wind

Fig. 4-19 between gaps

Fig. 4-20 screens

Source for 4-18,19, 20: Mc Cluskey, 1979

In order to maximize the benefits of plant material in public places, such as parking lots, there are some design specifications to do so, the following part would list some of them as an example;

-Locate trees in common areas, along streets, in parking lots, and commercial areas to maximize shade on paving and parked vehicles. Shade trees reduce heat that is stored or reflected by paved surfaces. By cooling streets and parking areas, they reduce emissions of evaporative hydrocarbons from parked cars that are involved in smog formation (Scott *et al.* 1998).

-Select tree species that are well-suited to the site where they will be planted.. Trees that are not well-adapted will grow slowly, show symptoms of stress, or die at an early age. Unhealthy trees do little to reduce atmospheric CO2, and can be unsightly liabilities in the landscape (Gregory *et al*, 1999).

-Avoid locating trees where they will block illumination from street lights or views of street signs in parking lots, commercial areas, and along streets (Gregory *et al*,1999).

-Maintenance requirements and public safety issues influence the type of trees selected for public places. The ideal public tree is not vulnerable to wind damage and branch drop, does not require frequent pruning, produces little litter, is deep-rooted, has few serious pest and disease problems, and tolerates a wide range of soil conditions, irrigation regimes, and air pollutants. Because relatively few trees have all these traits, it is important to match the tree species to planting site by determining what issues are most important on a case-by-case basis. For example, parking lot trees should be tolerant of hot, dry conditions, have strong branch attachments, and be resistant to attacks by pests (Gregory *et al*, 1999).

4-3-3 Plant material in Residential spaces

Increasing the area covered by trees and shrubs in domestic gardens and on private land is essential for the creation of a robust tree cover within any existing urban area or suburbia; doing so eventually leads to: the enhancement of biodiversity, lower energy consumption through the reduction of wind speed and a more enjoyable outdoor environment near the home (Beer, 2000). Moreover, plant

material could be used in residential gardens for growing food (Barton *et al .,* 2003). (appendix M).

The targeting of specific 'tree deficient areas' in a neighbourhood, wherever there is the space for tree planting within the parameter of the dwelling, helps to maximize a tree planting program's effectiveness and to use the limited financial resources efficiently (Beer, 2000). However, no tree planting programme can succeed on private land such as gardens without the support of those owning or managing the land; such a scheme cannot be imposed, but takes hold only as community support grows.

The right tree in the right spot saves energy.
Locate trees to shade windows so that they block incoming solar radiation, but do not block views (see Fig. 4-22, 4-23). Paved patios and driveways can become heat sinks that warm the home during the day. Shade trees can make them cooler and more comfortable spaces (Gregory *et al*,1999).

Fig. 4-22 : plant material for solar protection: Locate trees to shade windows subjected to un -preferred sun
Source: Sand, 1993.

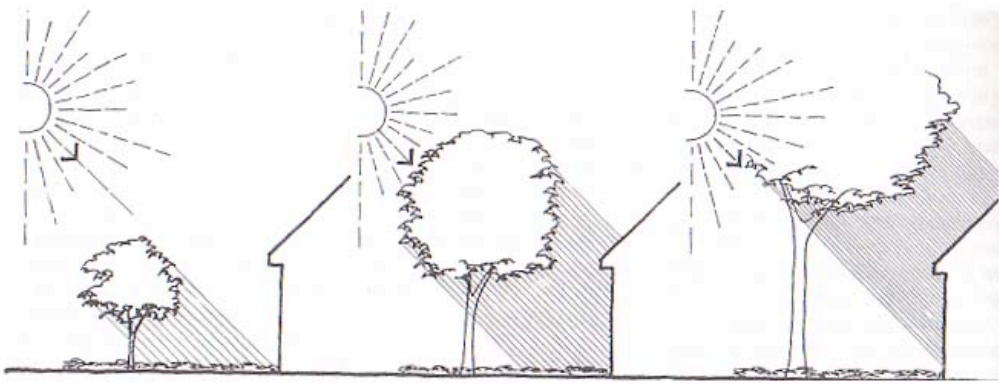


Fig. 4-23:Growth rate of tree on groundcover affecting light penetration
Source: Stephen Scrivens, 1990

Trees are ideal wind filters. Even leafless trees in the city can reduce wind speeds and heating costs. In situations where lot sizes are large enough to plant windbreaks, additional savings can be obtained (see Fig.4-24).

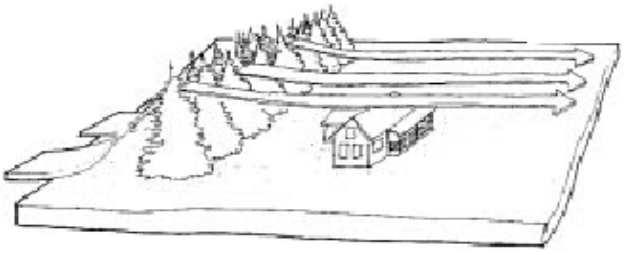


Fig.4-24 :Conifers guide wind over the building
Source: Sand, 1993

Locate rows of trees perpendicular to the primary wind direction. Design the windbreak row to be longer than the building being sheltered because the wind speed increases at the edge of the windbreak (Gregory *et al*,1999).

4-4 Evaluating Principles for Greensturcture in Neighbourhoods with Sustainability Aspects

4-4-1 Ecologic aspect

Sustainable green-structures have great ecological effect on the neighbourhood such as; the purification of the air by absorbing noxious gases, emitting oxygen and filtering out dust is one such service which they perform. With their roots they stabilize side slopes against erosion from wind and rain. They can be used to combat glare from in coming headlamps and to screen traffic from surrounding buildings. Noisy control and traffic guidance also number among their possible uses. Climate control too may be achieved through the provision of shade and shelter from the wind or rain. Tree belts can be used to protect roads from the worst prevailing winds. Plant material have even some Air quality impacts:
Urban trees can reduce atmospheric carbon dioxide (CO2) in two ways.
Trees directly store CO2 as woody and leafy biomass while they grow.
Trees around buildings can also reduce the demand for air conditioning, thereby reducing emissions associated with electric power production. Gregory *et al*,(1999) indicated that Urban trees provide direct air quality benefits by:

- Absorbing gaseous pollutants (ozone, nitrogen oxides)

through leaf surfaces,

- Intercepting particulate matter (e.g., dust, ash, pollen, smoke),
- Releasing oxygen through photosynthesis, and
- Transpiring water and shading surfaces, which lowers local air temperatures.

Trees can emit various biogenic volatile organic compounds that can contribute to ozone formation. The ozone forming potential of different tree species varies considerably. Gregory *et al*,(1999).

By shading asphalt surfaces and parked vehicles trees reduce emission of hydrocarbons that come from leaky fuel tanks and worn hoses as gasoline evaporates. These evaporative emissions are a principal component of smog and parked vehicles are a primary source.

Plant material have even some Water Quality Impacts

Urban stormwater runoff is a major source of pollution entering rivers and lakes. Gregory *et al*,(1999) indicated that trees improve water quality by:

- Intercepting and storing rainfall on leaves and branch surfaces, thereby

reducing runoff volumes and delaying the onset of peak flows,

- Increasing the capacity of soils to infiltrate rainfall and reduce

overland flow, and

- Reducing soil erosion by diminishing the impact of raindrops

on barren surfaces.

Urban forests can provide other water benefits. Irrigated tree plantations can be a safe and productive means of wastewater disposal. Reused wastewater can recharge aquifers, reduce stormwater treatment loads, and create income through sales of wood products.

The net benefits for the plant material in a site could be calculated as proposed by Gregory *et al*,(1999), (Appendix N).

4-4-2 Social aspect

Good quality local green-space enhances the quality of life and the sustainability of the local land uses in many ways, for instance, through increasing the range of local recreational opportunity, which in turn reduces the need for car usage in leisure time. Good quality green-space also enhances the visual environment, creates educational opportunities for children, allows the development of efficient local water management schemes and grows biomass for use locally.

In summary, the social benefits of green-spaces are listed below:

- decrease noise, by absorbing high frequency noise which are most distressing to people,
- Create wildlife habitat, by providing homes for many types of wildlife,
- Reduce exposure to ultraviolet light, thereby lowering the risk of harmful health effects from skin cancer and cataracts,
- Provide pleasure, whether by feelings of relaxation, or connection to nature,
- Provide important settings for recreation,
- Improve individual health by creating spaces that encourage walking,
- Create new bonds between people involved in tree planting activities,
- Provide jobs for both skilled and unskilled labor for planting and maintaining community trees,
- Provide educational opportunities for residents who want to learn about nature through first-hand experience, and
- Increase residential property values

4-4-3 Economical aspect: good designing for the Greenstructure of the neighbourhood decreases the urge to replan and redesign spaces left over after planning, known as "sloap" for it will provide more accurate and useful use of the land material and the distribution of greenspaces and corridors in the broader scale through planning and designing the whole greenstructure in the neighbourhood from the very beginning.

Green-spaces increase the range of local recreational opportunity, which in turn reduces the need for car usage in leisure time, which in turn decreases the expenditure on transportation.

-Green wastes could be used to provide energy and food production helps in cutting the expenditures of the neighbourhood and decrease pollution from transportation

4-5 Analysis of the Relationship between Sustainability Principles for green-structure and the Healthy Cell Characteristics

In the previous sections in this chapter, principles for sustainable green-structure in neighbourhoods have been presented and illustrated by examples for sustainable urban landscapes, given the evidence through evaluations, that those principles do promote and increase the sustainability of the neighbourhood, ecologically, economically and socially.

Consequently, this section is devoted to examine how those principles correlate with the healthy cell characteristics proposed in the introduction.

The following analyses would present how applying sustainability principles to green-structure in neighbourhoods would manifest their relation with the healthy cell characteristics.

2-3-1 Regeneration

A regenerative community is a one in which the concept of waste is eliminated. The following points would sum up the relationship between regeneration and sustainable principles for green-structure in neighbourhoods

- Regenerating pure air; the purification of the air by absorbing noxious gases, emitting oxygen and filtering out dust is one such service which plant material perform. This would add resources without depleting others
- Regenerating all old and unused spaces to reintegrate with the existing green-structure increases and strengthens the green-structure in the neighbourhood. This would help eliminate the concept of waste.
- Recycling of kitchen wastes in rear gardens and urban biodegradable waste in local parks helps eliminate the concept of waste and uses waste as resource.
- School sites could be vastly more utilized for numerous community functions, hosting activities such as neighbourhood meetings, distance learning, community based tutoring, sports camps, they could be recreation centers within the neighbourhood in the evenings and summers, which uses existing resources without depleting others and eliminating the need for everyone to drive to the major recreation center across town.
- Front gardens regenerates social relationship between residents.
- Roof gardens regenerates unused roof .With careful design a useful garden oasis can be created in the heart of the neighbourhood. This adds resources without depleting others

2-3-2 Self Sufficiency

A self-sufficient neighbourhood is a one which satisfies the needs of its residents, socially, economically and ecologically. Through the following analyses, we would get closer to examine the relationship between sustainability principles of green-structure in neighbouhoods and the features of the self-sufficient community as presented in the introduction.

- The availability of green-space and open space near every home for use

- Everyone should have equal access to parks.
- A park should be with walking distance of every resident
- Play Space within each home-patch
- Surveillance acts as a self-policing mechanism for an area. Opportunities for criminal activity can be minimized through effective screen
- Increasing opportunity for a proportion of residents to grow food increases self-sufficiency of the neighbourhood.
- Planting and maintaining community trees provide jobs for both skilled and unskilled labor , which increases self-sufficiency.
- Green wastes could be used to provide energy and food production helps in cutting the expenditures of the neighbourhood and decrease pollution from transportation

To measure the degree of self-sufficiency of green-spaces in a neighbourhoud there are some ratios that could be helpful for this task; the ratio of the locally produced food to the imported from outside the neighbourhood, the ratio of the availability of recreational facility in the neighbourhood to the demand on it

2-3-3 Self-Correction

The self-corrective neighbourhood depends on a self-correction process applied by community-based programs which has Two vital mechanisms that could be used with all community-based programs, these are **Monitoring** and **Evaluation.** The following part would present how sustainability principles need both monitoring and evaluation to keep on promoting green-structure in neighbourhoods towards sustainability.

Monitor status of present species of plants and animals in the area and any specific ones of special value or facing any threats and the current green-structure.

Evaluate the biodiversity on the neighbourhood and the contribution of the green-structure to the variety of species in the area.

Monitor patterns of present recreational activities and on any activities which local people feel that they would like to be involved in.

Evaluate the present leisure facilities, their environmental qualities and their areas and distribution in accordance to the local demand.

Monitor places of trees deficiency

Evaluate the tree map that should be followed in the future

2-3-4 Dynamic Adaptation to the Environment

As stated in the introduction, neighbourhoods which dynamically adapts to the environment are those which serve the changing needs of its residents, without imposing any stresses on the environment or compromising the needs of the future. The following analyses would high light how some of the sustainability principles of green-structure in neighbourhoods correlate with the dynamical adaptation to the environment.

- Shared external spaces are adaptable to changing lifestyles and age ranges.
- Roof garden and unused lots are both valuable recourses for future use in order to help the community adapt to the changing environment.

INTRODUCTION

This part deals with the second half of the resources in the neighbourhood, the " built environment", as mentioned earlier in the introduction of the research. The research chose the term " built environment" to stand for the resources man built on the natural environment. Depending on the definition of the term " built environment" form the encyclopedia of the Victorian institute in England, to be the base of any further classification in this part of the research, the encyclopedia determined the contents of the built environment as shown in the following table:

The Built Environment
• Residential (single- and multi-family housing)
• Commercial (stores and offices)
• Industrial
• Institutional (schools, public offices, etc.)
• Transportation facilities (roads, parking, etc.)
• Brownfield (old, unused and underused facilities)

Table 5.1 Major Land Use Categories
Source: TDM encyclopedia,2002

Concerning the sustainability in the neighbourhood, the movement network is an issue of some depth, and as the transportation facilities mentioned in the table above are subset of the movement network , therefore the research chose to discuss it in details in chapter five" movement network in sustainable Urban Landscapes".

As for the last item in the above table, " Brownfield", the research chose not to discuss it as it's not a basic land use in every neighbourhood.

The rest of the items , residential, commercial and institutional, as stated in the encyclopedia under the " built Environment " would be discussed in chapter six, " Land Use in Sustainable Urban Landscapes".

Introduction

Every settlement and every part of a region clearly needs a coherent movement strategy, tied in the evolved pattern of land use, giving a high level of accessibility with priority for energy efficient modes and the taming of inefficient modes.

Sustainability requires a more proactive approach which would lead to less environmental damage by design rather than in reaction to that damage.

This chapter of the research is divided into three sections. The first section is submitted to discover the principles of sustainability for designing a movement network in neighborhoods, that would promote our environments, socially, ecologically and economically as well as providing Illustrated examples for these principles to manifest the impact of those principles on the urban landscapes in neighborhoods. The second part evaluates those principles using the three sustainability aspects. The third part concludes from the first and second sections the relationship between the sustainability principles and the healthy cell characteristics mentioned before in the introduction.

Movement network facilities and activities have significant sustainability impacts, listed in Table 5.2. As a result, strategies that increase transportation system efficiency and reduce negative impacts from transportation are among the most effective ways to make progress toward sustainability objectives.

Economic	**Social**	**Environmental**
Traffic congestion	Inequity of impacts	Air pollution
Mobility barriers	Mobility disadvantaged	Climate change
Crash damages	Human health impacts	Habitat loss
Transportation facility costs	Community cohesion	Water pollution
Consumer transportation costs	Community livability	Hydrologic impacts
Depletion of non-renewable resources	Aesthetics	Noise pollution

Table 5.2- lists impacts that movement network activities tend to have on sustainability objectives.
Source: TDM 2002

Because movement network activities have so many impacts related to sustainability, it is important to identify strategies that help achieve multiple objectives, and avoid those that solve one transportation problem but exacerbate others. For example, a policy or program that reduces traffic congestion but

increases air pollution emissions or crashes cannot be considered a sustainable solution. Similarly, a strategy that reduces energy consumption and air pollution emission, but increases traffic congestion, crashes and consumer costs is not necessarily a sustainable strategy. The most sustainable strategies are those that simultaneously help reduce traffic congestion, pollution, crashes and consumer costs, increase mobility options for non-drivers, and encourages more efficient land use patterns, or at least avoid contradicting these objectives

The sustainable movement networks have some common characteristics that promote the community's ecological, social, and economical prosperity.
The Transportation Demand Management encyclopedia (TDM), (2002) highlighted some of those characteristics, and so has many foreign, European, American, and Canadian transportation association (appendix O).
Though there are common characteristics for the sustainable movement network, yet there still exist more than one method to measure transportation. These methods affect greatly transportation planning decisions, and so will affect the principles for a more sustainable movement network.
Form here, the research would present in the introduction those different methods for measuring transport, and the preferable one which would lead to a more sustainable movement network.

Measuring transport:

There are different ways by which transportation could be defined, compares how these different perspectives and approaches affect transportation planning decisions, and introduces a mean of measuring transportation, upon which the first section depends for identifying the principles for more objective and comprehensive planning for a sustainable movement network.
The TDM encycopedia, (2002), explains the three means of measuring transport , listed as follows:
Traffic-based measurements (such as vehicle trips, traffic speed and roadway level of service) evaluate transportation system quality in terms of motor vehicle movement.

Mobility-based measurements (such as person-miles, door-to-door traffic times and ton-miles) evaluate transportation system quality in terms of personal and freight movement.

Accessibility-based measurements (such as person-trips and generalized travel costs) evaluate transport system quality based on the ability of people and businesses to reach desired goods, services and activities.

The TDM encyclopedia marked Accessibility as shown from the comparison in the table below, as the ultimate goal for sustainable transportation and the best approach to measure transport, but it tends to be most difficult to quantify.

	Traffic	**Mobility**	**Access**
Definition of Transportation	Vehicle travel.	Person and goods movement.	Ability to obtain goods, services and activities.
Unit of measure	Vehicle miles.	Person-miles and ton-miles.	Trips, generalized costs.
Common Indicators	Vehicle traffic volumes and speeds, roadway Level of Service, costs per vehicle-mile, parking convenience.	Person travel volumes and speeds, road and transit Level of Service, cost per person-mile, travel convenience.	Quality of available transportation choices. Distribution of destinations. Cost per trip.
Assumptions concerning what benefits consumers.	Maximum motor vehicle travel and speed.	Maximum personal travel and goods movement.	Maximum transport choice and cost efficiency.
Consideration of land use.	Treats land use as an input, unaffected by transportation decisions.	Recognizes that land use can affect travel choice.	Recognizes that land use has major impacts on transportation.
Favored Transportation Improvement Strategies	Increasing road and parking facility capacity, speeds and traffic safety.	Increased roadway, transit and rail system capacity, speeds and safety.	Management strategies and improvements that increase transport system efficiency and safety.

Table 5. 3- summarizes differences between these three ways to measure transportation
Source: TDM Encyclopedia (2002)

For this, the research would highlight the importance of accessibility and its role in affecting sustainability of movement networks.

Accessibility

As mentioned above, the ultimate goal for sustainable transportation is accessibility, which is the ability to reach desired goods, services and activities.

The TDM encyclopedia (2002), indicated that access is measured by the trip, and does not favor faster modes or increased travel. It assumes that a short trip can have equal value to society as a long trip, and a slow mode can have equal value as a fast mode. As a result, it places a relatively high value on local transit service, walking and cycling, mobility substitutes, and efficient land use that reduces the need for travel.

Accessibility is relatively difficult to measure, since it is affected by a variety of quantitative and qualitative factors. For example, analysis of access to new jobs must take into account the travel abilities of potential employees (their ability to drive, use transit, cycle and walk), and the quality of transportation services and conditions in the area.

In recent years improved techniques have been developed to evaluate Transit and Non-motorized travel conditions. The TDM encyclopedia indicates that transportation engineers now have standardized methods for calculating pedestrian, cycling and transit Level of Service, just as they do for automobile traffic. These can help identify and evaluate strategies to create more multi-modal transportation systems.

There are several factors affecting accessibility, such as land use factors, mobility, transportation choice, Density, Clustering and Land Use Mix, roadway network. (appendix P).

5-1 Principles for Designing Movement Networks in Neighborhoods with Sustainability aspects

Before the research provides the principles of a sustainable movement network, it would first highlight the modes of transportation expected to be found in any typical urban neighbourhood. The most common modes are:

-public transport, ⟶ Bus and light rail
-non-motorized transport, ⟶ pedestrians and cyclists
-private transport, ⟶ roads, traffic calming, and parking

For each of theses modes, there are general principles that the research would provide in details in this section.

5-1-1 Principles for Public transport

The structure of public transport provision is critical to the sustainability of the neighborhood . Achieving the most effective public transport configuration should be given more weight in both the design and planning processes. Different land uses should then be hung on the public transport network.

Public Transport is an effective solution to certain transportation problems. It is most suitable for medium-distance trips in urban areas or on any corridor with adequate demand, and as an alternative mode for travelers who for any reason cannot use a private automobile.

Principles promoting public transportation would be dealt with through two points, the first; Encouraging the use of public transportation the second; improving public transport Service

5-1-1-1 Encouraging the use of public transport

The level of the service that the public transportation presents affects to a great extent the behavior of people's transport. The better the service and the more appropriate it is to the people its addressing, the more successful it is and the

more encouraging it is for the public to use it. The TDM encyclopedia,(2000) highlighted many ways to improve and encourage the use of public transit such as:

- Additional routes, expanded coverage, increased service frequency, and longer hours of operation.
- Lower and more convenient fares (such as discounts for frequent users).
- Comfort improvements, including bus shelters and better seats.
- Transit Oriented Development and Smart Growth (see chapter six for more details on Smart Growth), which result in land use patterns more suitable for transit transportation.
- Pedestrian and Cycling Improvements that improve access around transit stops.
- Improved Security for transit users and pedestrians.
- Services targeting particular travel needs, such as express commuter buses, and various types of Shuttle Services.
- Universal Design of vehicles, stations and pedestrian facilities to accommodate people with disabilities and other special needs.
- Park & Ride facilities.
- Bike and Transit Integration (bike racks on buses, bike routes and Bicycle Parking near transit stops).

An example for the encouragement of public transport usage is" Majorca development project".

The main development site just over 1.5 km2, 500 yards to the west of the university of the Balearic islands. To the north there is a designated zone of a further 50 ha which is a protected natural habitat. The terrain is fairly flat but undulates gently. Two flood torrents run directly through the site along shallow valleys.

The aim of the urban matrix of the Majorca development site is to integrate the elements with each other so that the systems for water agriculture, movement, social matrix, and energy strategy work together (Steele, 1997).

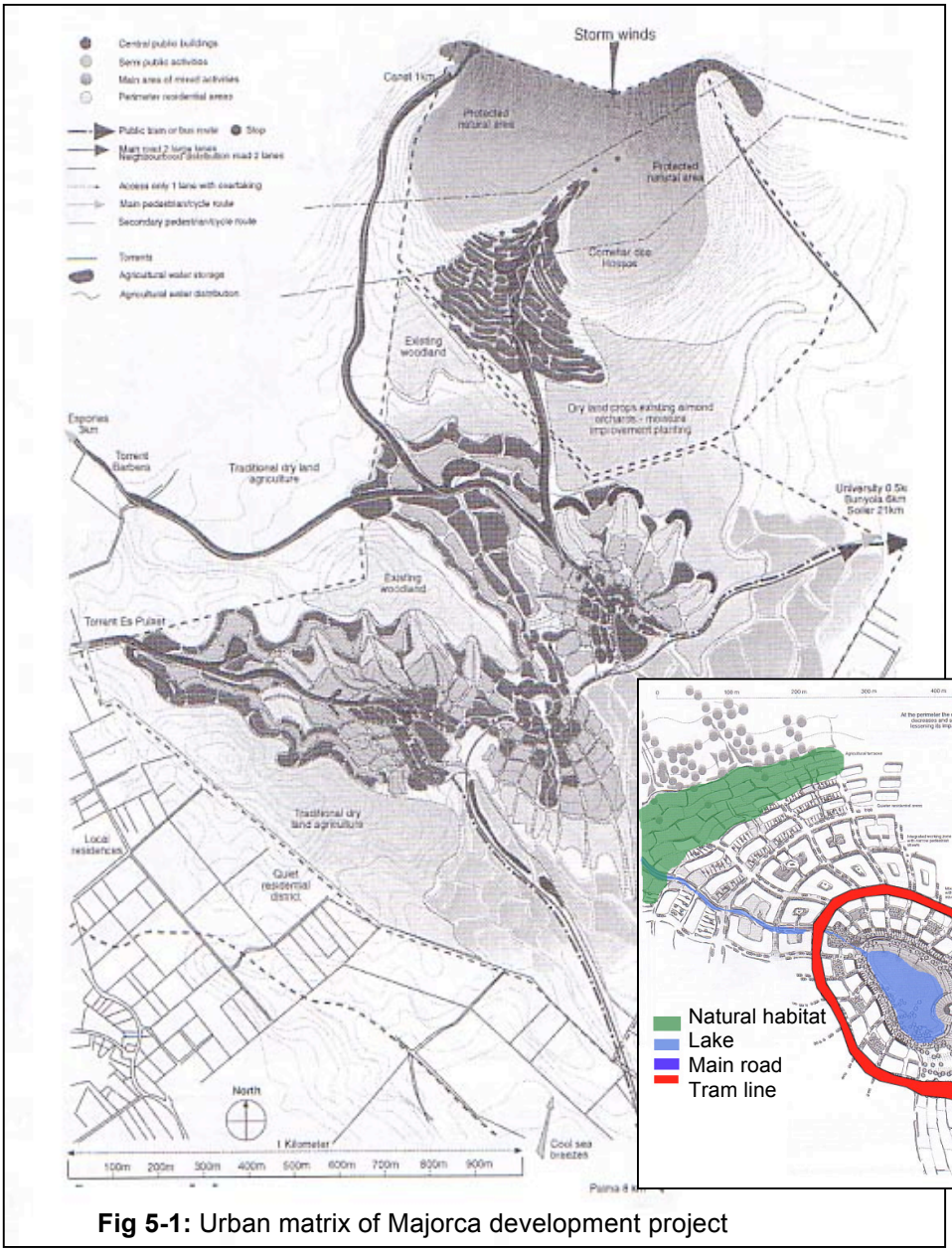


Fig 5-1: Urban matrix of Majorca development project

Source: Steele, 1997

Walking and cycling are encouraged by limiting car movement to certain streets and creating protected pedestrian routes.

All parts of the site are within walking distance of the 3 tram stations, along pedestrian routes which are shaded from the sun. this encourages the use of public transport rather than private cars.

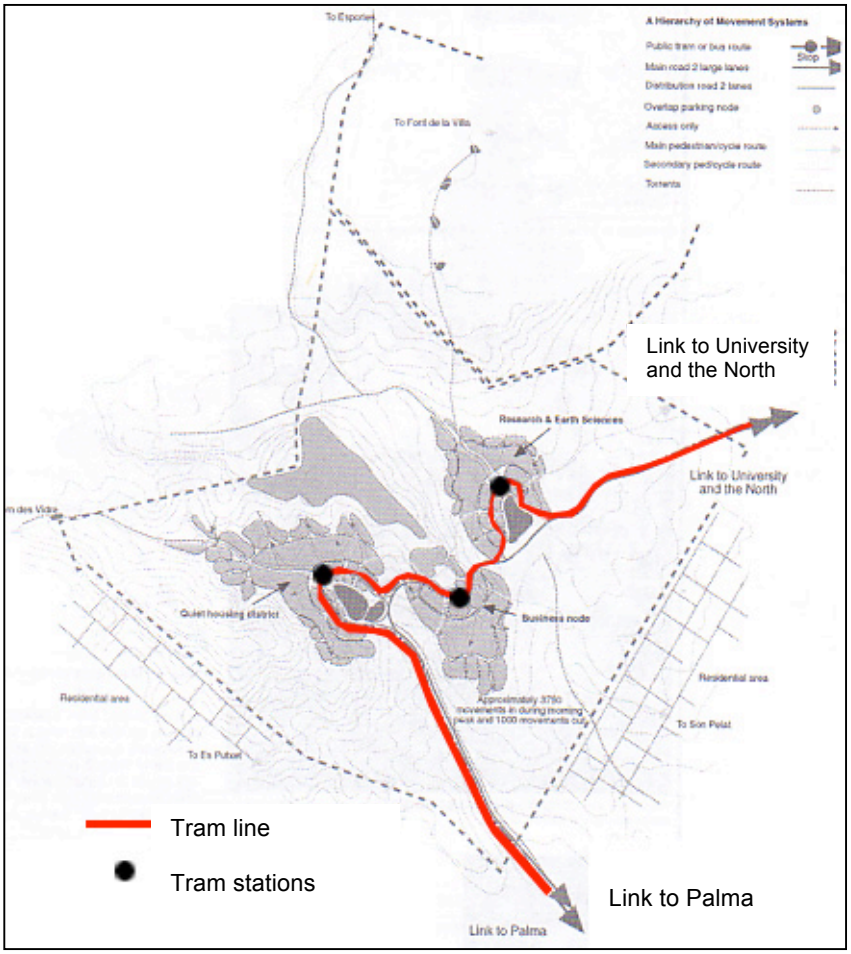


Fig 5-2: Movement network of the studied site
Source: Steele, 1997

Traditional transport system:

Integrated transport system:

= 65% reduction in energy and pollution

The proposal is for a hierarchical transportation system which reduces vehicular congestion in the community by focusing on the public system and encouraging pedestrian movement.

A road tram system is proposed that will serve 7000 people on the site. In the easy stages buses can be used in place of trams, which will avoid an initial capital outlay for the tram lines. Only after investment has reached sufficient levels, will roads be upgraded to take trams.

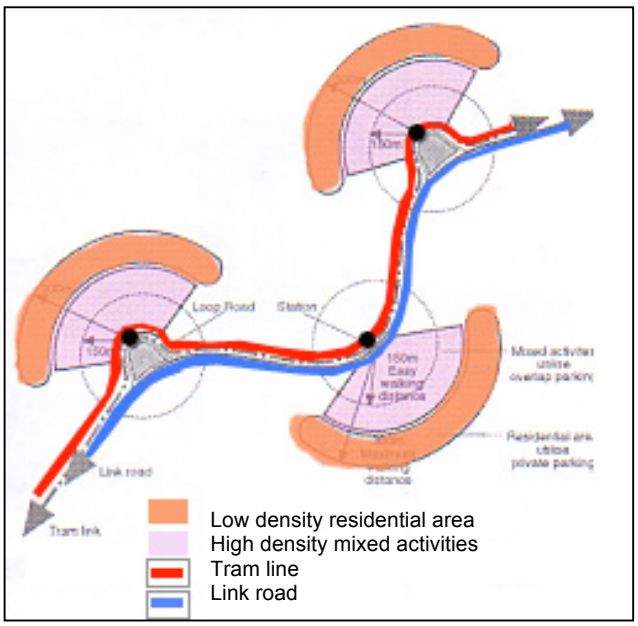


Fig 5-3: illustrating transport links and comfortable walking distances
Source: Steele, 1997

5-1-1-2 Improving public transport Service

Improved schedule information, easy-to-remember departure times (for example, every hour or half-hour), and more convenient transfers helps to increase transit use, particularly in areas where service is less frequent.

Barton *et al.*, (2003), were of the researchers marking the importance of the efficient linkage between the bus and tram lines, for they form a big part of the integrated movement network in any neighbourhood. He stated how efficient bus/tram integration should operate, Fig. 5-4

Directness: direct routes between points of primary attractions

Speed: given advantage of speed over other traffic

Density: higher density housing closer to stops

Clustering: cluster activities along high street

Environment: stops are safe, enjoyable and secure

Shelter/information: attractive shelters with passenger information.

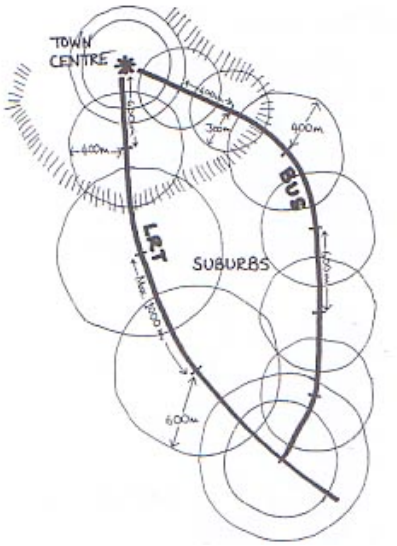


Fig. 5-4: stops and catchments
Source: Barton *et al*, 2003

Also the integration between the pedestrian routes and public transportation plays an essential role in improving the whole network , and so encouraging people to use pubic transportation.

Ideally pedestrian routes to public transport stops should be direct. Barton *et al*, (2003), stated that the maximum deflection is 15-20% from any location. But in practice they are often very indirect, in both lattice and contemporary culs-de-sac layouts. Also the effect of gradients must be taken into account when considering walking time, especially when older people are involved. Barriers also have a negative effect on people accessing public transportation. Main roads, subways,

and over bridges have this effect on walking distance, particularly the psychological barrier that is created by traffic intimidation and delay and may be the fear of assault.

The TDM encyclopedia (2002) describes a comprehensive planning process to make transit more responsive to community needs. These include:

- Transit planning should be integrated with land use planning (fig5-5), pedestrian and cycling improvements (for access to transit stops) that provide incentives to use public transit.

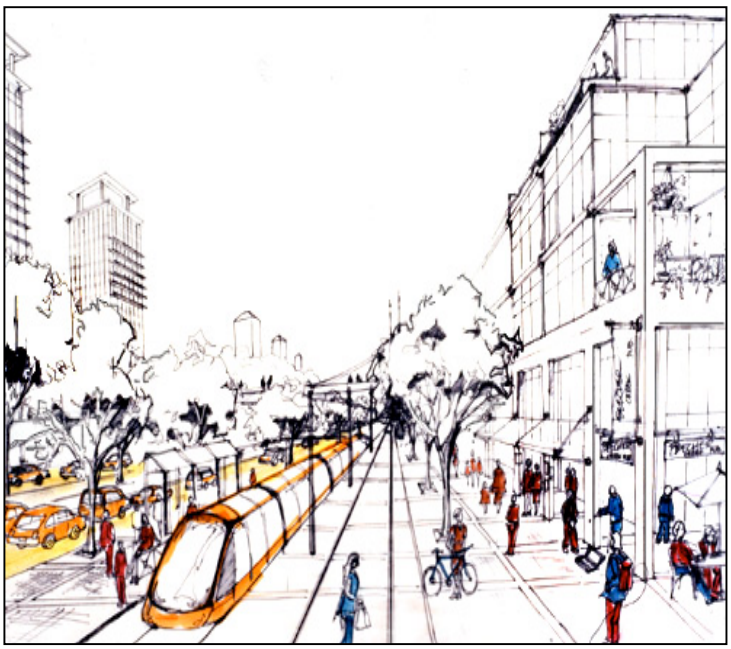


Fig (5-5)
The close integration of bus and light rail into the urban fabric welcomes pedestrians and cyclists, brings life to the street, and offers alternatives to car use. Landscaped boulevards, street trees, textured paving patterns on wide sidewalks, and a pedestrian bridge are all measures to mitigate the negative impact of auto traffic on the pedestrian realm. A maximum four-storey street-wall on either side maintains a human scale. Residences stacked above shops and offices provide housing and ensure continuous "eyes on the street."
Source: Condon *et al,* 1999

o Transport planning should reflect the multiple objectives that can be addressed by public transit, including mobility (improved travel choices for transportation disadvantaged people) and efficiency (reduced traffic congestion, road and parking facility cost savings, consumer savings, crash reductions, environmental protection fig. 5-6, and more efficient land use).

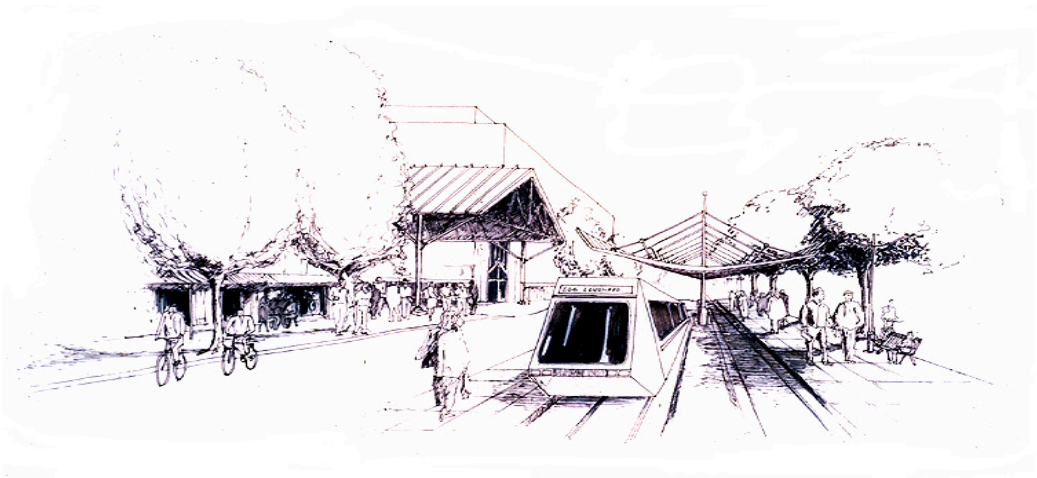


Fig (5-6): Light rail transit, potentially fuelled by a hydrogen fuel cell, is seamlessly integrated into the fabric of the street and provides a focus for higher-density mixed-use development
Source: Condon *et al,* 1999

o Transit agencies should identify and respond to the various market segments that they can serve, including basic mobility for people who are transportation disadvantaged, and fast, convenient travel for urban commuters.

o where possible local or district centers should be used as public magnets. Local people, may then choose to use buses for a longer journey having first made use of, local shops. They also act as magnets for the bus operators who may wish to serve them from several different directions. See fig.5-7, which illustrates :

- linear catchment zones
- magnets and nodes
- limited lateral movements
- fast and stopping services

where A and B locations are centers for mixed commercial and institutional use

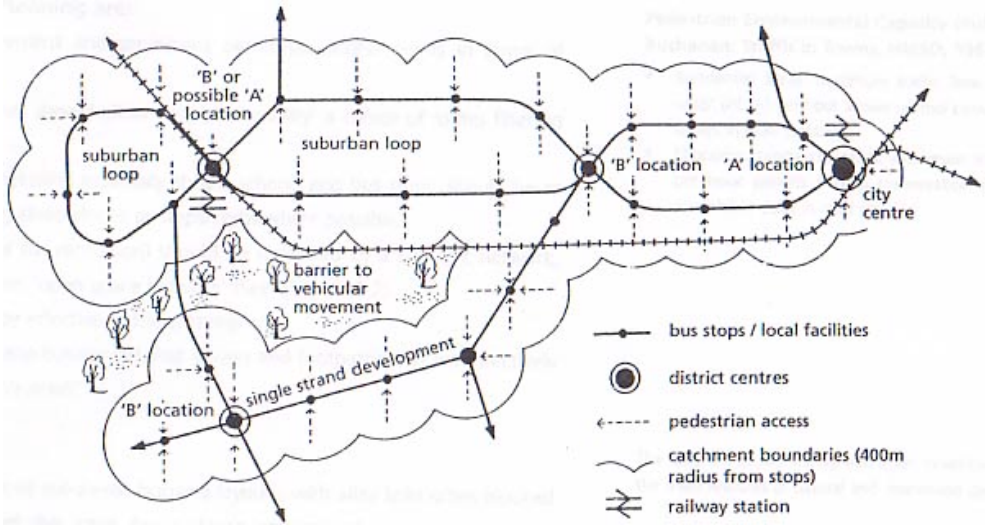


fig.(5-7): network of light rail and bus stops in relation to pedestrian network

A location : town center

B location :suburban "B" location (district center plus town center fringe)

Source: Barton *et al*., 2003

A good example for communities transit is Calthorpe's proposal .

In facing the problems of the urban sprawl, escalating traffic congestion, non-attainment of air quality standards, and growing demands for housing opportunities which meets the needs of an increasing diverse population,

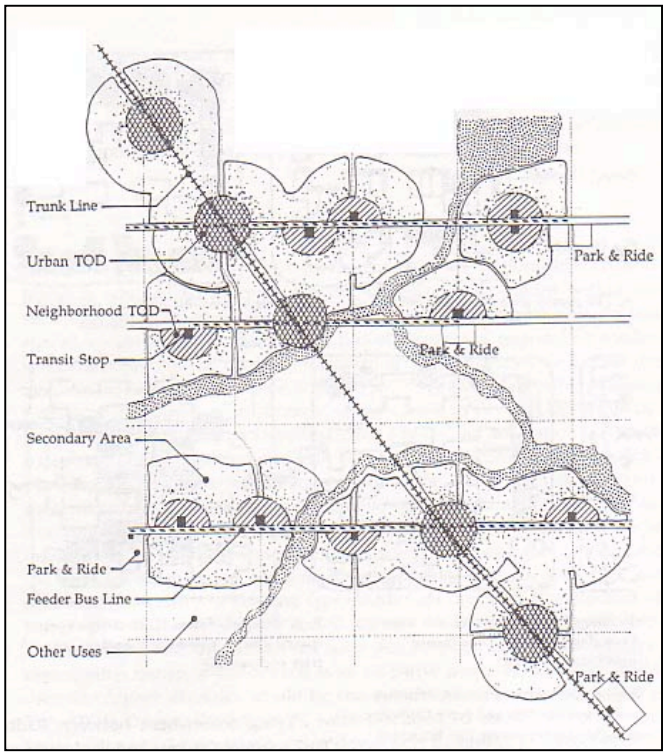


Fig. 5-8: networks of Transit oriented Developments for Sacramento country. Calthorpe associates, San Francisco, California

Source: Girling et al, 1994

Calthorpe proposed transit related satellite communities, (see chapter

six for more details on Calthorpe's proposal) by tying higher density development to rapid transit, necklaces of dense development could support rapid transit lines which needed higher populations for adequate ridership (Fig. 5-8). The plan was supported by several park and ride lots to help eliminate the dependency on cars. By limiting the location and impact of these high density areas to the less desirable lands along transportation corridors, the surrounding lands could be reserved for other valuable uses.

5-1-2 Non-motorized transport

This section would talk about the pedestrian network and the cyclist network as two means of non-motorized means of transport.

5-1-2-1 Principles for pedestrian network

Walking is the most common form of movement, open to almost everybody. Many motorized trips involve a walk at one end. And walking like cycling , involves little expenditure of energy and can be a healthy and pleasurable aesthetic and physical experience. Yet the pedestrian environment in many urban areas is increasingly hostile and this is being worsened by car oriented nature of much modern development.

Walking constitutes the majority of trips for non-car owners, therefore has an impact on overall energy use.

Pedestrian Transportation includes walking, Small-Wheeled Transport (skates, push scooters and hand carts) and Wheelchair travel. These modes provide both recreation (they are an end in themselves) and transportation (they provide access to goods and activities), although users may consider a particular trip to serve both. (users choose a nonmotorized mode, although it takes longer, because they enjoy the activity).

The research could find nothing better to describe what a walkable neighbourhood could look like , other than words of Burden, Dan (2002), in defining walkable communities;

> "A "*walkable community" is designed for people, to human scale, emphasizing people over cars, promoting safe, secure, balanced, mixed, vibrant, successful, healthful, enjoyable and comfortable walking, bicycling and human association. It is a community that returns rights to people, looks out especially for children, seniors and people with disabilities and takes aggressive action to reduce the negative impacts of sixty-plus years of auto-centric design and uncivil driving practices.*
> *A walkable community, like a livable community, smart growth community, or sustainable community, makes a neighborhood, hamlet, village, town, city or metropolis into a place where many people walk, ride bicycles and use transit, and where anyone who drives a car moderates their behavior in a way where they take nothing from the rights of those who wish to stay healthy and active by taking part in activities outside the car".*
>
> *Burden, Dan (2002)*

5-1-2-1-1 Improving Pedestrian network

Pedestrian improvements increase walkability, which reflects the overall support for pedestrian travel in an area . Walkability takes into account the quality of pedestrian facilities, roadway conditions, land use patterns, community support, security and comfort for walking. Walkability can be evaluated at various scales. At a site scale, walkability is affected by the quality of pathways, building access-ways and related facilities. At a street or neighborhood level, it is affected by the existence of sidewalks and crosswalks, and roadway conditions (road widths, traffic volumes and speeds). At the community level it is also affected by land use Accessibility, such as the relative location of common destinations and the quality of connections between them.

There are many ways to improve pedestrian network (ADONIS, 1999; Litman, 2000). Major categories include:

- Improved sidewalks, crosswalks and paths.
- Universal Design (transportation systems that accommodate special needs, including people using wheelchairs, walkers, strollers and hand carts).

- Develop pedestrian oriented land use and building design.
- Street furniture (e.g., benches) and design features (e.g., human-scale street lights).
- Traffic Calming, speed reductions and Vehicle Restrictions.
- Road Space Reallocation to increase the portion of public rights-of-way devoted to sidewalks.
- Address Pedestrian Security Concerns.
- Amenity: Barton *et al,*(1995) studied how amenity for pedestrians should be improved and they stressed on several points to be taken into consideration when designing pedestrian paths, like :
    - Traditional or historic footpath especially those with local names.
    - Landmark features which enhance local identity
    - Existing and proposed planting areas
    - Views
    - Microclimatic conditions such as orientation to north and shelter from sun
    - Sheltered form noise and air pollution.
- Accessibility and safety:

Barton *et al*, (1995) summarized into points the principles that helps promote both safety and accessibility to the pedestrian paths,

- Integrate non-motorized planning into all transport and land use planning activities.
- Educate all transportation professionals in nonmotorized transportation planning principles.
- Fund nonmotorized planning at a comparable rate as other travel modes.
- Insure that all roadways are suitable for walking unless it is specifically prohibited and suitable alternatives are available.
- Include nonmotorized travel in transportation surveys and models.
- Create pedestrian-oriented centers and neighborhoods.
- Perform user surveys to identify problems and barriers to pedestrian travel.

- Use Traffic Calming and other traffic control measures to make street environments safer and more pleasant for walking.
- Neighborhoods should have convenient and prominent access points in terms of signage, lighting, and gradients.
- The local pattern of footpath/pavements should allow easy permeability
- Routes from housing and local facilities, including shops, schools and bus stops, should be as direct and pleasant as possible.
- Longer distance walks (to the center, or for recreation) should be facilitated by a strategic network, havening green open spaces whenever possible.
- Safety from traffic should be improved by effective traffic calming.
- A feeling of security can be helped by appropriate detailed design and footpaths that effectively provide surveillance by near by residents (eye on the street).

A very good example for the mutual benefit of the pedestrian path is in a small neighbourhood in Spain. Blanes is designed with pedestrian paths, very enjoyable with very improved urban design which enhances the social life of its residents and at the same time makes the best use of its resources both natural and the built environment.

In fig. 5-9, the same pedestrian path serves as a Sunday market in the morning hours and the rest of the week a nice social assemblage of the residents of the neighbourhood with shops and cafeterias to serve as recreational facility.

Fig. 5-9 : pedestrian path in neighbourhood " Blanes", Spain.

Pedestrian pockets proposed by Calthorpe is a good example for the walkable community (see chapter six for more derails) in fig. 5-10 the movement network supported centralized shopping, offices and community services tied to rapid transit system.

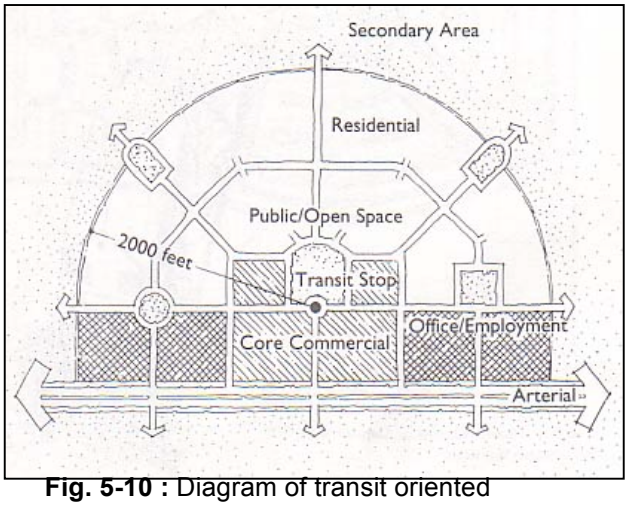


Fig. 5-10 : Diagram of transit oriented development.
Source: Girling et al, 1994

While Barcelona failed to provide an attractive pedestrian path in one of its neighbourhoods (see fig. 5-11). **Madrid formed a good example in designing pedestrian paths** which are sheltered enjoyable and well designed (see fig.5-12).

Fig. 5-11: Barcelona, Spain, (1992)
Source: Thomas, 2002

Fig.5-12: Madrid, Spain, 1998

5-1-2-2 Principles for the Cyclist Network

Cycling, like walking is an easy, healthy and enjoyable mean of transportation, where most youth and middle age people can practice, especially in school trips and shopping if its few blocks way form home**.**

For a good and sustainable cycling network, the planning process should specify the connections with the existing/ potential cycling routes in the surrounding area and require the development of a graded network of safe, continuous, convenient cycle routes, with appropriate trip-end provision.

Bicycle Parking, storage and changing facilities are important ways to provide convenience and security for cyclists at destinations. Inadequate facilities and fear of theft are major deterrents to bicycle transportation. If you see bicycles regularly locked to trees and posts, you probably need bicycle parking at that location. Effective bicycle parking requires a properly designed rack in an appropriate location for the type of use.

The following part is devoted to highlighting the principles for improving the cyclist network in the neighbourhood.

5-1-2-3 Improving cyclist network

The TDM encyclopedia (2002), summarized several points for improving the cyclist network , the research would explain some of them in the following part;

- Accessibility: direct access to homes and facilities is a particular advantage of the bike. Cyclist's behavior is relatively anarchistic, and they will take the route that provides direct access. In conventional layouts, this is normally the road. Segregated routes are desirable in some situations but are no substitute for roads that are safe to cycle.
- Continuity: main bike routes should be as continuous as possible, with few stops. cyclists prefer to conserve their momentum, to minimize effort and are therefore reluctant to stop- even at junctions, where most accidents occur. An effective network is created by optimizing continuity. Conversely, fragmented stretches of cycle path can actually increase overall dangers, so the process of implementation should allow for safe intermediate phases.

• Safety: accidents occur at or near junctions, yet most involve cycles traveling straight ahead, indicating that motor vehicle are often at fault. particular attention should by given to the design of junctions, to provide separate lanes or paths where there is a potential conflict with motor-traffic.

• Directness: cyclists will not accept a division of more than 10% of their journey distance. Segregated routes are sometimes impractical since the direct route in existing urban areas is via the main road. In new developments, priorities can be reversed, allowing cyclists and pedestrians the shortest route.

• Comfort: the design of adjacent buildings and landscaping can also contribute towards an optimum microclimate for the cycling.

• Amenity: routes should also be clean and free from heavy fumes, extreme noise, and the turbulence caused by speeding traffic.

• Bike-parks: bike parks are essential pearls in the necklace of movement, where people use them both at the end and middle of their trips.

> "*At each end of the transit trip people are required to be pedestrians or cyclists, and thus the integration of these modes into transit is essential*."
>
> Newman *et al,(*1999) p:164

Designs should link routes to conveniently located bike-parks or secure work place sheds that protect them from theft and rain. Here are some recommendations for bike-parks:

- Provide suitable bicycle parking where cyclists stop.
- Choose properly designed bicycle racks that support a bicycle's frame and are secure (see Fig. 5-13)

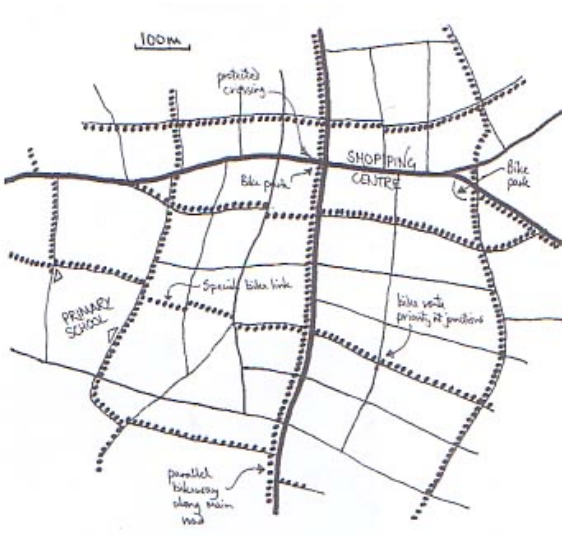


Fig. 5-13 : safe bike routes forming a complete network across the neighbourhood
Source: Barton *et al*, 2003

○ Locate bicycle parking where it is convenient to use, secure, visible, protected from weather, and has adequate clearance.

○ Provide well-protected, long-term bicycle parking for commuters, residents or anywhere else cyclists will leave a bicycle for several hours. If possible, also provide showers and clothes lockers for bicycle commuters.

○ Do not locate bicycle racks where they are in the way of pedestrian traffic.

Hanover bike park and Engleburg in Switzerland are both good **examples for choosing the right place for bike parking** at the attraction sites, fig.5-14 and beside bus stations and transits which encourages people to use the friendly means of transportation. Also using local materials to shelter the parking , fig. 5-15, makes it a local landmark for residents.

Fig. 5-14 : Hanover bike park. Bicycle infrastructure creates opportunities to find lost space in cities.
Source: Newman *et al.,*1999

Fig.5-15 : bike park, Engleburg, Switzerland,1999

5-1-3 Principles for designing Roads, traffic and parking

Principles provided in this will be divided into three parts, principles for road design and principles for traffic calming, and principles for sustainable parking policies.

5-1-3-1 Road design

This part describes how roadway design and management practices can be changed to encourage more efficient transportation.

Road space is a valuable public resource. Roadway design can have a significant effect on a community's character and its transportation patterns. Traditional transport planning practices tend to devote most road space to general traffic lanes and automobile parking. Since automobiles are relatively space intensive and impose crash risk, noise and air pollution impacts on nonmotorized travel, motor vehicle traffic tends to "squeeze out" other modes of transport. Therefore there is an urge for Road Space Reallocation

The TDM encyclopedia, (2002), stated that Road Space Reallocation involves shifting more road space to specific transportation activities, and managing roadways to encourage more efficient and equitable transportation. It is a method of encouraging transportation to favor higher value trips and lower cost modes.

Road Space Reallocation involes three basic points; accessibility, heirarchy, and capacity.

• Accessibility: Housing developments nowadays employ a tree structure of access, with only one main entry to the site. Fig.(5-19) shows a hierarchy of roads with culs-de-sac, which provide high vehicle flows towards the entrance.

Fig..(5-16): Culs-de-sac
Source: unknown

Dwellings located on the access road " 4A" in fig. (5-17) suffer significantly more air and noise pollution and risk of accidents, than those with in the culs-de-sac.

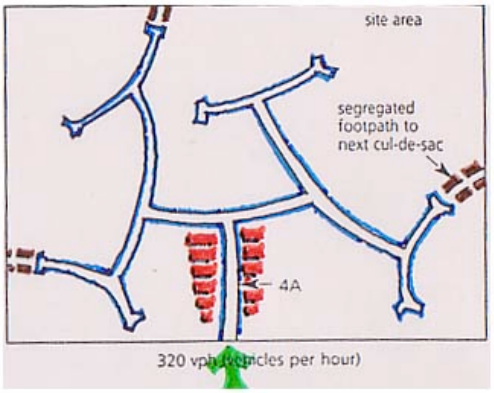


Fig.5-17 : 320 vph (vehicles per hour) culs-de-sac(adapted from DOE,1988, layout of housing roads: design guide)
Source: Barton et al.,1995

Barton *et al.,*(1995) suggests an increase in the number of access points fig. (5-18) so that the peak vehicle flows can be kept to a minimum. Traffic is distributed more evenly throughout the layout as shown on fig. weak links allow service vehicles and emergency services to travel along the short segregated cycle and pathways which break up the traffic grid.

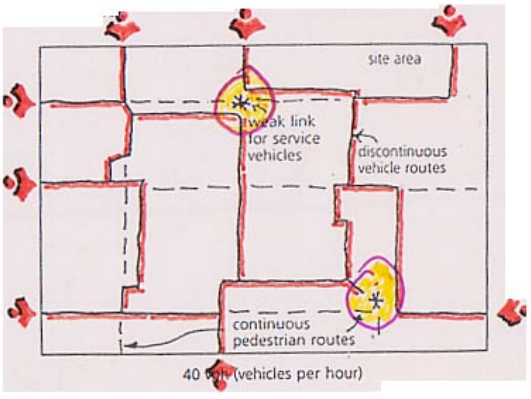


Fig. 5-18 : 40 vph (vehicles per hour) after DB32: a network or grid arrangement with many more vehicular entrances to the site area than in the above fig.
Source: Barton *et al.,*1995

• Road hierarchy needs to be easily legible and afford reasonably direct access from any place to any other place (i.e a good level of permeability) for all road users, with low route deflection which adds to the trip length and fuel use. Hugh Barton 1995. However, some route deflection are acceptable where pedestrian , cyclists and buses are given priority of the most direct route.

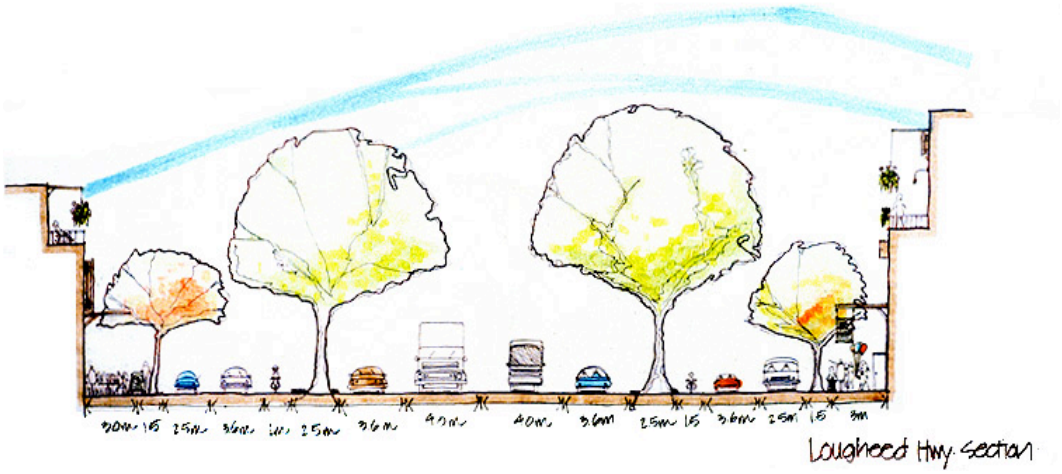
an example for the opposite urban landscape needed in our neighbourhoods is the grid traffic way in the neighbourhoods of Athens, **lacking hierarchy** which ignores socio-spatial needs and yield to the tyranny of motor-vehicle (see Fig. 5-19).

Fig.5-19: Athens, Greece,
source: Thomas,2002

another example of an unsustainable urban landscape is the endless loops in one of the states neighbourhoods Fig. 5-20, showing the excessive car use and the ill-treatment of the resources.

Fig. 5-20 : loops in Subdivisions (aerial), Miami, Florida
Source: Girling *et al*, 1994

Road capacity: Condon *et al*,.(1999) stated that road capacity should be given the priority of decreasing rather than increasing fig(5-21). The capacity should not be increased as Barton et al .,(1995) explain, except in the following cases:



fig(5-21): This section shows how the existing right-of-way is utilized so that the amount of roadway given to cars is greatly reduced. Cars, trucks, and buses are given a 14.4 meter paved roadway, which accommodates four lanes of two-way traffic. Landscaped boulevards on either side separate the high-traffic zone from the slow-speed, pedestrian friendly parking lanes.
Source: Condon *et al*,.1999

1- if the increase is essential for access to new intensified development

2- if the increase is essential in order to allow efficient public transport operation.

3- if the increase does not harm the environmental quality and safety.

4- if the level of increase compatible with existing capacity of adjacent roads.

Otherwise the road capacity for ordinary traffic should be reduces as a side effect of positive planning for other modes of transport, for example:

- By widening pavements and safeguarding pedestrian route continuity and safety.
- By inserting bus priority measures or tramlines
- By bike priority measures

This approach is particularly relevant in environmentally sensitive areas or along streets where the environmental capacity is being exceeded. Reduction may also occur as a result of improving the aesthetic quality of the public realm by increasing tree planting.

An example of decreasing road capacity and giving priority to pedestrians is in Blanes in Spain where roads furnished to welcome pedestrians and not cars (Fig. 5-22).

Fig. 5-22 : Decreasing road capacity

5-1-3-2- Traffic Calming Strategies

Traffic calming refers to various design features and strategies intended to reduce vehicle traffic speeds and volumes on a particular roadway. To explain our urgent need to traffic calming is our contemporary neighbourhoods, the research would borrow the words of Jim Mc Cluskey.

> "*The need to curb the impact of cars in certain zones like town centers and housing developments is now realized and various measures have been devised to implement this process which has come to be known as traffic calming."*
>
> Mc Cluskey,1997,p:287.

There are several strategies used to implement traffic calming policy, and Table 5.4 describes some of these strategies. Traffic Calming projects can range from minor modifications of an individual street to comprehensive redesign of a road network.

Appropriate speed limits should be built into the design of roads and on traffic management measures, with the ambition of achieving modest but steady speeds, avoiding stop-start conditions.

A worth mentioning fact is that traffic speeds, in the center of London have now fallen to an average of 10.3 mph- the same average speed as in the nineteenth century when horses and carts were used (Newman et al., 1999).

Type	Description
Curb extensions "pinch points"	Curb extensions, planters, or centerline traffic islands that narrow traffic lanes to control traffic and reduce pedestrian crossing distances. Also called "chokers."
Speed tables, raised crosswalks	Ramped surface above roadway, 7-10 cm high, 3-6 m long.
Mini-circles	Small traffic circles at intersections.
Median island	Raised island in the road center (median) narrows lanes and provides pedestrian with a safe place to stop.
Channelization islands	A raised island that forces traffic in a particular direction, such as right-turn-only.
Speed humps	Curved 7-10 cm high, 3-4 m long hump.
Rumble Strips	Low bumps across road make noise when driven over.
Chicanes	Curb bulges or planters (usually 3) on alternating sides, forcing motorists to slow down.
Roundabouts	Medium to large circles at intersections.
Pavement treatments	Special pavement textures (cobbles, bricks, etc.) and markings to designate special areas.
Bike lanes	Marking bike lanes narrows traffic lanes.
"Road diets"	Reducing the number and width of traffic lanes.
Horizontal shifts	Lane centerline that curves or shifts.
lanes narrow to 1-lane	Curb bulge or center island narrows 2-lane road down to 1-lane, forcing traffic for each direction to take turns.
Semi-diverters, partial closures	Restrict entry/exit to/from neighborhood. Limit traffic flow at intersections.
Street closures	Closing off streets to through vehicle traffic at intersections or midblock
Stop signs	Additional stop signs, such as 4-way-stop intersections.
"Neotraditional" street design	Streets with narrower lanes, shorter blocks, T-intersections, and other design features to control traffic speed and volumes.
Perceptual Design Features	Patterns painted into road surfaces and other perceptual design features that encourage drivers to reduce their speeds.
Street Trees	Planting trees along a street to create a sense of enclosure and improve the pedestrian environment.
Shard surfaces	Streets with mixed vehicle and pedestrian traffic, where motorists are required to drive at very low speeds.
Speed reduction	Traffic speed reduction programs. Increased enforcement of speeding violations.

Table 5.4- summarizes various Traffic Calming devices and strategies.
Source : TDM Encyclopedia, (2002)

A good example for the traffic claming strategy to narrow the road lanes is in Blanes fig.

Two pedestrian paths on either side of the road and one car lane in the middle with many stop signs for safe pedestrian crossing (see Fig. 5-23).

Fig. 5-23 : traffic calming in Blanes, Spain

5-1-3-3 Parking principles

parking demand has a direct relation with the intense of private car usage in a certain neighbourhood. The more people depend on their own cars, and the more dispersed land uses in a neighbourhood, the more the demand on parking places would grow. For this reason this part would be devoted to discussing the issue of reducing the demand on parking, and the strategies helping to achieve this target.

I - Reduce Parking Demand

This includes strategies that give people an incentive to reduce automobile travel and shift to other modes or destinations.

This way is a flexible, quick and cost effective way to reduce parking problems. It can also help achieve a variety of transportation and land use objectives, including reduced congestion, facility cost savings, road safety, environmental protection and more efficient land use. The research would discuss two strategies the TDM encyclopedia, (2002), highlighted, to reduce the demand on parking; price parking and shared parking.

- **Price Parking**

This includes charging motorists directly for using parking facilities. Even a relatively small parking fee can cause significant travel impacts. Governments directly control prices for on-street parking, off-street parking at public facilities (offices, schools, parks, etc.), and municipal parking facilities. This often represents a significant portion of total parking, particularly in urban areas with

parking problems. Shoup (1995) proposes creating Parking Benefit Districts in residential areas that experience parking problems, which involves charging non-residents for parking on local streets, and returning a portion of the revenue to neighbourhood residents.

- Public policies can encourage pricing of privately owned parking. Governments can reduce the supply and increase the price of public parking.
- Businesses can unbundle parking (rent parking separately, rather than automatically including it with building rentals), so consumers can choose how much parking they wish to pay for. For example an apartment might rent for $1,000 per month, which includes two parking spaces. Unbundling could mean that the apartment alone rents for $800, plus $100 for each parking space. This typically reduces parking demand by 10-30%.
- Prices can be structured to achieve particular objectives. For example, more convenient parking spaces can be priced to favor customers and clients, with hourly rates, “First Hour Free” discounts, and two hour maximums. Other parking can be priced to favor long-term parkers (commuters and residents), with discounted monthly rates.

ii -Shared Parking

Shared Parking means that parking spaces are shared by more than one user, which allows parking facilities to be used more efficiently. It is a type of Parking Management. Shared Parking takes advantage of the fact that most parking spaces are only used part time by a particular motorist or group, and many parking facilities have a significant portion of unused spaces, with utilization patterns that follow predictable daily, weekly and annual cycles. Parking can be shared in various ways, described below .

Shared Parking Between Sites

Parking can be shared among different buildings and facilities in an area to take advantage of different peak periods (see Table 5.5).

Weekday Peaks	Evening Peaks	Weekend Peaks
Banks	Auditoriums	Religious institutions
Schools	Bars and dance halls	Parks
Distribution facilities	Meeting halls	Shops and malls
Factories	Restaurants	
Medical clinics	Theaters	
Offices		
Professional services		

Table 5.5- indicates peak parking demand for different land use types. Parking can be shared efficiently by land uses with different peaks
Source : TDM Encyclopedia (2002)

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For example, an office complex can efficiently share parking facilities with a restaurant or theaters, since offices require maximum parking during weekdays, while restaurants and theaters require maximum parking during evenings and weekends. As a result, the total amount of parking can be reduced 40-60% compared with standard off-street parking requirements for each destination (Smith, 1983).

A good example for the sustainable parking strategy is the Majorca development already discussed earlier in this chapter.

By encouraging the use of public transport in Majorca , keeping walking distances short and well protected , the demand for parking is reduced. Overlap parking within the multi activity zones ensure efficient use is made of the parking provision. Each property has to cater for their own reduced parking requirement with semi-submerged or basement car parks. There is a certain amount of over-spill parking at grade for peak use, such as for tourist in summer or convention delegates.

5-2 Evaluating Principles using Sustainability Aspects

Sustainability and consequently sustainable movement network are difficult to measure directly, so various indicators have been proposed to help evaluate them. Some are relatively narrow, focusing on just a few impacts, such as air pollution emissions, but others attempt to represent a broader range of economic, social and environmental objectives.

5-2-1 Evaluating public transport principles

A- Benefits And Costs

Most direct benefits of transit services can be divided into two major categories: **Mobility benefits** : *increased* travel by people who are economically, physically and socially disadvantaged. **Efficiency benefits** : *reduced vehicle traffic* when inefficient automobile travel shifts to more efficient transit travel.

Objective	Rating	Comments
Congestion Reduction	3	Reduces automobile use on congested corridors.
Road & Parking Savings	2	Reduces road space and parking requirements. Buses may increase road wear costs.
Consumer Savings	3	Provides affordable mobility.
Transport Choice	3	Increases transport choice for non-drivers.
Road Safety	2	Tends to be safer than driving overall.
Environmental Protection	2	Tends to reduce air pollution.
Efficient Land Use	3	Tends to discourage sprawl.
Community Livability	3	Contributes to neighborhood livability.

Rating from 3 (very beneficial) to –3 (very harmful). A 0 indicates no impact or mixed impacts.
Table 5.6: Benefit Summary of public transportation
Source: TDM Encyclopedia, 2002

5-2-2 Evaluating principles for pedestrian networks

a-Mobility Benefits

Improved non-motorized transport conditions increase travel choice and mobility, which particularly benefits non-drivers. Walking tends to be one of the most Affordable transportation modes. People who are transportation disadvantaged often rely heavily on nonmotorized transportation, for trips made entirely by walking, and to access transit

b-Livability

Streets that are attractive, safe and suitable for walking are a key factor in community livability. Pedestrian-friendly streets create opportunities for people to meet and interact, helping to create community networks (see Fig 5-24).

Fig (5-24): Section through the commercial/civic hub. To the left is the refurbished Mall surrounded by a vibrant public gathering place. the primary route for busses and cyclists, is connected by a covered pedestrian walkway to the main light rail transit station, positioned centrally along Highway.
Source: Condon *et al*,.1999

c-Recreation Benefits

Many people enjoy walking and the healthy exercise it provides. Walking is one of the most common forms of physical recreation. Some people argue that transportation funding should not be spent on recreational walking facilities, yet a significant portion of motor vehicle travel is for recreation.

d-Economic Development

In several case studies, improving walking conditions in a community significantly increased retail sales and property values (LGC-Local Government Commission,2001).

Costs

Costs are generally associated with program expenses and facility improvements.

5-2-3 Evaluating principles for cyclist routes

Benefits

a-Mobility Benefits

Improved cycling conditions increase travel choice and mobility, which particularly benefits non-drivers. Cycling is often one of the most Affordable transportation options. People who are transportation disadvantaged often rely heavily on nonmotorized transportation, for trips made entirely by cycling and to access transit.

b-Safety and Health Impacts

Cycling has a relatively high casualty rate per mile of travel, but this is offset by reduced risk to other road users, and by the fact that cyclists tend to travel less overall than motorists. International research suggests that shifts to nonmotorized transport result in overall increases in road safety.
Cycling can provide significant aerobic fitness health benefits, which more than offsets the increased crash risk (Roberts*, et al.*, 1996; Frank *et al,* 2000).

c-Recreation Benefits

Many people enjoy cycling and the healthy exercise it provides. Some people argue that transportation funding should not be spent on recreational activities, such as walking and cycling facilities, yet a significant portion of motor vehicle travel is for recreation. It makes no sense to refuse funding for a path or bike-lane, yet fund roadway capacity so motorists can drive to a health club where they pedal a stationary bike. This suggests that both transportation and recreational funding can be devoted to cycling improvements.

Costs

Costs are generally associated with program expenses and facility improvements. Some nonmotorized transportation improvements, such as traffic calming, may reduce motor vehicle traffic speeds.

Objective	Rating	Comments
Congestion Reduction	2	Reduces automobile use.
Road & Parking Savings	3	Reduces automobile use.
Consumer Savings	3	Provides affordable mobility.
Transport Choice	3	Increases travel choices.
Road Safety	3	Reduces automobile use and provides health benefits.
Environmental Impacts	3	Reduces automobile use, particularly high-polluting short trips.
Land Use Impacts	3	Supports higher-density development.
Community Livability	3	Reduces motor vehicle traffic and increases local access.

Rating from 3 (very beneficial) to –3 (very harmful). A 0 indicates no impact or mixed impacts

Table 5.7 Benefit Summary of cyclist routes

Source: TDM Encyclopedia

5-2-4 Evaluating principles for designing roads and traffic

A-Traffic calming:

Traffic Calming benefits and costs are summarized in the table below.

	Description
Benefits	
Increased Road Safety.	Reduced traffic accident frequency and severity, particularly for crashes involving pedestrians and cyclists.
Increased comfort and mobility for non-motorized travel.	Increased comfort and mobility for pedestrians and cyclists.
Reduced automobile impacts.	Increased non-motorized travel substitutes for automobile trips, reducing congestion, expenses and pollution.
Increased Community Livability	Reduced noise and air pollution, and improved aesthetics.
Increased neighborhood interaction.	More hospitable streets encourage street activities and community interaction.
Increased property values.	Reduced traffic speed and volumes increase residential property values.
Public Health	More opportunities for walking and other physical activity.
Costs	
Project expenses.	Financial costs associated with implementing and maintaining Traffic Calming facilities.
Liability claims	Increased liability claims caused by Traffic Calming.
Vehicle delay.	Reduced traffic speeds. Motorists either increase their travel time or reduce travel distance.
Traffic spillover on other streets.	Traffic Calming on one street can shift traffic to other streets.
Problems for emergency and service vehicles.	Delay to fire trucks, and problems for buses, garbage trucks and snow plows.
Increased drivers' effort and frustration.	Increased effort required for driving on traffic calmed roads and the resulting frustration.

Table 5.8 Traffic Calming Impacts Source: (Litman, 1999)

B-Roads design:

Road Space Reallocation can encourage the use of alternative modes and create a more efficient transportation system, research by Cairns (1999) indicates that it can increase road safety as well.

5-3 Analysis of the Relationship between Sustainability Principles for movement network and the Healthy Cell Characteristics

Earlier, principles for sustainable movement network in neighbourhoods have been presented through the illustration of examples for networks of motorized and non-motorized means of transportation in neighbourhoods given the evidence through evaluations, that those principles do promote and increase the sustainability of the neighbourhood, ecologically, economically and socially.

Consequently, this section is devoted to examine how those principles correlate with the healthy cell characteristics proposed in the introduction.

The following analyses would present how applying sustainability principles upon the both means of transportation in the movement network already tackled earlier in this chapter would manifest their relation to the healthy cell characteristics.

5-3-1 Regeneration

A regenerative community is a one in which the concept of waste is eliminated

The following part would match sustainable urban landscapes in the main land uses in the neighbourhood with the above mentioned characteristics.

5-3-1-1Public Transportation

the public transportation is a mean of transportation which uses the existing resources(energy, road network) for mutual benefits of all the public using it. Sustainable public transportation also regenerates the available public transportation, through improving the service and encouraging its use for the residents, which increases the value of the available network.

Decreasing the use of fuel and the dependency on private transport through the improvement and encouragement process for the public transport decreases the concept of waste of energy.

5-3-1-2 Non-Motorized Network

Adding comfort, directness, safety and good accessibility to existing networks for both pedestrian and cyclists regenerates the available networks through the sustainability principles.

Using pedestrian paths as markets and assembly points adds more value to them and uses existing resources for mutual benefit.

5-3-1-3 Road design, Traffic Calming

Regenerates community livability and compactness through a coherent sustainable movement network.

Regenerates the desolated land uses through good accessibility and affordable means of transportation.

Shared parking makes use of the same parking lot for more than one kind of user to make mutual benefit of the place and at the same time eliminate the waste the place devoted to parking.

5-3-2 Self Sufficiency

A self-sufficient neighbourhood is a one which satisfies the needs of its residents, socially, economically and ecologically. Through the following analyses, we would get closer to examine the relationship between sustainability principles in movement network and the features of the self-sufficient community as presented in the introduction

5-3-2-1 Public Transportation

Provides affordable mobility which enhances the economy of the society

Reduced vehicle traffic when inefficient automobile travel shifts to more efficient transit travel which enhances the environment ecologically.

Increased travel choices for people who are economically, physically and socially disadvantaged which enhances the environment socially.

5-3-2-2Non-Motorized Network

Decrease depletion of non-renewable resources.

Increase the use of friendly environmental means of transportation

Insure the ability of the neighbourhood to provide a good and efficient movement network that decreases auto-dependency

Enhancing recreational benefits through the availability of enjoyable walking and healthy exercise

Enhancing recreational benefits through the availability of enjoyable cycling routes and healthy exercise

Cycling is often one of the most Affordable transportation options

5-3-2-3-Road design and Traffic Calming

Efficient land use saves resources of the neighbourhood to be used in a way to help increase self-sufficiency.

Community livability increases when pedestrians paths takes over the cars and people can move safely and more freely on streets.

Parking saving helps to save resources and makes those parking available sufficient for the use of the residents.

5-3-3 Self-Correction

The self-corrective neighbourhood has two vital self-corrective mechanisms that could be used with all community-based programs. These are **Monitoring** and **Evaluation.**

The following part would present how sustainability principles need both monitoring and evaluation to keep on promoting the neighbourhood towards sustainability.

5-3-3-1Public Transportation: to keep the public transportation in the neighbourhood moving towards sustainability, a system of self-correction needs to be applied as follows:

Monitor the percentage of public transport consumption.

Evaluate strategies to create more multi-modal transportation systems Evaluate the public demand on public transportation, encouraging an increase in it through the development and prosperity of this facility.

5-3-3-2-Non-motorized Network: for the non-motorized network to keep on moving towards sustainability, , a system of self-correction needs to be applied as follows:

Monitor accidents of violence on pedestrian path due to non-surveillance, also the efficiency of the non-motorized means of transportation from accessibility, directness, comfort and amenity.

Monitor the number of residents depending on pedestrian and cyclist path for a whole journey, or half journey

Evaluate the efficiency of service provided by the non-motorized network and the ideas to upgrade its level.

5-3-3-2 Road Design and Traffic Calming: to keep on decreasing the use of private transportation, calming speeds inside the neighbourhood, decreasing the need for parking spaces, a system of self-correction needs to be applied as follows:

Monitor the percentage of private transport consumption and public parking available. monitor traffic accident frequency and severity, particularly for crashes involving pedestrians and cyclists.

Evaluate the level of energy consumption and pollution production.

Also Evaluate the need of the neighbourhood to the parking and trying to reach the levels of the sustainable principles.

6-3-4 Dynamic Adaptation to the Environment

Neighbourhoods which dynamically adapts to the environment are those which serve the changing needs of its residents, without imposing any stresses on the environment or compromising the needs of the future. The following analyses will high light how sustainability principles of sustainable movement network in neighbourhoods correlate with the dynamical adaptation to the environment.

6-3-4-1 Public transportation

Increasing (or decreasing) the intensity of public transportation through Providing the light rail transit and all the public and non-motorized modes of transportation

depending on the demand upon it and the densities of facilities along the routes and mixed land use or major focal points and intersections in the neighbourhood

6-3-4-2 Non-Motorized network

Providing newly built uses with the appropriate pedestrian and cyclist paths finding solutions to paths that serve land uses with a difficult contour lines, widening those that serve an increasing number of residents, or those with changed land uses along them. Providing new paths to serve new bus stops or new light rail.

6-3-4-3 Road design and traffic calming

Road hierarchy that is easily legible and afford reasonably direct access to newly designed or redesigned zones in the neighbourhood (i.e. a good level of permeability) for all road users, with low route deflection which adds to the trip length and fuel use.

Introduction

This chapter would be spotting out the main land uses forming the neighbourhood, sustainability principles for each land use and how each use of them could be illustrated in the sustainable urban landscape context.
The chapter concludes with the relationship between those principles and the healthy cell characteristics explained earlier in the introduction.

The definitions of the term "land use" are various and all depends on the situation and the aim of the user of this term. In the Transportation Demand Management encyclopedia,(2002), it is simply classified as the earth's surface, unique, limited and valuable resource. Land Use (also called Land Development, Spatial Development or The Built Environment) refers to how the landscape is treated, including the location and design of buildings, transportation facilities, parks and farms. This chapter is concerned with the major land use categories which are listed below.

- **Residential :** will be discussed in this chapter under the title*" Housing"*
- **Commercial :** will be discussed in this chapter under the title "*Neighbourhood Center"*
- **Institutional :** will be discussed in this chapter under the title*" Jobs and Facilities"*

According to TDM,(2002), there are two main strategies to achieve sustainability in planning land uses. These two strategies are:

- **The smart growth strategy**
- **The clustering strategy**

> ***"Smart Growth** is a general term for land use practices that create more resource efficient and Livable communities, with more accessible land use patterns that reduce the amount of mobility required to reach goods and services. Smart Growth incorporates many efficiency and amenity features that could be applied to "master planned" communities, such as incremental expansion of development to minimize infrastructure costs, and coordination between land uses to maximize access.* "
>
> TDM encyclopedia,2002

> ***"Clustering** is a Land Use Management strategy. Clustering refers to common destinations located close together, which tends to increase accessibility. Clustered land use tends to increase accessibility by reducing travel distances and by creating walkable centers that can be connected efficiently by public transit and ridesharing as well as automobile travel".*
>
> TDM encyclopedia,2002

The research would present principles of each strategy. Further more the research would extend to evaluate those principles using sustainability aspects, and demonstrate them using examples to see the picture of our expected future urban landscapes.

6-1 Principles for Planning Land Use in Neighborhoods with Sustainability aspects

This part presents the principles for both the two strategies mentioned earlier, which are, "smart growth" and "clustering". Further more, the research would present the application of sustainability principles of those two strategies in the main land use categories mentioned earlier (neighbourhood center- housing- jobs and facilities).

6-1-1 Smart Growth

Starting with the smart growth strategy which the TDM encyclopedia,(2002) marked as one of the main strategies leading the sustainability in the neighbourhood and according to Barton *et al*.,2003, the most prevailing principles of the smart growth strategy is the mixed land use principle. In the following section, the research highlights this main principle and some other general principles for this strategy.

Smart Growth includes a number of individual policies and practices. Several researchers determined the basic principles for the smart growth strategy, among them; USEPA, (2001); Trohimovich, (2001).
The research would present some of those basic principles in the following points:

- **Create more self-contained communities**. Reduce average trip distances, and encourage walking, cycling and transit travel, by locating a variety of compatible land uses within proximity of each other. For example, develop schools, shops and recreation facilities in or adjacent to residential areas.

- **Foster distinctive, attractive communities** with a strong *sense of place.* Encourage physical environments that crate a sense of civic pride and community cohesion, including attractive public spaces, high-quality architectural and natural elements that reflect unique features of the community, preservation of special cultural and environmental resources, and high standards of maintenance and repair.

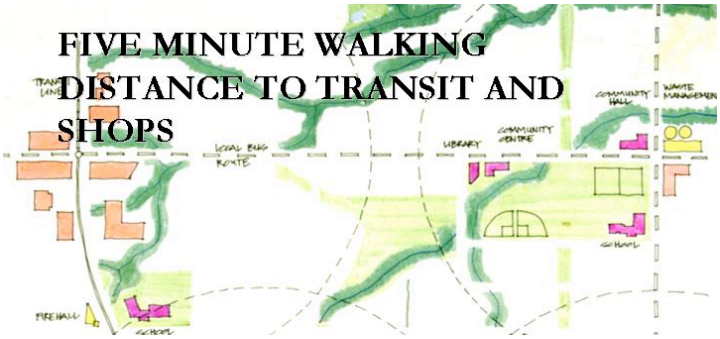
- **Encourage quality, compact development**. Allow and encourage higher density development, particularly around transit and commercial centers. Reduce minimum lot sizes, building setbacks, minimum parking requirements, and minimum street size. Allow transfer of develop capacity of outlying areas to more centralized areas. Demand high quality designs that addresses problems associated with higher density.

- **Encourage Cluster development**. Keep clusters small and well defined. Coordinate development to facilitate accessibility. For example, encourage employment centers near commercial centers, so employees can walk to perform errands during their breaks.

- **Encourage infill development**. Reduce average trip distances, and encourage walking, cycling and transit travel, by locating new development in already developed areas, so that activities are close together. Review public costs to insure that public expenditures do not favor new development over existing residents or infill development. Encourage redevelopment of older facilities.

- **Concentrate activities**. Encourage pedestrian and transit travel by creating “nodes” of high-density, mixed development that are linked by convenient transit service. Concentrate commercial activities in these areas. Retain strong downtowns and central business districts. Use access management to discourage arterial strip commercial development.

- **Encourage Transit Oriented Development**. Increase development density within walking distance of high capacity transit stations and corridors, and provide high quality pedestrian and cycling facilities in those areas (see fig. 6-1).



Research suggests that Residents will leave the car home if they can walk to the store or transit in five minutes or less.
If we are serious about reducing auto dependence we must design neighbourhoods with this in mind

Fig . 6-1 , Encourage Transit Oriented Development.
Source: Condon, 2000

- **Manage parking for efficiency**. Encourage Shared Parking, (review chapter five, p:138) and other Parking Management strategies. Reserve the most convenient parking for rideshare vehicles.

- **Avoid overly-restrictive zoning**. Reduce excessive and inflexible parking and road capacity requirements. Limit undesirable impacts (noise, smells and traffic) rather than broad categories of activities. For example, allow shops and services to locate in neighborhoods provided that they are sized and managed to avoid annoying residents.
- **Preserve green space.** Preserve open space, particularly areas with high ecological and recreational value. Channel development into areas that are already disturbed.
- **Improve non-motorized travel conditions**. Encourage walking and cycling by improving sidewalks, paths, crosswalks, protection from fast vehicular traffic, and providing street amenities (trees, awnings, benches, pedestrian-oriented lighting, etc.).

- **Create a network of interconnected streets**. Keep streets as narrow as possible, particularly in residential areas and commercial centers. Use traffic management and traffic calming to control vehicle impacts rather than dead ends and cul de sacs. Fig. 6-2

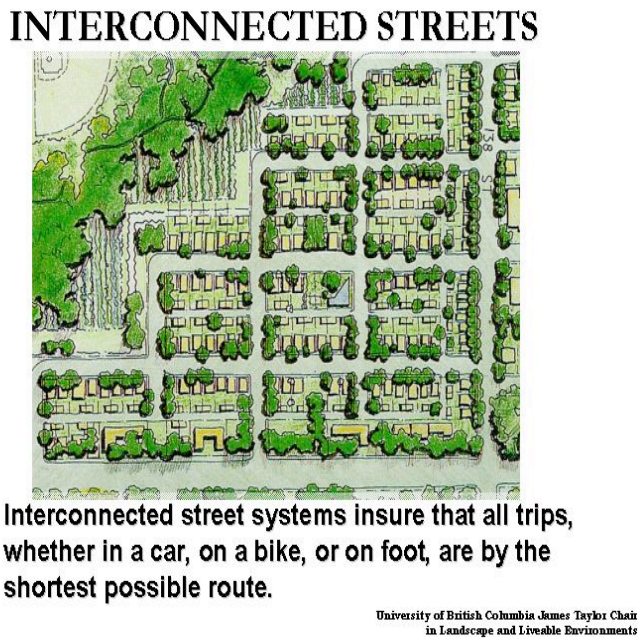


Fig. 6-2, interconnected streets
Source: Condon , (2000)

- **Site design and building orientation**. Encourage buildings to be oriented toward city streets, rather than set back behind large parking lots. Avoid large areas of parking or other unattractive land uses in commercial areas. Fig. 6-3

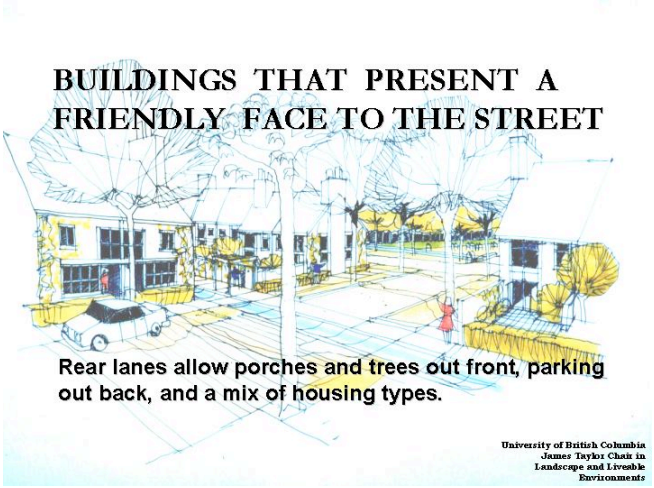


Fig. 6-3: building orientation
Source: Condon , (2000)

- **Encourage a mix of housing types and prices**. Develop affordable housing near employment, commercial and transport centers. Develop second suites, apartments over shops and other innovations that help create more affordable housing. Fig. 6-4

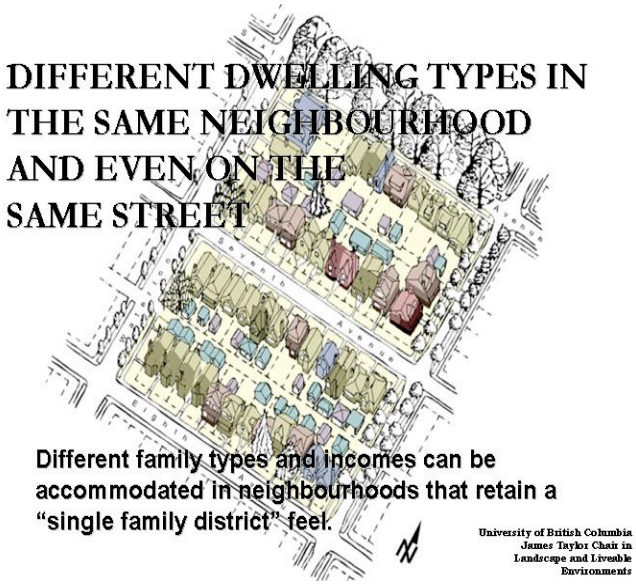


Fig. 6-4: mix of housing types
Source: Condon , (2000)

- **Utility Management**. Use on-site storm-water drainage systems. Encourage water conservation. Fig. 6-5

Fig 6-5: drainage systems
Source: Condon, 2000

6-1-1-1- Mixed Land Use

Several researchers and among them Barton et al.,(2003) marked " mixed land use" as one of the most significant principles of the smart growth strategies. However, the move towards fostering mixed-use development has become all pervading in recent urban planning policy. It is perceived as a method of reintegrating urban areas often sterilized by over half a century of zoning policies. These policies have resulted in monoculture areas generating concentrated periods of condensed traffic movement and dead periods where a zone is deprived of any activity (for example shopping centers and industrial areas, after hours, or residential estates during weekends).

According to Barton et al.,(2003), mixed land uses could be achieved through these principles:

• In every sector of a large urban area, and in every small town, there should be a rough balance of homes, jobs and services, so as to increase the opportunity of work and reach facilities locally.

• Commercial centers should combine office, retail, leisure, civic and high density residential uses in close and overlapping pattern, knit together by the pedestrian network. This will increase the viability and vitality of the centre, facilitate multi purpose trips, and increase the viability and service quality of public transport.

• The functional linkage between activities should be a key determinant of setting decisions. This will increase the potential for dual use of space, trip purpose sharing and multi-functional design. fig. 6-6

• Establishing Connections Between Uses. The important linkages may be in

Fig. 6-6: Clustering of facilities allows some shared use and pooling of resources.
Source: Barton *et al,* 2003

terms of potential for shared provision, thus saving capital resource use and quite possible increasing the quality of facilities.

• Linkages could be in terms of human behavior, where there is potential for trip purpose sharing and economies of association between activities. Fig: 6-7

Linkage could also be a matter of searching for a common solution to a whole range of problems, for example a noise buffer could function as a break, a wildlife corridor, a fuel source, a recreational source of aesthetic delight.

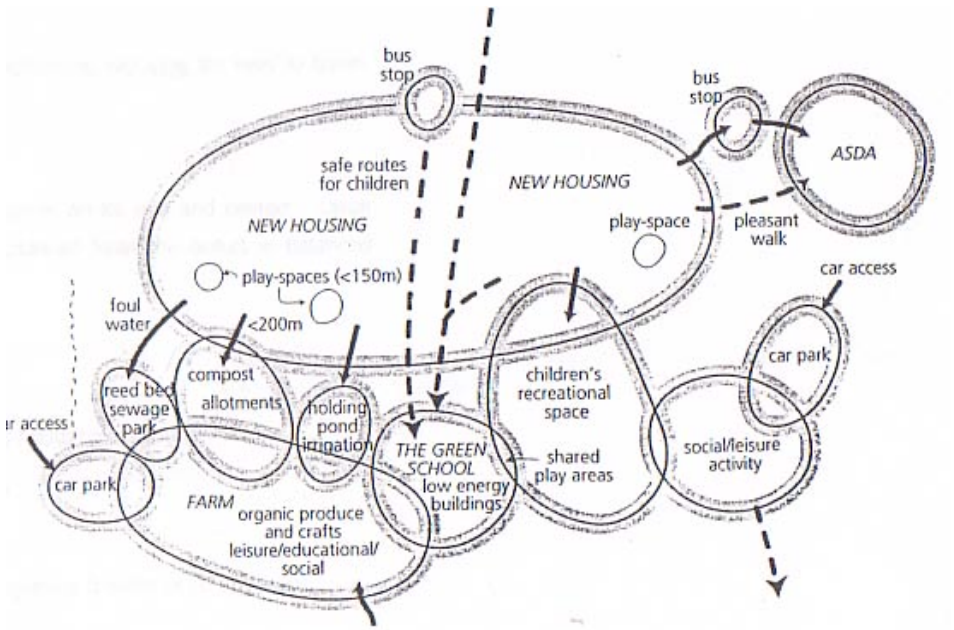


Fig.6-7: interrelated functions of housing , open space, schools, and facilities.

Source: Barton *et al.,*1995

6-1-2 Clustered Land Use Strategy

As mentioned before in the introduction, Clustering is a Land Use Management strategy. This is the second strategy presented by the TDM encyclopedia, to achieve sustainability in planning land uses.

Clustered land use tends to increase accessibility by reducing travel distances and by creating walkable centers that can be connected efficiently by public transit and ridesharing as well as automobile travel.

Clustering can occur at various scales and in many different ways. Clustering at a neighborhood level, with good pedestrian conditions creates multi-modal centers, that is, they are suitable for walking, cycling, ridesharing and transit, as well automobile transport. These are sometimes called urban villages or walkable centers.

The TDM Encyclopedia (2002), listed some of the principles for this strategy

- Public agencies should encourage clustering in their land use and transportation policies, including the location and design of their own facilities.
- Existing policies that discourage land use clustering (such as single-use zoning, excessive building setbacks and parking requirements) should be eliminated or made more flexible.
- Clusters should include an appropriate mix of activities. For example, employment centers should also include shops and services, and residential centers should include schools, shops and public services.
- Special care should be taken to create convenient and attractive walking conditions, and clusters should include bicycle, ridesharing and transit improvements as appropriate.

Clustering is most effective at improving access if it includes complementary land uses. For example, increasing housing densities in a residential-only development may do little to improve access, but will if common destinations such as schools and shops are also located in the cluster.

Therefore densities in a clustered neighbourhood should be taken with great care in order to avoid negative consequences and still to make the best of all the clustered uses to enhance the sustainability of the neighbourhood.
The research will present in the following part how densities affect sustainability and what are the best densities in the sustainable neighbourhood.

6-1-2-1- Density

As the location of uses and their densities within the neighbourhood plays a great role in its moving to or away form sustainability, this part displays two scenarios, presented by Hall *et al,* 2001, for the distribution of uses in the neighbourhood and their densities to try to show how far does densities and their distribution affect the health and sustainability of the neighbourhood.

The first scenario is of a traditional neighbourhood development pattern. The fig. 6-8 shows continuous office/commercial uses along the primary corridors. Primary intersections encourage major concentrations of commercial use. Successive bands of multi-family, medium-density, low-density residential evolve behind the primary corridor. To access commercial concentrations, all residential traffic must utilize the collector streets, as no other alternate routes exist. Increasing traffic requires constant upgrading of collector streets, which in turn attracts more traffic. Continued sprawl along the collector streets is the ultimate result to this approach.

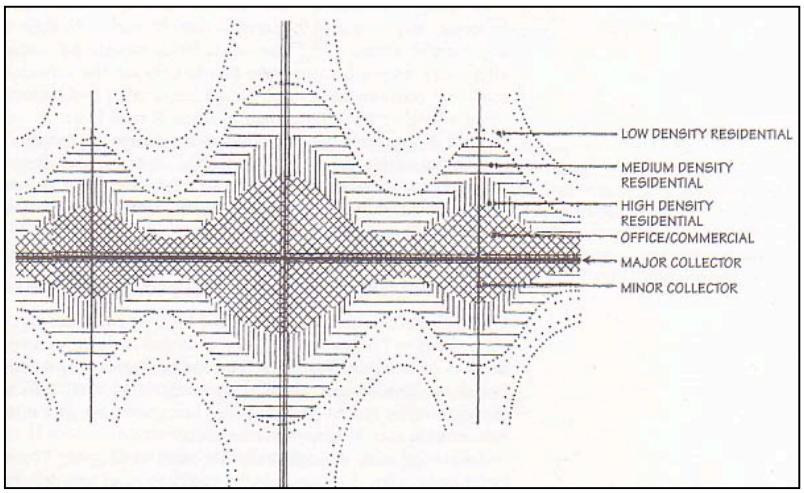


Fig.6-8, traditional suburban development patter, far form sustainability
Source: Hall *et al.,* 2001

The second scenario of a more sustainable alternative development pattern. Fig. 6-9 Shows Concentrating commercial at the primary intersection and limiting its expansion capability creates a confined commercial district. Multi-family areas hold the commercial in place and provide high-density housing within easy walking distances. Residential collector street channels local traffic to the office/commercial areas without conflicting with the through traffic on the primary collector streets. Secondary loop street around the office /commercial allows convenient local traffic movement without mixing with through traffic at the primary intersection.

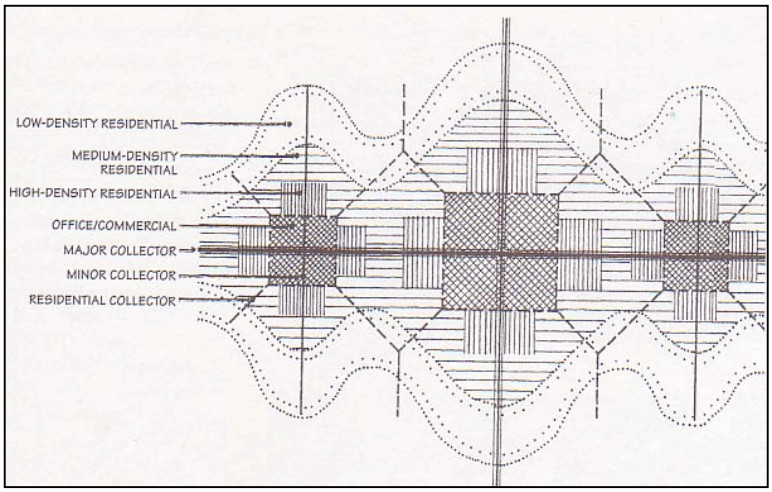


Fig. 6-9 :a more sustainable neighbourhood development pattern alternative
Source: Hall *et al.,* 2001

In the UK research by ECOTEC, 1993 for the department of the environment demonstrated that people in the UK living at the lowest densities traveled twice the distance by car per week as the people living at the highest densities. fig. 6-10

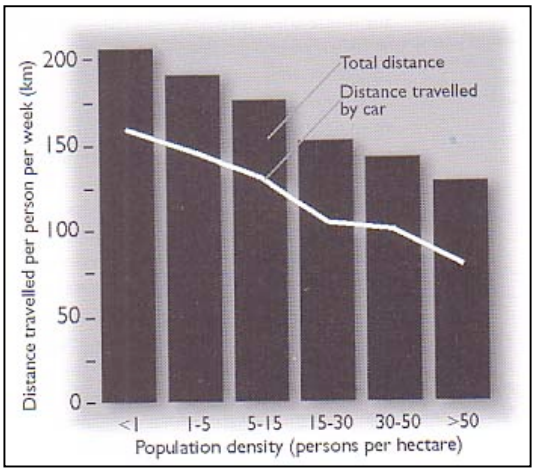


Fig. 6-10 : Density and Travel
Source: Hall *et al.,* 2001

Bernick and Cervero (1997) stressed how density is by far the biggest factor in determining the level of transit use in a city. It is important however that any attempts to increase densities and mixed land use be part of a coherent design strategy .

As to the confliction between having high densities and the problem of cramming, Barton *et al,* (2003) stated that

"*Achieving the benefits of higher density- especially good accessibility –without the problem of town cramming means a rise in the average new built net densities, while gross densities are kept low enough to encompass the parks, allotments, shelter belts and wildlife refuges that sustainable development demand.*"

Barton *et al,* (2003) pp,79-80.

They also stated that to achieve the best densities, some principles should be followed. these principles are summarized below in points:

• There should be explicit density policies in development plans covering residential, commercial, and institutional use.

• Within the higher average net residential density there should be a wide variety of dwelling and garden types at different densities reflecting different consumer demands.

• Gross densities for an urban area or neighbourhood should not rise in parallel with net densities, but should be low enough to allow the greening of the settlement. (see appendix R)

• The pattern of density variation should directly relate to the level of access to public transport services.

Having discussed the two main strategies of sustainability in planning landuses, the following part will display how these strategies could be applied on the main land use categories mentioned in the introduction (neighbourhood center, housing, jobs and facilities)

6-1-3 Neighbourhood Center

Emerging form both clustering and smart growth strategies, the compact center is a recommendation for the sustainable neighbourhood center (Barton et al.,2003) .

A compact neighbourhood center should focus a wide variety of uses and activities necessary for residents' immediate requirements. fig. 6-11. according to the researchers mentioned earlier, the design should take into consideration some principles, summarized into these points:

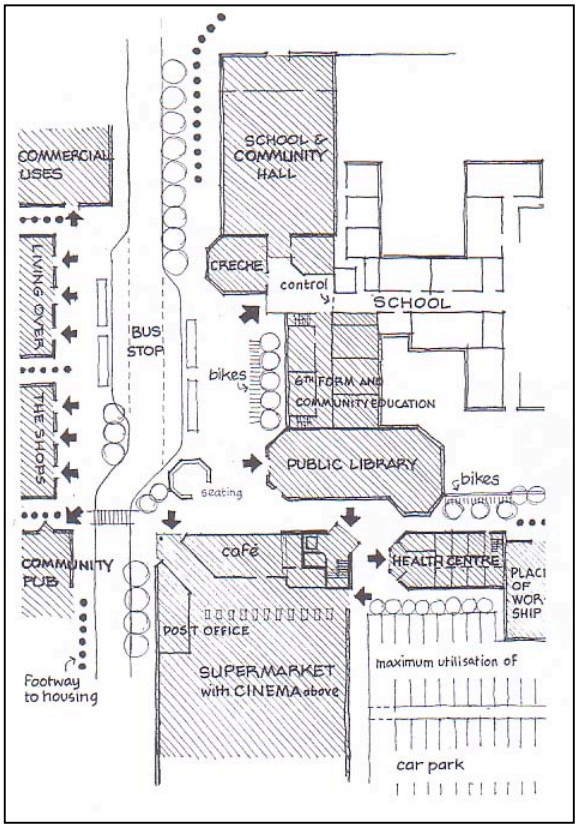


Fig. 6-11: neighbourhood center in plan

Source: Barton *et al,* 2003

-The center should be laid out to be at the convergence of foot, cycle and bus routes from residential streets.

-It is anticipated that the residents will use the center as a single destination for all their basic requirements- making it convenient for them and economic for the enterprises and services as there will be maximum footfall across frontages.

-Ensure liveliness, sociability and safety(at weekends, and weekdays, night and day) there are overlaps in the utilization of space and time as much as possible, in particular the school incorporates shared school/ community use at its interface with the neighbourhod square

-the square should be planned to accommodate bus shelters, bike parking facilities, partially covered seating, spill out areas in front of shops and restaurants for display and sitting out and space for performances and market stalls.

An example for the compact neighbourhood center with various activities is the Easton center in the united states.

Situated in Ohio near the city of Columbia, a mixed land use center that integrates shopping with entertainment , recreational, office space and other public amenities. A major bookstore is designed as a library, a fitness center looks like a high school gym, and a fire station. Easton's center is an enclosed mall designed with screen cinemas, high tech video arcade and other entertainment oriented tenants. Fig. 6-12

Smaller stores and cafes at street level fill Easton's rigid street grid. Office space is above the stores on the second level. Narrow streets and on street parking slow cars traveling through the center, keeping wide sidewalks safe for pedestrians

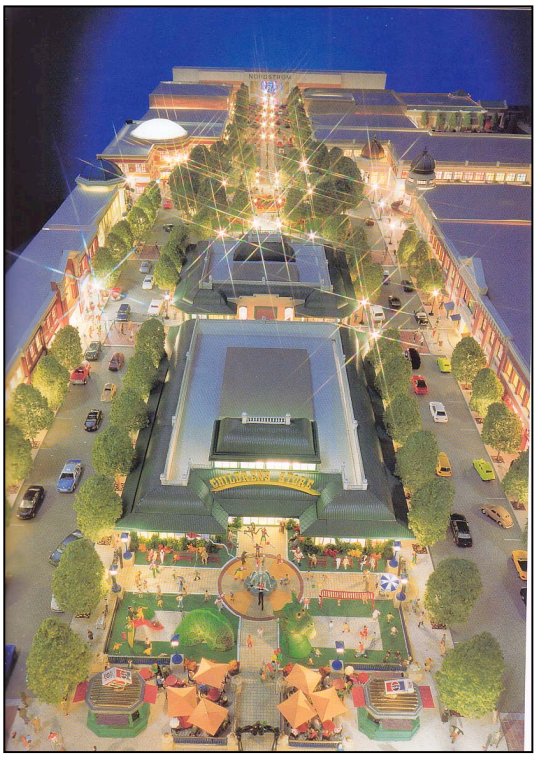


Fig. 6-12: Easton center, Ohio, Colombia
Source: Development Design Group Incorporated,2001

The neighbourhood center having the main and most concentrated activities along spines in a linear organization, is now commonly described and classified under the name of " *future high street*". Integrated design through linearity and mixed use through a coherent overall pattern could illustrate one of the sustainable urban landscapes in neighborhoods that our research seeks. The following section shows how sustainability objectives can be achieved by the concentration of facilities along "high streets" rather than centers. According to Barton *et al*,1995, high streets have the following characteristics:

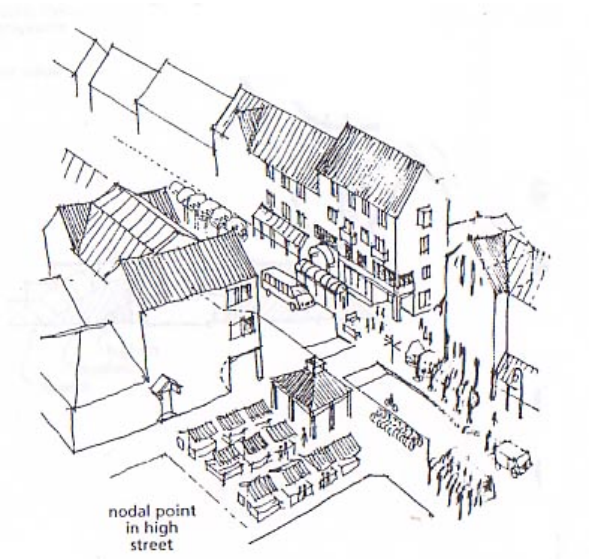


Fig. 6-13: future high street
Source: Barton et al., 1995

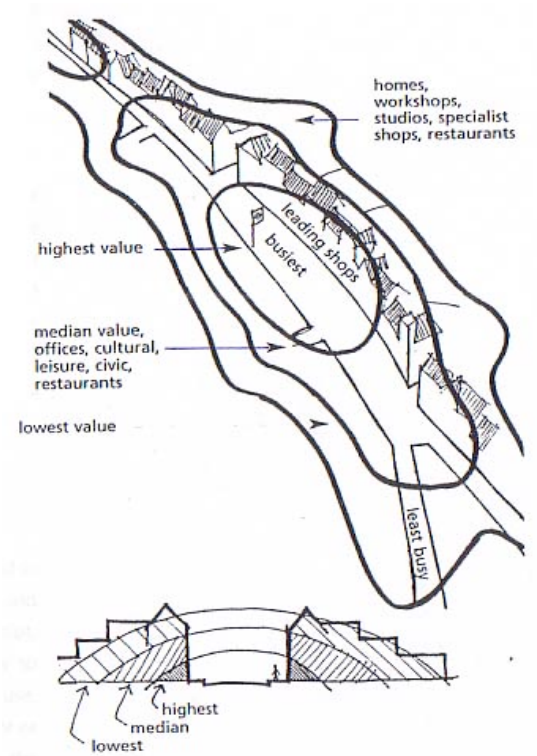


Fig. 6-14 , future high street
Source: Barton et al., 1995

○ Variation in activity, intensity, and property values: high street is not uniform in activity, levels and uses, thus, not uniform in property values. There are zones of prime locations, secondary and tertiary locations, both in horizontal, and vertical distance. Fig. 6-13

○ Variation in shape and form: Rarely geometrically straight, changing direction gradually and opening out to places of congregation.

○ Vertical as well as horizontal mixed use: Fig. 6-14
○ Adaptability: high street is an organic structure, some areas improve, others decline, and some being renewed.
○ Vitality and Viability: vitality is a measure of how busy a centre is and viability as a measure of its capacity to attract ongoing investment for maintenance, improvement and adaptation

An example for the high street is that one in Glendale, California. Glendale is a community next to Los Angeles, but not one of its suburbs. The design guidelines that featured this community meets to a great extent the sustainable future high street, fig. 6-15, where those features are summarized below:

-building addressing the street in ways that reinforce the sense of the street as a space.

-Visual coherence and the building responding to the design features of the old building adjacent to them.

-Retail, restaurant, service, and other high intensity pedestrian uses at the ground leveling building fronting major streets.

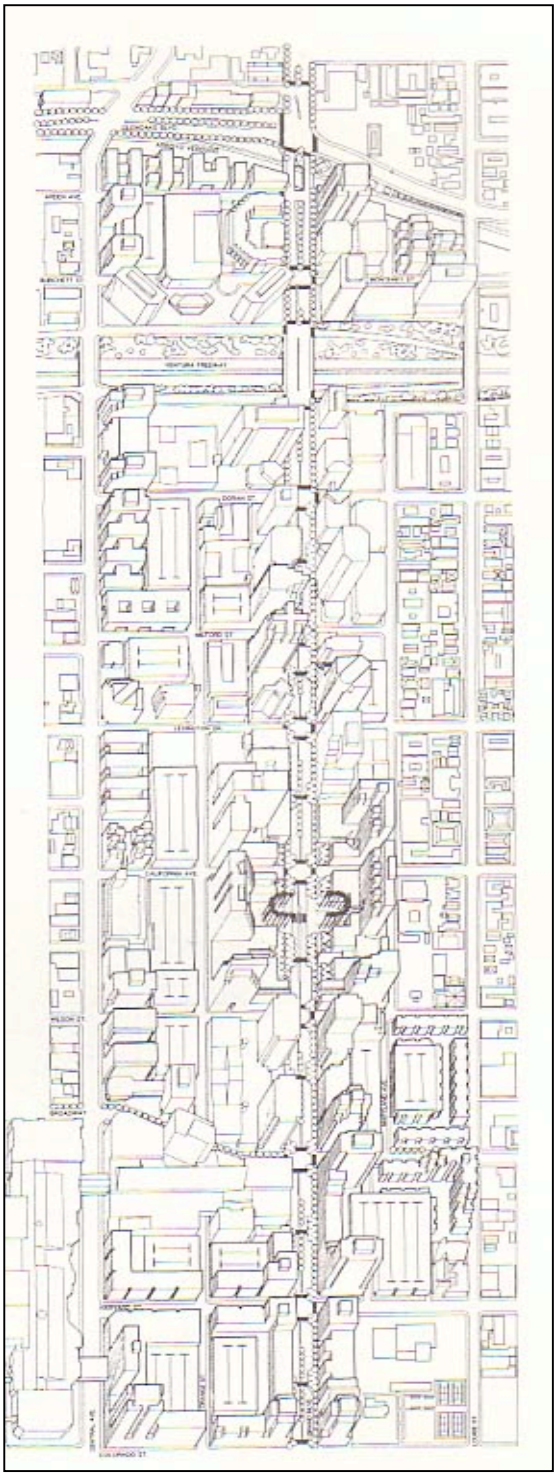


fig. 6-15 : Glendale, California

source: Attone et al.,(1989)

Easton town high street sets a good **example for the Viability and vitality of the high street** , with the busy pedestrian lane and the variety of shops and facilities added to the good furnishing if the street. fig. 6-16

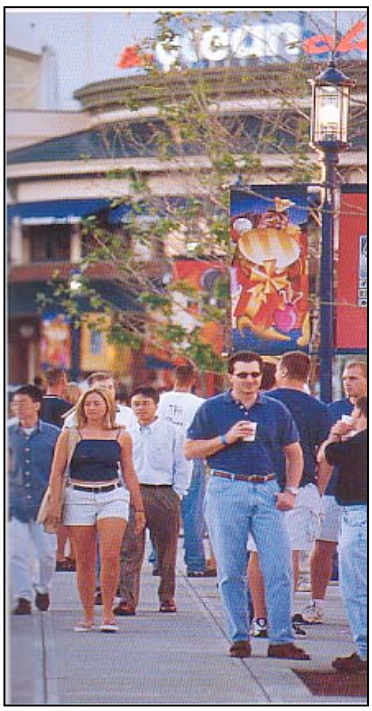


Fig. 6-16 : Livability shown in Easton town high street
Source: Development Design Group Incorporated,2001

An example for the security in the neighbourhood center is Easton high street, Ohio, USA, fig. 6-17, where the safety for the pedestrian contributes to the livability of the space

fig. 6-17 : Easton high street, Ohio, USA
source: Development Design Group Incorporated,2001

Active Fronts in the neighbourhood center is a sign for the sustainability of that center where, aside from economic considerations, the way the built environment address the public space is a commitment to ensuring the public vitality of the urban environment.

An example for active fronts is the transparency and curvature illustrated in Cowes, Isle of Wight: curved shop fronts with transparent frontage provide maximum show casing of merchandise to the street and invite entry for closer inspection. Fig. 6-18

Fig. 6-18: Active curved, transparent fronts in Cowes, Isle of Wight
Source: Thomas, 2002

also non- Blank walls are used in san Francisco, USA: where no windows are possible onto the street, other ways of providing a frontage can be devised. Fig. 6-19

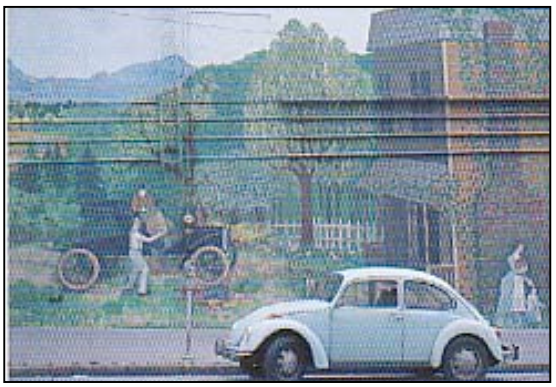


Fig. 6-19: Blank walls in San Francisco.
Source: Thomas, 2002

Another example for the concentration of activities along high streets is The future high street illustrated in fig. 6-20 in the center of Shanghai where high rise buildings concentrate on the main route, and heights decrease as we go further.

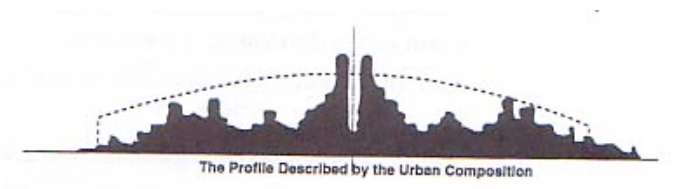


Fig.6-20: high street in shanghai
Source: Steele,1997

Achieving a mix of activities also has significant environmental advantages. A good balance between residential and commercial activities evens out demands on the infrastructure, for example power generation and transport.

6-1-4 Housing

The sustainable house is dependant upon various conditions at both the design and planning level. conditions of land use policy , density of development, integration of transport, social mix ownership and tenure mix, all emerge form the two strategies mentioned earlier in details, the Smart Growth and Clustering strategies.

One thing is certain of sustainability and that is that lifestyles will need to change. At the planning level, lifestyles will need to adapt to denser layouts, less land use segregation, more social interaction, less private transport access and very much altered housing design.

Sustainable Housing of the future as Edwards,2000, tried to picture it, will not be functionally separate and isolated as in the past, but constructed within neighborhoods or blocks containing other land uses. The close integration of different functions into overlapping zones of activity will drastically alter the face of housing.

Existing residential neighbourhoods will come under pressure to absorb other land uses within garden space or lofts, whilst new housing areas will not be monocultures as in the past. The change opens up opportunities for innovative design.

At the design level, achieving sustainable housing could be reached by using design skills to create higher density, mixed use neighbourhoods utilizing smaller urban sites than normally considered viable by volume house builders. In the process, energy, water and material use can be reduced by applying specific not standard solutions to housing problems. The urban landscape presented by sustainable development is complex and many types of solutions are possible depending upon the priorities and conditions of a particular site.

Edwards,(2000) illustrated in one of his latest publications how most architects and developers acknowledge that sustainable housing neighbourhoods will need to display the following general features:

- high density, mixed use and diversified tenure
- integration of land use and transport planning with emphasis upon public means of transportation.
- Urban layout that creates shelter and safety.
- The exploitation of renewable energy supplies (wind, sun, etc.).
- Capture of rain fall for certain water uses.
- Use of open space (streets, parks and squares) to facilitate social interaction and ecological well being.
- Pollution and waste strategies.
- Creation of natural habitats integrated with housing.

The emphasis upon dense and compact forms of living, which is the main design advice to date for sustainable housing , carries inevitably problems for social behavior and human interaction. People will need to accept less privacy, and less silence as sustainable housing takes hold. Society will need to accept a "forgiveness factor", in order for the change to high densities, mixed land use lifestyles to occur. The old separation of living working, education and leisure will end and in its place dense overlapping communities for people, lifestyles and urban activities will take place. This is shown clearly in the diagram presented by Edwards (2000), in Fig.6-21. The main mechanism to make

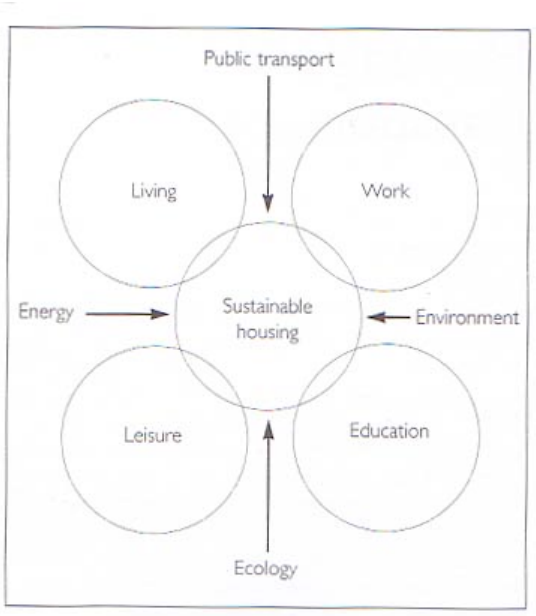


Fig.6-21 key relationship in sustainable housing
Source: Edwards ,2000

this bearable for the bulk of people is the power of design.(see appendix S for key elements of design guide for Hulme, Manchester)

This vision of the sustainable housing was earlier proposed in 1994, by Peter Calthorpe, through the pedestrian pocket, which is a compact community, with public transit to the urban center and the others. Each community would have a shopping center, back office development, cultural center, or light industry providing a significant number of jobs to local residents **(Girling et al., 1994)**. Calthorpe's vision was an orientation toward public outdoor space and the provision of a complete retail and business services in the community to enable people to spend more of their lives within one locale. His attention was focused

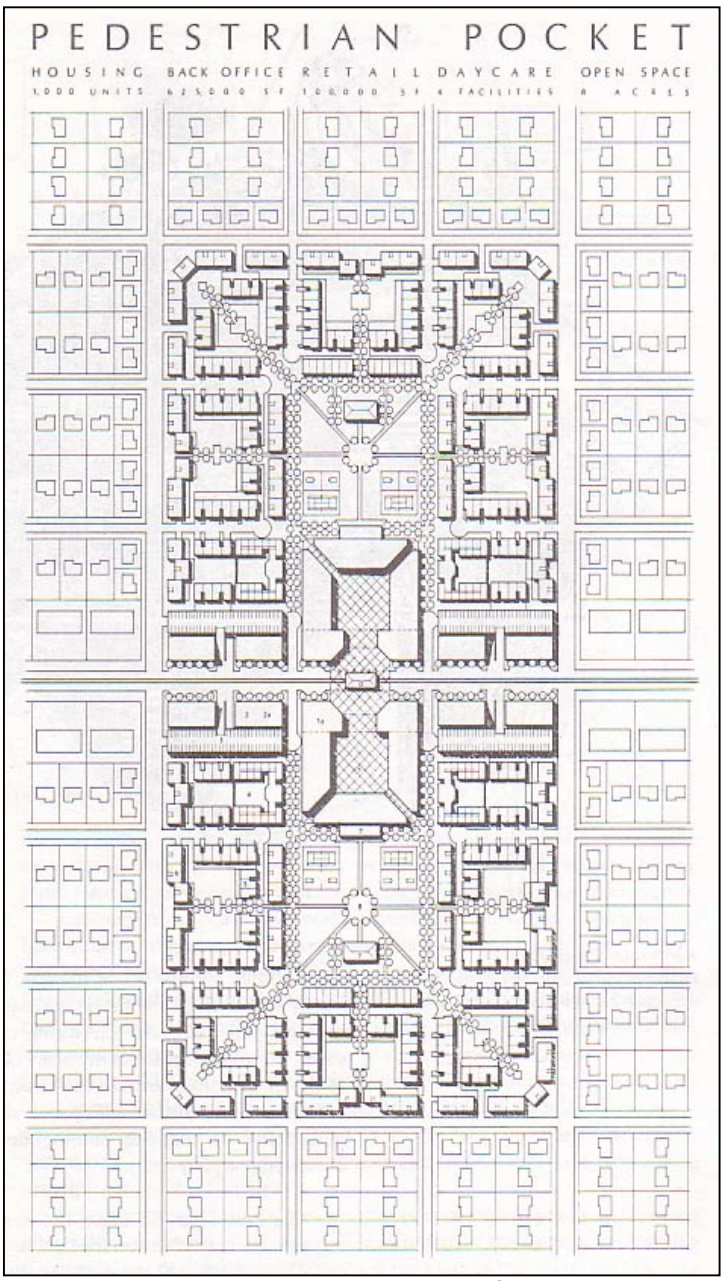


Fig. 6-22: the pedestrian pocket. Peter Calthorpe and Mark Mack, unpublished paper, 1987
Source: Girling et al., 1994

on sustainability and alternative energy perspective through reducing automobile dependency and automobile driven development patters .fig 6-22

The pedestrian pocket included a structured network of programmed open spaces with gradients of privacy ranging form intimate yard to very public gathering places the layouts strongly resembled patterns that Calthrope used in urban housing projects such as Somerset Parkside housing fig. 6-23. There on a single block in downtown Sacramento, he created four semi-public courtyards surrounded by 2 storey family housing, all enclosed within a perimeter wall of three and four storey apartment buildings. Each unit had small private yard and each faced a courtyard intended for play, gardening or relaxation **(Girling et al., 1994).**

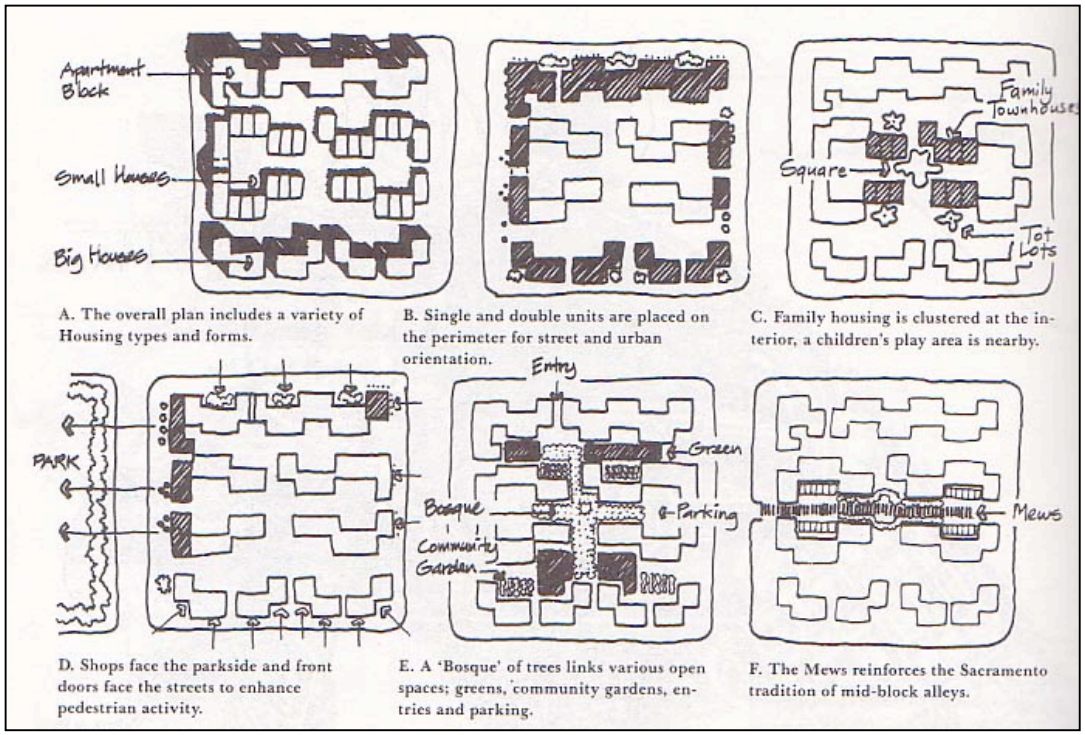


Fig. 6-23: diagrams of Somerset Parkside housing
Source: Girling et al., 1994

The Dutch government sets a good **example for presenting the sustainable housing**, as it was the first in Europe to adapt the principles of the Brundtland Report of 1987 in the proposal of Ecolonia, Netherlands. Fig 6-24

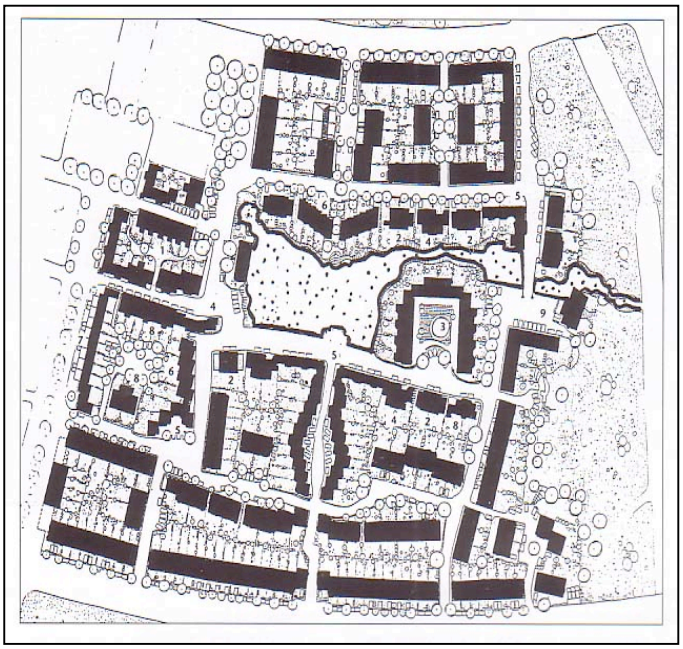


Fig. 6-24 : master plan of Ecolonia. The lake in the center and the use of mainly terraced houses. The neighbourhood tests various ecological approached to design and construction
Source: Boonstra,2000

The plan includes clusters of housing gathered around open green spaces, with safe and calm traffic in between the clusters and a variety of housing types, giving diversity and variety in the population.

An example for the security and self-surveillance is in Barcelona, Spain , where high density neighbourhoods provide surveillance by the presence of occupants themselves is almost automatically a by product**.** in medium to high density residential settings, with balconies overlooking the street, the effect of deterring the incidence of crime is potentially enhanced. Fig. 6-25

Fig. 6-25: Barcelona, Spain
source: Thomas, 2002

On the other hand in Jerusalem, Palestine, fig. 6-26 iron bars on windows in the second and third floor reflect a sense of fear and insecurity in the neighbourhood, in addition to the haunted outer space, vacant from any by-passers

.

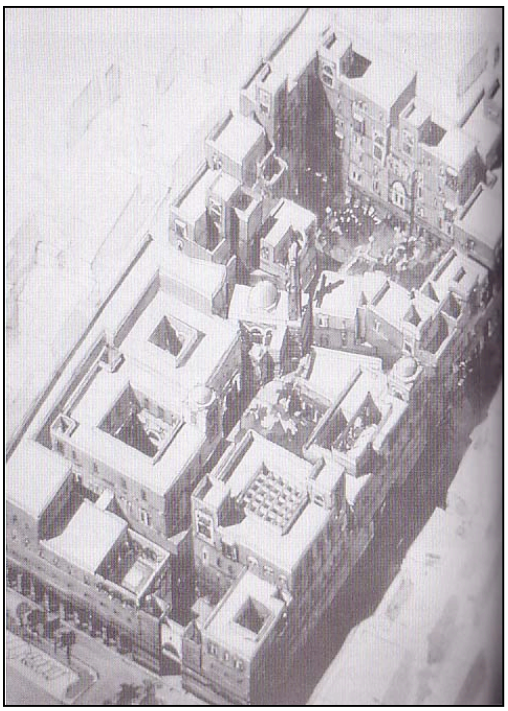
fig. 6-26 : Insecurity in Jerusalem, Palestine

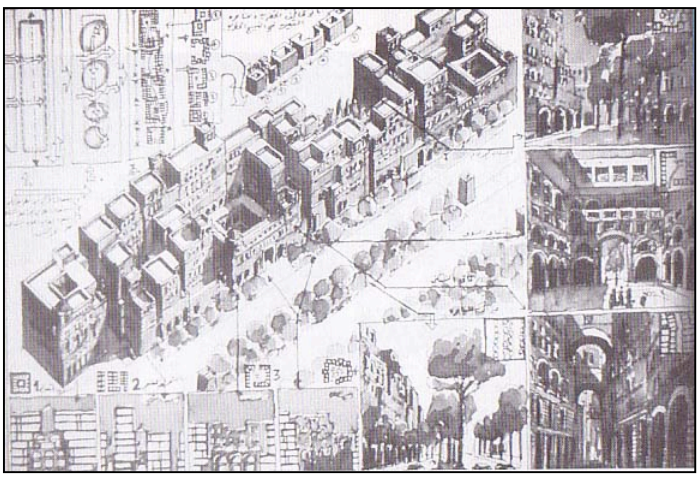
source: Thomas, 2002

An **example for the compact housing and mixed land uses** is proposal of Rasem Badran for Sna'a.

Rather than spreading out horizontally, with individual courtyards on each house, urban residential groups in Yemen are stacked vertically, and clustered around a common garden. Badran identified that residential units occupy about 30 to 40 percent of the land available, in linear organization, and he attempted the same configuration in the 100,000 square meters on housing he was asked to provide. Using the same linear, vertically stacked organization, grouped around common gardens, he located housing away from the public streets for privacy, using offices, shops and hotel accommodations as a buffer (Steele, 1997).

Fig. 6-27 : new housing proposal for Sana'a
Source: Steele, 1997





6-1-5 Jobs and Facilities

The existence of a variety of uses within a neighbourhood, is no guarantee of short trips (people make their own choices), but does permit short trips. The " Job Ratio" (see appendix T) is suggested as an indicator of mixed use when comparing development locations, and it does correlate with trip length , however the spatial patterning of jobs and facilities in relation to residential development is critical. The higher the job ratio within neighbourhood, the more self-sufficient and closer to sustainability it is.

Good range of **job** opportunities should be provided, to match the character of the local work force. Locations of those jobs are chosen so as to maximize non-car access by employees and minimize the environmental impact of freight movement. Home-working should be encouraged and promoted (Barton et al.,2003).

Facilities should be located to permit access by foot, bike and local bus. Facilities should be clustered together at locations well served by both motorized and non-motorized means of transportation with good accessibility and preferably located in leaner clusters long high streets in the neighbourhood.

Principles in locating jobs and facilities:

- Local facilities should be distinguished from sub-regional or district facilities and clustered within residential neighbourhoods at points served by pedestrian, bike and bus networks.
- All major trip generating activities serving a more than local area should be concentrated at public transport nodes, where good access by public transport can be gained from most directions.
- Major facilities serving a regional or city-wide catchments should in addition be located where good regional/national public transport access is available.
- Warehousing or extensive manufacturing industry should be located close to the main road system with existing or potential access by rail or water.

Mixed use centers, where employment uses are complements by retail, leisure, educational etc, activities, are to be fostered, while isolated single use development should be deterred (Barton *et al*,1995).

6-2 Evaluating Land Use Principles using Sustainability aspects

6-2-1 Evaluating Smart Growth strategy

Smart Growth critics tend to focus on individual factors without considering the overall effects of a coordinated Smart Growth program. For example, critics often highlight negative impacts associated with density, such as increased congestion, without considering how Smart Growth can offset such problems by improving access and travel choice.

Before setting out to evaluate the Smart Growth strategy from the three aspects of sustainability, the research would present the Benefit summary of the smart Growth strategy in the table below as stated by the TDM encyclopedia, to give a brief idea of the expected benefits of this strategy.

Objective	Rating	Comments
Congestion Reduction	2	Higher density may increase local congestion, other Smart Growth features tend to reduce congestion.
Road & Parking Savings	2	Reduces automobile trips and travel, although it may increase some costs (such as more structured parking).
Consumer Savings	2	Reduces household transportation costs, and some infrastructure costs.
Transport Choice	3	Increases alternative travel choices.
Road Safety	2	Reduces automobile traffic speeds and volumes.
Environmental Protection	3	Reduces automobile travel and land devoted to roads and parking.
Efficient Land Use	3	Reduces automobile travel and land devoted to roads and parking.
Community Livability	3	Creates more livable communities.

Rating from 3 (very beneficial) to –3 (very harmful). A 0 indicates no impact or mixed impacts.

Table 6.2 Benefit Summary of smart growth strategy
Source: TDM Encyclopedia 2002

6-2-1-1 Economic aspect:

There are studies indicate that Smart Growth can reduce costs for public services, such as water and sewage, roads and schools (Burchell, et al, 1998).

Per-household transportation expenditures vary significantly from one metropolitan region to another, due to land use and transportation factors. She found that households in sprawl regions devote more than 20% of household expenditures to surface transportation (more than $8,500 annually), while those in communities

with more efficient land use spend less than 17% (less than $5,500 annually), representing savings of hundreds of dollars a year (TDM,200).

Another objection to some Smart Growth measures, such as urban growth boundaries, is that they increase housing costs by reducing the supply of land available for residential development (Litman, 2001). Smart Growth can also reduce households' transportation costs, which can offset increased housing costs More Smart Growth reduce rather than increase household costs, as illustrated in Table 6.2. This suggests that Smart Growth can increase overall housing affordability, or at least cannot be blamed for reduced housing affordability

Reduces Housing Affordability	Increases Housing Affordability
• Urban growth boundaries (reduce developable land supply). • Increased building design requirements (curbs, sidewalks, sound barriers, etc.).	• More accessible housing reduces total transportation costs (leaves more money for housing expenses). • Reduced parking and setback requirements (reduces land requirements per housing unit). • Higher density development and (reduces land requirements, increases land supply for housing.) • More diverse, affordable housing options (secondary suites, apartments over shops, loft apartments). • Reduced property taxes and utility fees for clustered and infill housing.

Table 6.3 Smart Growth Housing Affordability Impacts
Source: (Litman, 2001)

6-2-1-2 Social aspect

Smart Growth can increase community Livability, Traffic Safety and Health by reducing total per capita vehicle travel, encouraging shifts to safer modes, and reducing traffic speeds. Some studies indicate that more pedestrian-oriented land use patterns can increase community cohesion and reduce crime, particularly if there are special programs and design features to Address Security Concerns.

6-2-1-3 Ecological aspect

Smart Growth costs can include additional planning, construction and operating costs needed to develop higher density facilities and increase travel choices. Higher-density, infill development may increase local traffic congestion and exposure to noise and air pollution, although regional traffic and pollution tends to decline if residents drive less. Increased density can reduce the amount of green space within an urbanized area, although it can increase total regional green space by reducing per capita area of land development. These negative impacts can be reduced with appropriate design features (such as noise insulation and carefully located parks), but these mitigation activities may also involve additional costs.

Smart Growth can provide a variety of economic, social and environmental benefits, as summarized in Table 6.3. The actual benefits of a particular Smart Growth program depend on the components of the program and the conditions in which it is implemented.

Economic	Social	Environmental
Reduced development and public service costs. Consumer transportation cost savings. Economies of agglomeration. More efficient transportation.	Improved transportation choice, particularly for nondrivers. Improved housing choices. Community cohesion.	Greenspace and wildlife habitat preservation. Reduced air pollution. Reduce resource consumption. Reduced water pollution. Reduced “heat island” effect.

Table 6.3 Smart Growth Benefits
Source: (Burchell, 1998)

6-2-2 Evaluating Clustered land use Strategy

although there are beliefs that increased density and clustering is harmful to individuals and society, and that consumers always prefer lower-density development patterns (Moretti, 1999), there is considerable evidence that at least some consumers value clustered development if it is well designed, affordable, increases accessibility, and incorporates other valued amenities such as personal security and good schools.

Clustering can provide a variety of benefits. Clustering improves accessibility and transportation options (walking improvements and transit services are tend to be most feasible and cost effective with clustered land use), encourages use of alternative modes, and reduces per capita automobile costs and impervious surface. Clustering reduces the costs of providing public infrastructure and services such as roads, utility lines, policing and schools Smart Growth. This can help reduce regional traffic congestion, road and parking facility costs, consumer transportation costs, crashes, energy consumption, pollution emissions and urban sprawl. These benefits tend to be greatest if complementary land uses are mixed.

6-2-2-1 Economic aspect

Clustering increases some costs, including some types of infrastructure costs (such as some utility costs), traffic congestion within the cluster, although regional traffic and pollution emissions tend to decline if clustering reduces total vehicle use. Reduced automobile use and improved opportunities for Parking Management can reduce road and parking facility costs.

Clustering tends to provide agglomeration benefits, which consist of the accessibility and network effects that increase economic efficiency and productivity (TDM,2002).

6-2-2-2 Social aspect

Clustering can increase Livability if it is implemented in conjunction with pedestrian and cycling improvements, traffic calming and other streetscape enhancements. It can increase opportunities for neighborhood interaction and community cohesion. However, clustering can also increase exposure to noise and air pollution.

Many higher-density urban neighborhoods have higher rates of social problems (crime and poverty) than lower-density suburban neighborhoods. Some people assume that this indicates that clustering and density *cause* social problems. But, although studies find an association between *crowding* (density measured in residents per residential room, an indication of poverty) and social problems, there is no such association with *density* measured in residents per acre (1000 Friends of Oregon, 1999).

This indicates that the association between density and social problems reflects the tendency of distressed households to concentrate in higher-density, urban neighborhoods, not that higher-density development causes social problems. This suggests that clustering does not increase social problems, and urban infill could reduce such problems if distressed households become less segregated (Litman, 2001).

6-2-2-3 Ecological aspect:

Clustering can reduce the amount of greenspace in an area, although it can increase total regional greenspace by reducing per capita road, parking and building area requirements. Most of these negative impacts can be reduced with appropriate design features (such as noise insulation and carefully located parks), but these mitigation activities may also involve additional costs. The TDM encyclopedia summarized the benefits of the Clustered land use strategy in the following table:

Objective	Rating	Comments
Congestion Reduction	1	Can increase local congestion but reduces regional congestion.
Road & Parking Savings	2	Reduces road and parking requirements.
Consumer Savings	2	
Transport Choice	3	
Road Safety	2	
Environmental Protection	2	
Efficient Land Use	3	
Community Livability	1	

Rating from 3 (very beneficial) to –3 (very harmful). A 0 indicates no impact or mixed impacts.

Table 6.4 Benefit Summary for Clustered land use Strategy
Source: TDM Encyclopedia 2002

6-3 Analysis of the relationship between Sustainability Principles for Land use management and the Healthy cell Characteristics

Earlier, principles for sustainable urban land use planning in neighbouhoods have been presented through the illustration of examples for sustainable urban landscapes in neighbourhoods given the evidence through evaluations, that those principles do promote and increase the sustainability of the neighbourhood, ecologically, economically and socially.

Consequently, this section is devoted to examine how those principles correlate with the healthy cell characteristics proposed in the introduction.

The following analyses would present how applying sustainability principles upon the main land uses already tackled earlier in this chapter would manifest their relation to the healthy cell characteristics.

6-3-1 Regeneration

A regenerative community is a one in which the concept of waste is eliminated.

The following part would match sustainable urban landscapes in the main land uses in the neighbourhood with the above mentioned characteristics

Being the two main issues tackled in the neighbourhood center, the mixed land use and the future high street would therefore be chosen to represent sustainability principles in the neighbourhood center.

6-3-1-1 Neighbourhood center

Mixed Land Use

The functional linkage between activities will increase the potential for dual use of space, trip purpose sharing and multi-functional design. This in turn will lead to using existing resources for mutual benefit and helping the neighbourhood to be more regenerative

High Street

In the future high street all the unused lots and old blocks are regenerated to get back in service. This in turn will lead to Eliminating the concept of waste

6-3-1-2 Housing

The concept of sustainable housing Regenerates the old non-sustainable housing to become more sustainable and more efficient to the current needs of its residents. This concept Adds Resources Without Depleting Others

Both The exploitation of renewable energy supplies and Pollution and waste strategies in housing proposals help as well to eliminate the concept of waste.

6-3-1-3 Jobs and Facilities

guided by sustainable principles to provide jobs and health care centers and facilities makes the best use of all local efforts in the neighbourhood regenerates the neighbourhoods social resources.

6-3-2 Self sufficiency

A self-sufficient neighbourhood is a one which satisfies the needs of its residents, socially, economically and ecologically. Through the following analyses, we would get closer to examine the relationship between sustainability principles in planning land uses and the features of the self-sufficient community as presented in the introduction

6-3-2-1 Neighbourhood center

Mixed Land Use

Through applying the mixed land uses in the neighbourhood center, the disabled and chronically-ill are ensured independence and dignity. This is achieved through increasing the opportunity of work and facilities locally and increasing the accessibility and transportation options, which benefits lower income households and non-drivers and increase economic opportunity and development among low-income populations and decrease the Inequality and discrimination.

High Street

The future high street with a linear, mixed use, focus for cheaper infrastructure, saving the neighbourhoods resources and helping self-sufficiency

6-3-2-2- Housing

The variety of housing sizes, densities and tenure makes it easy for the neighbourhood to be more self-sufficient as most of the people would have access to affordable and safe housing and families of all kinds are strengthened, preserved and flourish

- The Creation of natural habitats integrated with housing helps to satisfy the neighbourhood demands to open spaces
- The use of renewable energy in the integrated designs of housing in the neighbourhood helps the community to be self-sufficient in providing energy, and may be exporting it to the other neighbourhoods where most people would

  enjoy the benefits of clean air, clean water and a healthy and sustainable environment.

6-3-2-3- Jobs and Facilities

People acquire and retain jobs and achieve economic independence, through the existence of a variety of jobs and facilities which in turn increase the viability and vitality of the centre, facilitate multi purpose trips, and increase the viability and service quality of public transport, and thus supports the self-sufficiency of the neighbourhood

6-3-3 Self-correction

The self-corrective neighbourhood has Two vital self-corrective mechanisms that could be used with all community-based programs. These are **monitoring** and **evaluation**

The following part would present how sustainability principles need both monitoring and evaluation to keep on promoting the neighbourhood towards sustainability.

6-3-3-1 Neighbourhood center

Mixed Land Use

Monitor the linkage between the different uses

Evaluate the impact of uses on each other and search for a common solution to a whole range of problems, for example a noise buffer could function as a break, a

wildlife corridor, a fuel source, a recreational routeway and source of aesthetic delight

High Street

Monitor the presence of mixed use with a diversity in lots sizes and arrangements around the high streets

Evaluate the need of any land use to be changed or transferred to another site.

6-3-3-2 Housing

Monitor available vacant housing opportunities and their condition and prices

Evaluate the housing market and highlighting the decrease in a certain housing level according to the demand and supply rule giving opportunities to the native families over outsiders to purchase houses in the neighbourhood

6-3-3-3 Jobs

Monitor any data on local employment trends should be collated and consideration should be given to the potential for short and long-term change in local employment patterns. Assemble data on where local people work, the type of work they do, how they travel to and from work, how many are unemployed and what type of work they are seeking, the level of skills available in the community and the existence of training opportunities locally

Evaluate the deficiency or increase in available job opportunities to fight unemployment and decrease the urge for jobs outside the neighbourhood to reduce the journey to work.

Local employment opportunities (or the lack of them) can have a major impact on the possibilities for developing a more sustainable approach to interacting with the local environment

6-3-3-4 Facilities

Monitor the levels of education achieved by members of the local community and identifying any areas of relative educational deprivation. It is also useful to know where the local children go to school and to gather data on how they travel to and

from school. Assemble data on where and how often local people shop, as well as how they travel to and from the shops. What recent impact has any shift in shopping patterns had on the local central area facilities? What impact does the present shopping pattern have on vehicle use?

Evaluate and develop ideas on the local need for skills training and any deficiency in educational institutions.
Determine the level of efficiency of facilities in the neighbourhood

6-3-4 Dynamic adaptation to the environment

Neighbourhoods which dynamically adapts to the environment are those which serve the changing needs of its residents, without imposing any stresses on the environment or compromising the needs of the future. The following analyses would high light how sustainability principles in planning land uses in neighbourhoods correlate with the dynamical adaptation to the environment.

6-3-4-1 Neighbourhood center

Mixed Land Use

Mixed land use could Increase the opportunity of changing and adapting to the environment through a variety of choices between the different suitable uses

High Street

High street is an organic structure, some areas improve, others decline, and some being renewed, which gives a great opportunity to adapt to the changing needs of the society.

6-3-4-2 Housing

The arrangements of the housing patches to suit the climatic character of each neighbourhood and materials used in building added to the new technologies to use the renewable energy in both heating and cooling shows greatly how successfully the housing could adapt to the environment

6-3-4-3 Jobs and Facilities

Sustainability principles make the best use of the environment and adapt to the local resources for providing job opportunities and encouraging local investments. The facilities should go along with the new demands of the society and adopt to their changing needs

Introduction

The issue of the "Sustainable Urban Neighbourhood" is so vast and indeed it needs more than one research to explore all its perimeters and details. In this research there was a concentration only on the *inside of the cell or the neighbourhood*. The research displayed the contents of the neighbourhood from resources both natural and man-man, that are available in the neighbourhood and how to deal with an approach promoting sustainability.

As mentioned before that the concern of this research was to get closer to the meaning of the "Sustainable Urban Neighbourhood" and the principles that helps promote it . The illustration of those principles into existing urban landscapes in the previous chapters helped to bring those principles to life, in order to be fully understood, stressing on the economical, social and ecological benefits of sustainability in urban neighbourhoods.

This chapter would present a conclusion of what the introduction has proposed at the beginning of the research and what the body of the research analyzed in details.

The introduction proposed the healthy cell characteristics and suggested an analogy between them and the sustainability principles for the urban neighbourhood. The body of the research explored those principles and analyzed the correlation between them and the healthy cell characteristics, and in this chapter a sum up of the previous conclusion would be presented and an approach to sustainable urban landscapes would be concluded.

This chapter would also discuss the applicability of the concluded approach on two samples of Egyptian neighbourhoods and the way to change the contemporary status to the sought sustainable urban neighbourhoods.

The conclusion of the research aims at discussing these points:

- ❖ Concluding the relevance between the current and the proposed approach
- ❖ The applicability of the healthy cell approach on the Egyptian neighbourhood.
- ❖ Catalysts to ensure efficiency and applicability of the proposed approach
- ❖ Further Research in the subject matter of "Sustainable Urban Neighbourhood"

7-1 Concluding the relevance between the current and the proposed approach

Throughout the research, the principles of sustainability have been displayed in various urban landscapes, evaluated and illustrated in dealing with all the resources through which the common neighbourhood is developed. The research will sum up the tested relevance between the current and the proposed approach (fig. 7-1, 7-2) and a closer outlook at the four characteristics of the proposed approach "healthy cell approach" and how far do they comply with the sustainability principles for dealing with the resources in the neighbourhood.

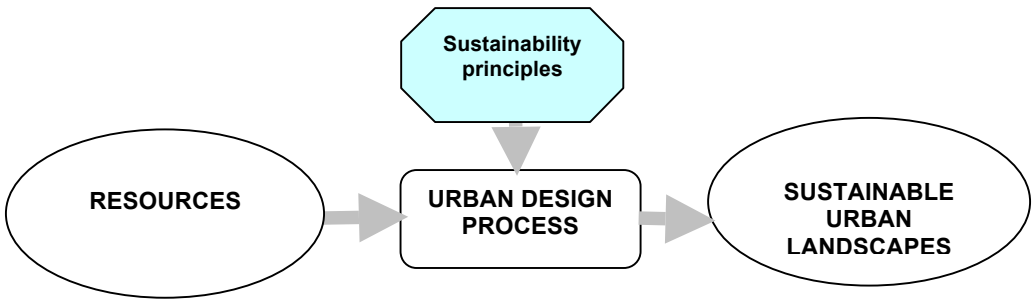


FIG. 7-1: CURRENET APPROACH

the current approach had two main mechanisms, "principles and indicators" to help reach out to sustainable development, while the proposed approach has four main processes to help reach out to "sustainable development".

In the proposed approach the four processes will help maintain the health of the neighbourhood and fight or overcome and threats through the prevention of deterioration, while in the current, only treatment of the illness might sometimes work, and sometimes fail.

The proposed approach helps to minimize the dependency on the external resources, and maximize the use of the local ones, satisfy as much as possible the needs of the neighbourhoods and minimize the waste outputs, then use it as a resource. This could be explained in details in the following g four points:

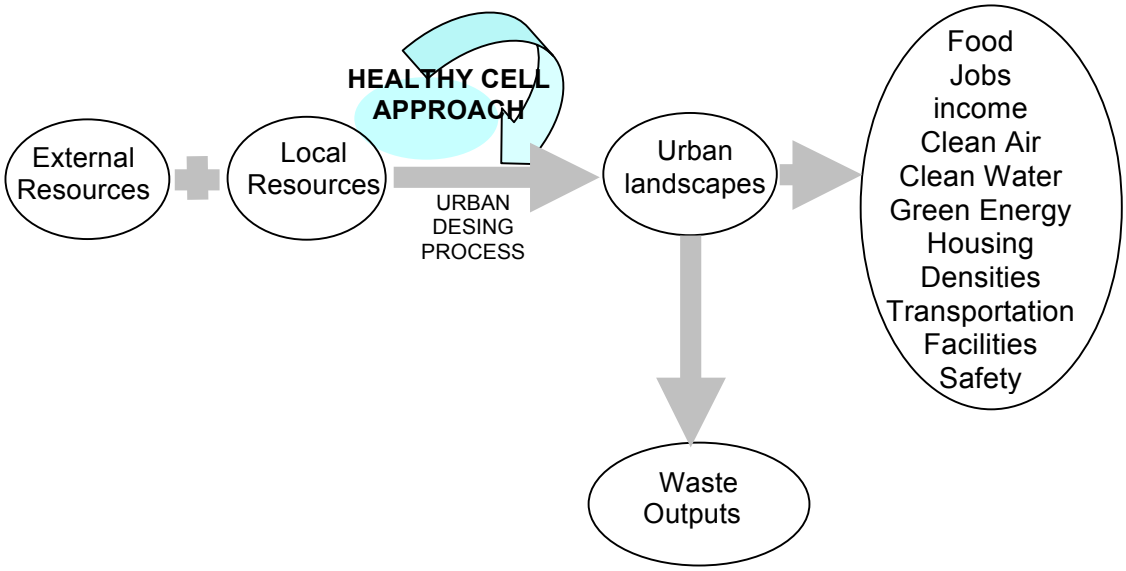


FIG. 7-2: PROPOSED APPROACH

7-1-1 Self-Correction

As much as the human cell needs a system to detect the illness and propose a treatment, the self-correction system is that kind of system for the unsustainable neighbourhood. it is a pre-active system. It gives a signal that the cell is infected through its monitoring system and starts evaluating the best action to respond to that illness.

As stated earlier, self-correction system is composed of two main components, monitoring and evaluation. Through the great evolution of the technology, an information system could be the base through which any disturbance could be easily monitored, evaluated and corrected in the cheapest, most appropriate way, to reach sustainability goals.

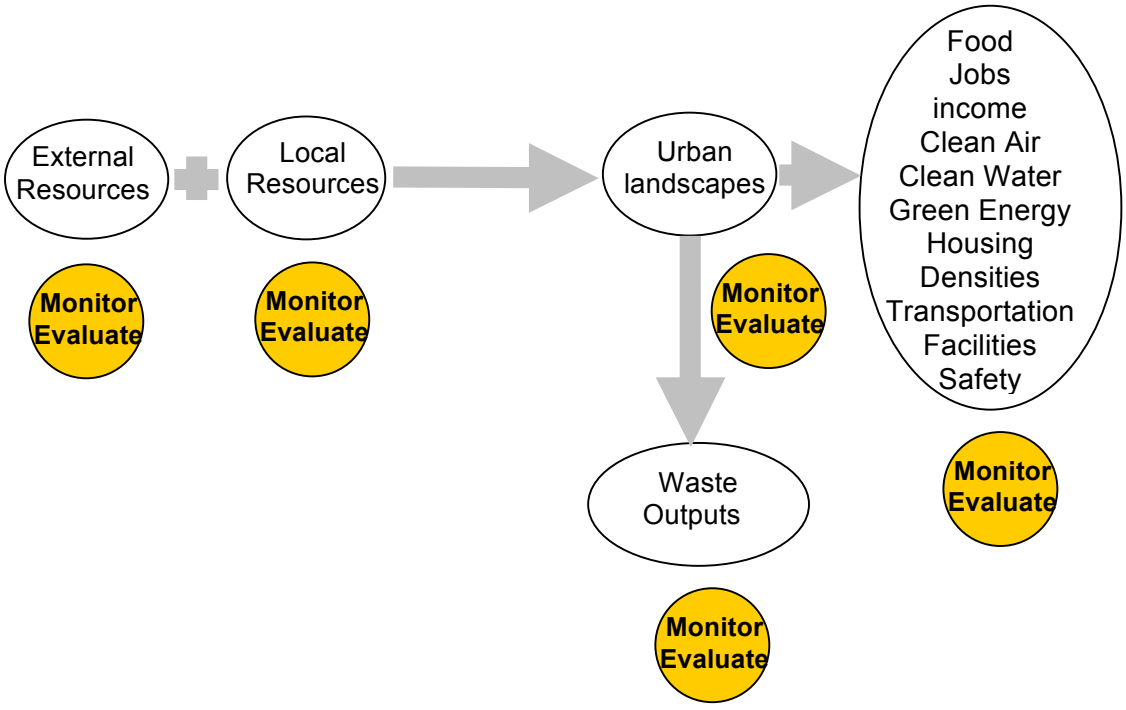


Fig. 7-3: self-correction process in the neighbourhod

Depending on earlier analysis of the sustainability principles and the healthy cell characteristics, the research proposes a center for **self-correction**, which monitors and evaluates the resources in the neighbourhood, to determine the efficiency of their usage. The following table is an example how this center could work.

Monitoring	Evaluation
Resources: record resources in the neighbourhood, whether natural or man-made, including land, water, movement network and air quality	Evaluate the opportunities that the resources offer neighbourhood whether economical or ecological
Land planning controls: Record, by mapping where possible, the latest local government land use strategies and policies for the study area, as well as any details of land use plans. Identify any special planning controls within and near the study area (green belt, tree preservation orders, conservation area status, or any other local controls).	Evaluate the application of the strategies and policies of the local governments for the neighbourhood, the condition of the conserved areas and the greenstructure.
Air: percentage of air pollution Annual per capita rides on local Transit	Evaluate air quality and correcting it's percentage to meet to the levels of the bearing capacity of the neighbourhood
Water: record water consumption in the neighbourhood, measurement of pollution in running water in neighbourhood	Evaluate the increase or decrease in water consumption and encouraging the residents through sustainability policies to reduce the water consumption in the neighbourhood.
Waste: Solid waste generation per person per year, Percent of total trash recycled	Evaluate policies and programs concerning waste production to control the amount of waste produced, the amount of recycling.
Population: Number of Individuals by Age Group, Population Density	Evaluating the densities, gross and net

Table: 7-1 check list of monitoring and evaluation of the self-correction center in the neighbourhood

Social status: social analyses to each family, number of school children, youth, and labor age.	Evaluate the level of facilities and services needed to correspond to their demands
Economic status: Gross Retail Sales Number of New Building Permits, Number of Business Licenses Issued, Number of New Retail Developments, Unemployment Rate, Personal Income	Evaluate the economic status of the neighbourhood
Employment: Any data on local employment trends should be collated and consideration should be given to the potential for short and long-term change in local employment patterns. Assemble data on where local people work, the type of work they do, how they travel to and from work, how many are unemployed and what type of work they are seeking, the level of skills available in the community and the existence of training opportunities locally.	Evaluate the deficiency or increase in available job opportunities to fight unemployment and decrease the urge for jobs outside the neighbourhood to reduce the journey to work. Local employment opportunities (or the lack of them) can have a major impact on the possibilities for developing a more sustainable approach to interacting with the local environment.
Green spaces: places of trees deficiency Number of neighborhood parks Park acreage per resident	Evaluate the tree map that should be followed in the future, if there are differences in the number of parks in low-income neighborhoods as compared to the number in other neighborhoods.
Housing: Total number of housing units. Average housing unit values. Number of owner-occupied, renter-occupied, and vacant housing units. Rental Cost. Number of new residential structures (single-family, multi-family).	Evaluate the housing market and highlighting the decrease in a certain housing level according to the demand and supply rule giving opportunities to the native families over outsiders to purchase houses in the neighbourhood
Education and training :Assembling data on the levels of education achieved by members of the local community and identifying any areas of relative educational deprivation. It is also useful to know where the local children go to school and to gather data on how they travel to and from school.	Evaluate ideas on the local need for skills training and any deficiency in educational institutions.

Table: 7-1 (continued)check list of monitoring and evaluation of the self-correction center in the neighbourhood

Local shopping patterns: Assemble data on where and how often local people shop, as well as how they travel to and from the shops. What recent impact has any shift in shopping patterns had on the local central area facilities? What impact does the present shopping pattern have on vehicle use?	Evaluate the level of efficiency of facilities in the neighbourhood.
Leisure: Assemble data on present recreational patterns and on any activities which local people feel that they would like to be involved in.	Evaluating the present leisure facilities, their environmental qualities and their areas and distribution in accordance to the local demand.
Public transportation: Total Number of neighbourhood Transit Rides per Year Total Operating Expenditures for Transit per Year	Evaluate strategies to create more multi-modal transportation systems Evaluate the public demand on public transportation, encouraging an increase in it through the development and prosperity of this facility.
Private transportation: percentage of private transport consumption Total Number of Vehicle Accidents per Year, Percent of Vehicle Accidents by Roadway Conditions, Daily Traffic Counts on Main Street	Evaluate the level of energy consumption and pollution production. Evaluate safety measures on road network in the neighbourhood
Non-motorized transportation: percentage of public dependence on non-motorized transportation for daily whole trip or half trip. Miles of Bike Trails	Evaluate the efficiency of the non-motorized means of transportation and ideas to upgrade its level of service.
Parking: Number of Metered Parking Spaces in the center of a neighbourhood	Evaluate the need of the neighbourhood to the parking and the availability of parking in the central area which has a direct impact on the ease with which people can visit local merchants and vendors.

Table: 7-1 (continued)check list of monitoring and evaluation of the self-correction center in the neighbourhood

Using the data provided, it is possible for a community to develop its own agreed statement of long- term intentions for the local environment . Once this has been done, it is possible to progress to translating these ideas into local neighbourhood 'actions' on the ground. Through having all the above stated information available in the neighbourhood self-correction system, it is easy to reach solutions, and evaluate each experience, and put a plan or a strategy to reform it in the future.

Through this self-correction system, the resources of the neighbourhood, whether natural or man-made, could be used in an optimum way.

7-1-2 Regeneration

While the regeneration process in the cells of the human body regenerates all the dead and ill-functioning parts in it, the regeneration process in the healthy neighbourhood concentrates on:

- diminishing the idea of source to waste and considers waste as a source in itself
- uses existing resources for mutual benefit
- adds resources without depleting others.

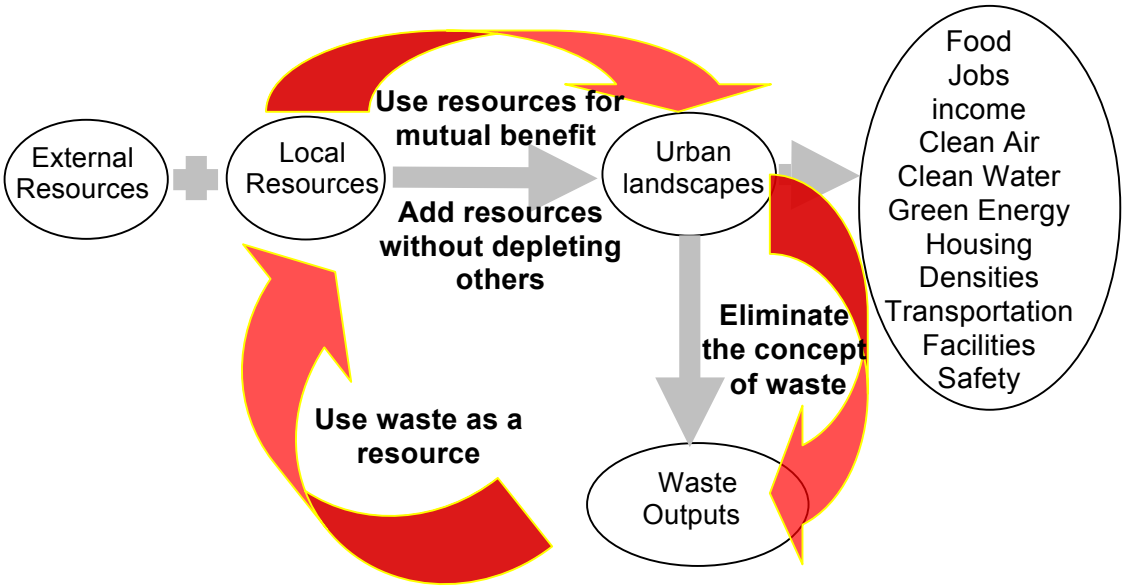


Fig.7-4 : the regeneration process in the neighbourhood as the planning unit

Regeneration parameters measured by self-correction:

For every parameter of the regeneration process many measures could be deduced to monitor and evaluate the efficiency of the regeneration process in the neighbourhood. The table below illustrates an example of some measures deduced from the three main parameters of the regeneration process:

Parameters	Measures
.Eliminating the concept of waste	Percent of recycled waste
Using resources for mutual benefit	Number of resources used for more than one purpose, without negative effects on other resources.
Adding resources without depleting others	Added value for each resource

Table 7-2 : Regeneration parameters measured by self-correction

7-1-3 Self-Sufficiency

As much as the self-sufficiency in the human body has solid limitations- where the cell depends on other parts of the body to provide it with proteins and oxygen,……etc, so is the healthy neighbourhood- where it could never be cut-off from its district and its surrounding region. The relationship between the neighbourhood and its surrounding district , region, country and even the whole world can never be ignored, but has to be studied so as not to have severe and destructive influence on the environment's resources.

The Self sufficiency of the neighbourhood helps to make the best use of the neighbourhoods local resources for the benefit of its residents. For example, self-sufficiency of neighbourhoods helps the increase of the range of local recreational opportunity, reduces the need for car usage in leisure time, creates educational opportunities for children, allows the development of efficient local water management schemes and grows biomass for use locally.

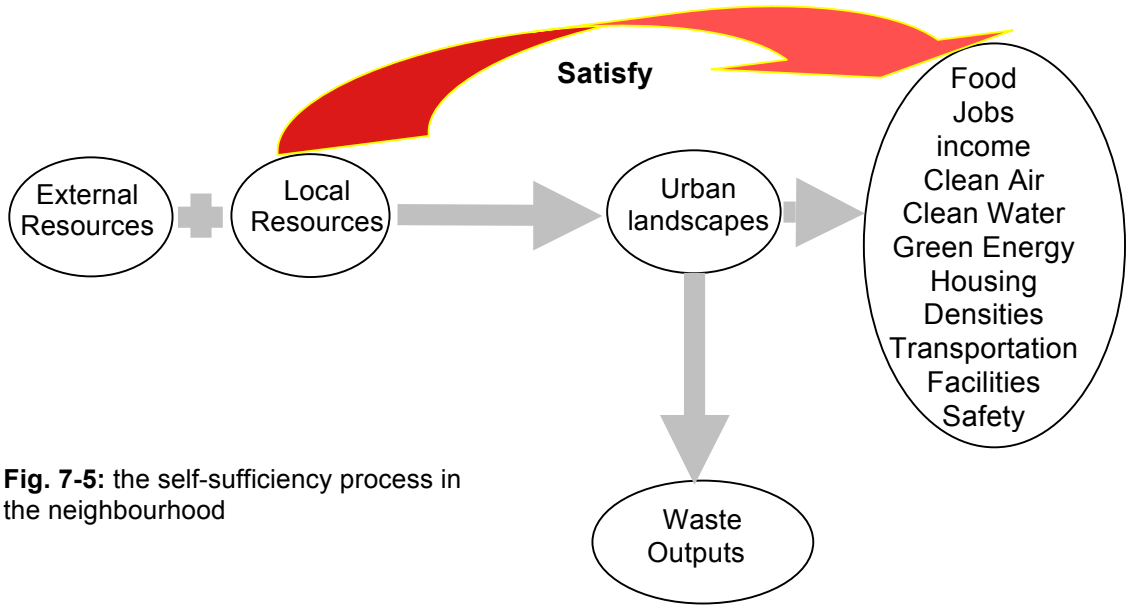


Fig. 7-5: the self-sufficiency process in the neighbourhood

Self-Sufficiency parameters measured by self-correction:

Depending on the analysis of the sustainability principles and the healthy cell characteristics, some parameters could be detected by which the self-sufficiency of the neighbourhood might be assessed.

The following table illustrates some of those parameters and the extracted measures for each of them:

Parameters	**Parameters**
jobs : number of jobs available to the number of people in the working age in the neighbourhood	**Densities :**ratio between net and gross densities. Net densities should relatively increase with a steady or low gross density
Air: Air pollution emitted in the neighbourhood to the maximum bearing capacity of the local environment.	**Transportation**: percentage of nom-motorized trips (pedestrian, cyclists, buses and light electric rail(to the motorized trips in the neighborhood
Water: Percent of consumed water to the recycled grey water	**Facilities:** the ratio of the availability of each facility in the neighbourhood to the demand on it, meaning, recreational, educational, health care, …etc
Green Energy: percent of the clean and renewable energy produced to the non-renewable energy consumed in the neighbourhood	**Safety:** number of crimes detected by natives in the community" self-surveillance and good urban design" to those detected by higher authorities.
Housing:percentage of adequate housing supplied for every economic sector of the population in the neighbourhood to the demand on each of them. Varieties of supplied housing in the neighbourhood	**Local food production**: the ratio of the locally produced food to the imported from outside the neighbourhood.

Table 7-3: Self-Sufficiency parameters measured by self-correction

As the above parameters are not exclusive, and they present only an example of how could the self-sufficiency of an area be evaluated, every neighbourhood could develop its own list, depending on the resources available in its premises, accuracy and efficiency of data available, and the local participation of its

residence. In every urban neighbourhood a check list could be made and self-sufficiency could be easily calculated if enough data is provided.

7-1-4 Dynamic Adaptation to the Environment

The research would extend at this point the comparison stated in the introduction in highlighting the similarities between the neighbourhood and the human cell, to go further to state that they both should have an immunity system to live efficiently.

As much of the illness of the human beings lies in the mal functioning of the immunity system, so is the case in the neighbourhood. What's meant by the immunity system of the neighbourhood is a system for dynamic adaptation to the environment. This system should be in every neighbourhood to detect with its sensors any deficiency or problem on it's way before striking or attacking the neighbourhood. It defends the neighbourhood against any attacks that might face it. It is a proactive system, working before the illness occurs.

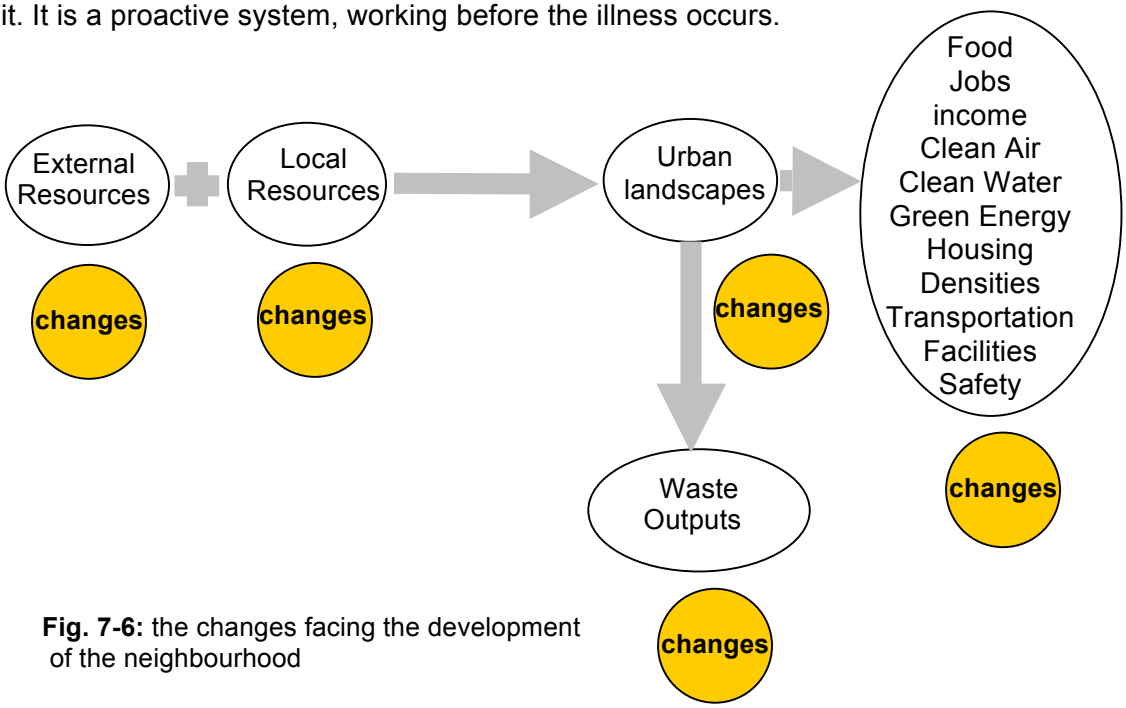


Fig. 7-6: the changes facing the development of the neighbourhood

This trait of the sustainable neighbourhood serves the research so much in it's trial to compare the neighbourhood with a living human cell.

As this character is one of the fundamental characteristics of the living human cell, the research showed how it is also one of the fundamental traits of the sustainable neighbourhood. This will support so much the idea that the neighbourhood is not just a composition of built structures and infrastructure, but rather it can be seen as a series of interacting systems- systems for living, working and playing- crystallized into built forms. With a good and efficient management, it could in turn change to a living thing that is responding and changing to suit its community with the best it could offer.

Resulting from the above discussion, all sustainability principles are enhancing the four characteristics of the healthy cell. This would help us to find solutions for any unsustainable urban landscape appearing in the neighbourhood, and at the same time protect the neighbourhoods from any future unsustainable urban landscape before it appears. This could be easily done through the enhancement of the healthy characteristics in the neighbourhood.

7-2 The Proposed Approach

Through the analogy undergone between the "human cell" and the "urban neighbourhoood", the research would export some terminologies from the biology of the human cell, in order to manifest this analogy, and to serve the research in explaining the proposed approach.

The term "*Health*" stands for "*Sustainable*"

The term "*illness*" stands for "*un-sustainable*"

The term "*observation*" stands for "*studying closely*"

The term "*symptom*" stands for "*negative results of un-sustainability*"

The whole subject of "sustainable urban landscapes in neighbourhoods" could be viewed from more than one side. Most previous researches approached the way to sustainability from observing the symptoms of the illness and trying to find the treatment "principles" to cure that illness.

As the environments, natural, social, and physical are in a continuous dynamic state, the sought "health" of the urban landscapes in those environments is complicated. It is hard to ensure "health" through mere principles of managing resources, full of do-s and don't-s. Dealing with dynamic environments needs an approach that is dynamic as well, to ensure the continuity of the "health" or "sustainability" of the neighbourhood. Therefore the previous approaches do not prevent illness, and at the same time, do not ensure the cure of the illness after applying the principles of sustainability.

This research viewed the same subject –sustainable urban landscapes in neighbourhoods- differently. It started from the "health" of the "human cell" and explored its characteristics, then consequently viewed the treatment of the illness by enhancing the "health characteristics". Through the analogy made between the "human cell" and the "urban neighbourhood", the characteristics "regeneration, self-sufficiency, self-correction and dynamic adaptation to the environment" were viewed as an essentiality for maintaining the health of the neighbourhood.

The new "Healthy Cell" approach holds two medicines for dealing with the neighbourhood. ***Prophylactic*** medicine and ***Therapeutic*** medicine. The former is represented by the "dynamic adaptation to the environment". If this Prophylactic medicine is working with full efficiency, it guaranties the continuous health of the neighbourhood. The latter is represented by the "self-correction". If this therapeutic medicine is working with full efficiency, it guaranties the treatment of any illness in the neighbourhood.

The research would present an example to explain how those two medicines work in an urban context;

If the shared external space within a home patch in a neighbourhood is being used as a place for communal events and celebrations. The net densities of this home patch increased by time and a need for a playing area for the children in this home patch aroused. If this need was sensed by the "dynamic adaptation system" and

eventually met through adapting this shared external space to contain a playing area for the children, the neighbourhood would stay healthy.

If the "dynamic adaptation system" was not functioning efficiently, and the neighbourhood was already ill, the self-correction would record this illness and its degree through the "monitoring system" and an evaluation of the best action to be taken to cure the illness would be proposed.
In other words

- the "monitoring system" would record the ***"symptoms"*** :

increased use of car in leisure time
increased energy use
increased air pollution

- an evaluation would be made to spot out the "illness**"**:

"insufficient recreational areas"

- and propose the ***"remedy"*** for the illness:

increase self-sufficiency of recreational areas in the neighbourhood.

Through the comprehension of the proposed approach, and the concluded relationship between sustainability principles and the healthy cell characteristics, the final concluded results of the research could be stated as follows:

The health of the neighbourhood is dependant on the health of the internal environment (resources composing it) and the interaction between it and the surrounding environment.

7-3 The applicability of the Healthy Cell approach on the Egyptian neighbourhood.

Before discussing the applicability of the proposed approach in the Egyptian neighbourhood, the research would high light some of the problems hindering the way for the Egyptian neighbourhood to be sustainable. The research would present some problems and discuss what the proposed approach of the healthy cell could offer.

7-3-1 Major problems hindering Sustainability in the Egyptian urban Neighbourhood

7-3-1-1 Inequity

Analytically, the process of urbanization can be explained by the disparities between the rich and the poor, city and countryside. Cairo dominates the remainder of the country and hinders other parts form developing.
Diverse modes of transportation are physical manifestation of the relationship between the rich and the poor. Urban ills in Egypt clearly indicate an inequitable distribution of wealth which is concentrated in small proportion of the population.
The skewed income is often associated with an unequal access to resources and processes of decision making.

7-3-1-2 Inadequate provision of social and physical infrastructure

Rapid population growth strains physical and social infrastructure. Growing densities in the existing housing cause rapid deterioration to the built environment. The lack of sufficient social services to the poor leads to inappropriate environmental behavior and continuous environmental deterioration.
Egyptian communities suffer from inadequate provision of social services such as education, health and green areas.

7-3-1-3 Data deficiency that hinder monitoring:

The components of effective monitoring are consistency and continuity. If the data base or collection system from one source is inconsistent with the base or system used by another source of data, conclusions will be inaccurate.

Consistency and continuity over time are very important, because data is always changing, through the continuous changes in improvements and deteriorations. Data sets in Egypt began as a part of development project supported by donor funds and foreign expertise which established good monitoring systems, installed equipments and trained local staff. Once foreign assisted projects are finished, many of those systems collapsed afterwards. Sometimes, because of the lack of funds from local organizations necessary for maintenance of equipments or continuing the employment of the efficient staff to collect, analyze and distribute the information that the system is designed to produce.

For decision making purposes, monitoring the state of the neighbourhood sustainability over time needs to be supplemented with information concerning violation of the laws. Data concerning violations is not available because of lack of enforcement of existing laws.

Egyptian authorities should attempt to consolidate sustainability measures and indicators on a well maintained website. This would facilitate and increase the study of neighbourhoods by reducing the time individual researchers need to track down the same data. A website would also allow researchers and policymakers to quickly realize what information is available and what needs to be collected.

7-3-2 The Applicability of the " Healthy cell approach" on "El-Korba" in Heliopolis and "El-Manteka el-oula" in Nasr City

To illustrate the applicability of the healthy cell approach, the research would extract "symptoms" of unsustainable urban landscapes in two Egyptian neighbourhoods, with different urban contexts, in a comparative analysis form.

This comparative analysis form serves to explain how the same illness in two cells could have different symptoms and the same symptoms in two cells could revert to different illness.

The areas chosen in that comparison are in Heliopolis and Nasr city.

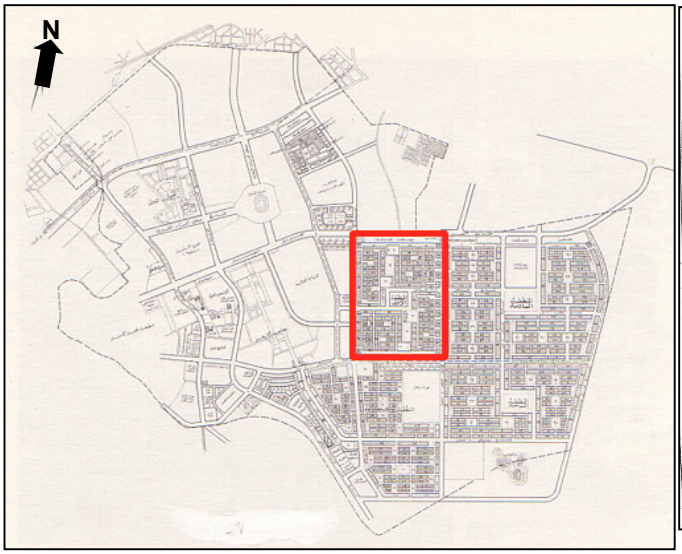


Fig.7-7 : layout of the studied area in Nasr city.

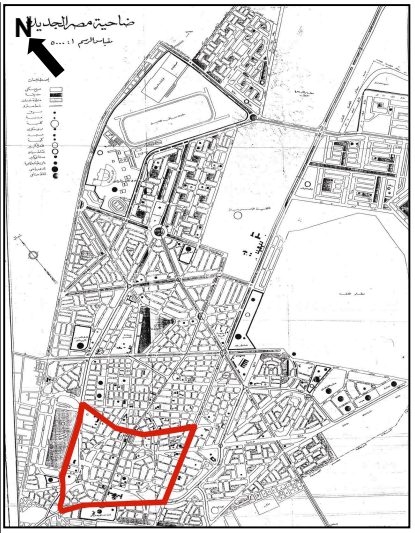


Fig.7-8 : layout of the studied area in Heliopolis.

Both areas in figs., 7-7, 7-8, are with well defined edges. The chosen area in Heliopolis, "El-Korba". is surrounded by "El-oroba street" from the south east, "El-marghani" street from the south, "El hegas street" from the west and "Nazeah Khalifa" street form the north. "El Korba", has an area of "321 fd" with a population of "22,237".

The chosen area in "Nasr city", " El-manteka el-oula" is surrounded by "Abas EL-Akad" street form the east, "El-Tayaran street " from the west, " Aly Ameen" street from the south, and "El-Nasr road" form the north. " El-manteka el-oula" has an area of " 456 fd " with a population of "26,701".

Those areas are chosen specifically as they are in close proximity to each other, both initiated at almost the same period of time, and they are with no specific historical value. The difference in their "health state" will serve the research in the examination of the applicability of the proposed approach, were Heliopolis adopts much more sustainability principles than "Nasr city". Consequently, this will help explain the "healthy cell approach" on two samples, one of them is "healthier" than the other.

Since the "dynamic adaptation to the environment" is a proactive character or a prophylactic medicine which works before the cell is infected or before unsustainable urban landscapes appear in the neighbourhood, therefore it would be excluded in dealing with the illness in the two proposed areas.
On the other hand, the self-correction system is a pre-active character or therapeutic medicine, which works after the neighbourhood is infected by unsustainable urban landscapes. It detects the illness and evaluates the best treatment for the illness.
Due to the lack of information about resources in Egyptian neighbourhoods (due to the previously stated problems), the "monitoring " of the self-correction system would not function well. As the research is just testing the applicability of the proposed approach, the precise measures of the monitoring system could be replaced by detecting the "symptoms" of the illness in those two areas.

As the proposed measures for the healthy cell approach are not exclusive, therefore the extracted symptoms are not exclusive as well, for they are merely examples of the health state of the contemporary urban landscapes in those Egyptian neighbourhoods.

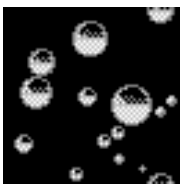
Therefore, the comparative analysis would start from health as the research started, and would propose the remedy (regeneration and self-sufficiency), their measures, their symptoms if deficiency in any of them occurred,
An observation of "urban landscapes" would be made for both areas.
The following tables would present this comparison in a diagnostic form:

The two studies areas showed different levels of health and illness in so many urban landscapes, sometimes the same symptom could contribute to different illness as seen in table 7-8, where both areas suffer deficiency in public transportation, "El-Korba" needs regeneration of existing metro lines and bus stations, while "El-manteka el-oula" needs transplantation of a sufficient public transportation network inside the area. On the other hand the same illness could have more than one symptom as seen in table 7-8. both areas suffer from "poor accessibility. "el-korba" needs redistribution of traffic flow on available entrances, while "El-manteka el-oula" needs increase in the number of main entrances.
As the previous tables showed, the right and accurate diagnoses of the neighbourhood would lead to the right treatment, even it is a long term one.
Accurate diagnosis depends mainly on accurate information and so depends on a very good "self-corrective system".

7-4- Catalysts to ensure efficiency and applicability of the proposed approach

The proposed approach needs several catalysts to ensure its efficiency and applicability. Those catalysts are listed as follows:

7-4-1 Decentralization



The neighbourhood has to acquire some independence from higher authorities in order to maintain its fast track on the sustainability process. People of the neighbourhood are the best to decide for themselves strategies and plans that would help them move their neighbourhoods towards sustainability according to their capabilities, economically and intellectually.

Plans set up by higher authorities lacks the sensitivity to the local resources in the neighbourhood and its application lacks local participation. This would all add up to the lack of sense of community to the residents of the neighbourhood, which in turn would affect the

neighborhood's environments. The result is continuous deterioration in the sustainability of the environments, natural, social, economic and urban.

Local planning is a very different process from the formal system set up by planning authorities concerned with decision making to meet legal requirements over large areas. This does not negate the role of the official planning mechanisms, however, since they deal with wider economic and social issues, linking both national and regional needs to the planning of a specific local administrative area.

Local Participation of residents has to involve several aspects:

Authority: elections held by the community should nominate the representatives of the neighborhood's residents.

Decision making: public participation in decision making makes all the difference in transforming plans to reality on ground, chooses what's best for the community and upgrade the environments sustainably.

Administration and execution : the only way to make planning a reality on the ground is by the participation of its residents in the administration and execution process. They are the best who cares, and the most concerned and involved.

Finance: the whole process of sustainability needs funding. People's participation in funding would push the neighbourhood faster on the track of sustainability. Local financial participation comes as a result in their participation in the above points.

7-4-2 Community Level Environmental Planning

LOCAL PEOPLE HAVE A VITAL ROLE IN PLANNING AND IMPLEMENTING A MORE SUSTIANABLE FUTURE FOR THEIR COMMUNITY

The sustainable urban landscapes in neighbourhoods could be promoted through raising the local awareness and the spirit of competition between the residents in the neighbourhood (for example a competition for the best private garden in the neighbourhood and a fund raised, or financial support for this garden).

A Community Environmental Plan, will enable local communities to target their 'actions' on the ground and financial resources more effectively. An efficient way of enhancing local levels of environmental sustainability through the way in which communities interact with the local environment, is through local 'actions' and changes in the behavior patterns of members of specific communities that this will be achieved, rather than through rules and regulations imposed from above through the planning process.

A community environmental plan in which residents took the greatest part in its planning could have a great influence on the local environment, where its application would be easier and levels of co-operation would be increase than if that plan was imposed on them from higher authorities. This would be reflected on the economic status of the neighbourhood and on the ecological environment as well added to the social bonding arising among the residents while planning and applying the community environmental plan.

7-4-3 Support from developed countries

the international achievements of the sustainable urban neighbourhood are so various. Some are moving on the right track and other are still beyond. Some countries suffer various internal problem hindering their way to sustainability.

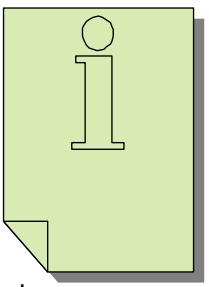
For the issue of sustainability to arise and activate in under-developed countries, there is an urgent need to get the enough help and support from those counteris which have experiences in that matter. For example,

In the UK national level documents giving advice on environmental sustainability issues as they relate to the land use planning and site planning process include:

Sustainable Development: Agenda 21 statements, The UK Strategy (1994); Planning Policy Guidelines -PPG13: a Guide to Better Practice (1995); and Planning for Sustainable Development: Towards Better Practice (1998).

These documents do much to indicate the vital part that the planning system has to play in promoting more sustainable land use patterns and use of resources; they show how plans can be drawn up which, as far as possible, promote development which is sustainable and recognize that it is not only town planners who are involved in this development process, but many other organizations and individuals.

7-4-4 Information Technology



Through the information technology it has become a small world, and the time has now come to reach out to this utopian destination, or the sustainable neighbourhood through a community environmental plan, which will identify locally 'actions' requires data about the local area and its people must be gathered and assessed. This assessment needs to be carried out both in relation to the objectives of any official local planning documents and in relation to any national performance criteria , before going on to work out what local changes are needed in land use and land management.

Both process, self-correction and self-sufficiency are based on an information system provided by local neighbourhood technology and information center.

This information also needs to be stored in an accessible format for long-term use by local people and officials, to monitor the effectiveness of local 'actions' and to ensure that the planning and decision making processes are open to all interested parties.

7-5 Further Research in the subject matter of "Sustainable Urban Neighbourhood"

From the researcher point of view , future research could take two forms (fig.7-18, 7-19);

Longitudinal form; which starts form the cell, or the neighbourhood, and discusses its recourses individually in a much deeper way, to explore all sustainability or healthy premises of that resource and at the same time explore all the healthy cell characteristics individually as follows;

- designing a check list of self-sufficiency for each category of Egyptian neighbourhoods.
- Designing a monitoring list of the self-correction process for the indicators of sustainability in each category of Egyptian neighbourhoods.
- A study for the regeneration process for the resources of the neighbourhood and the strategies and principles promoting it.
- The study of the Egyptian urban neighbourhood through the identification of Landscape Structure Zones, and the categorization of all kinds of urban Egyptian neighbourhood, depending on those zones. The analysis of the problems facing each zone.

Cross-sectional form; which starts from the cell, or the neighbourhood, and extends the biological analogy made in this research, to test its credibility on larger scales like, suburbs, regions and countries as follows;

- The analogy between the suburb and the human tissue, the region and the organ and the country and the human being.

MEASURE	• Accessibility • transportation choices. • Distribution of destinations. • Number of entrances to the neighbourhood. • Speeds at entrances • Total Number of Transit Rides per Year
LOCAL SYMPTOM	• High speeds at entrances. • Congestion at entrances. • Non-synchronized land uses and road hierarchy
POINTS OF DISCUSSION	Entrances to the neighbourhood.

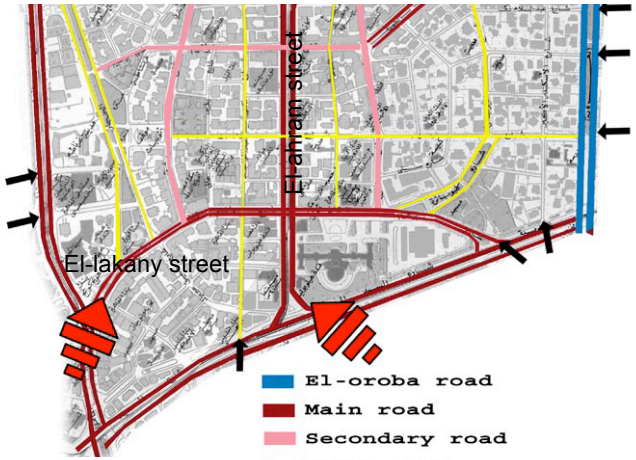


Fig. 7-13 : Entrances and accessibility at "El-

COMMENTS

After recent modifications, the area has three main entrances.

The Observation of the urban landscapes demonstrated above :

• High traffic speed at entrance of "El-thawra tunnel", fig. a - the major entrance to the studied area from the eastern side of Heliopolis - and congestion at side roads along the tunnel.

• Considerable traffic flow at the second and third main entrances from "El-lakany" and "El-ahram" streets respectively (see fig.7-7).

• Calmed and steady speeds on Secondary entrances due to the narrow width and mostly one direction ways.(see fig.7-7).

In the past the area used to enjoy two other main entrances, one from the north east side, from "Bayrout" street,(see fig.b), and the second form the west side, from "Nazeah khalifa" street.(see fig. c). Now they both serve as an exit form the area.

The Symptom of the first urban landscape is *high speed and pedestrian problems.*

The illness *is the lack of self-sufficiency of movement network.*

The high speed in the main entrance to the studied area is due to the encouraged through traffic in "El-thawra" street, to "Nazeah Khalifa" street, and then out of the studied area to the western side of Heliopolis. This forms a lot of pressure on the area especially during rush hours.

The tunnel fragmented the urban fabric of the homogenous area, damaged the equilibrium and accessibility of surrounding land uses, and encouraged motorized transportation over friendly non-motorized one, forming more stress on the fuel

RECOMMENDATIONS

The remedy of the infected urban landscape lies in distributing traffic flow equally on all available entrances in the area. This means decreasing the permeability (traffic flow or speeds) at El-thawra street and increasing it at the other dead entrances (those which used to function in the past). The Reactivation of both entrances of "Bayrout" and "Nazeah khalifa" streets would eventually decrease the traffic flow by distributing it on many entrances other than only one.

The tunnel would still be the most attractive entrance. To decrease its attraction for "through traffic", many traffic calming strategies (like stop signs before the entrance of the tunnel from both directions, narrowing the street lanes outside the tunnel, etc. see chapter four), with special safety considerations to the case of the tunnel.

This remedy is expected to increase the symptom of traffic congestion on the short run, but the result on the long run is an increase in the self-sufficiency of the movement network as follows:

The frustration of congestion and high cost of private transportation would encourage other friendly types of transportation. Public transportation enhancement would have a great contribution in the movement network as well. The enhancement of pedestrian environment and

MEASURE	• Accessibility • transportation choices. • Distribution of destinations. • Number of entrances to the neighbourhood. • Speeds at entrances • Total Number of Transit Rides per Year
LOCAL SYMPTOM	Deficiency of Public transportation services
POINTS OF DISCUSSION	Transit oriented development-auto oriented development

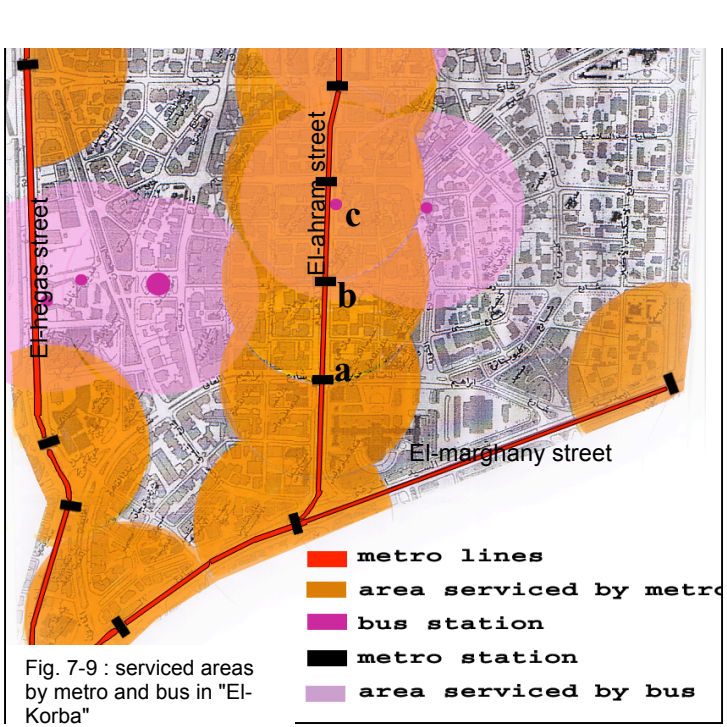


Fig. 7-9 : serviced areas by metro and bus in "El-Korba"

Fig. 7-10 : se

COMMENTS

From ***the observation*** of the urban landscapes demonstrated above and listed below:

1) The Heliopolis metro lines running along "El-Ahram" street, "El-marghany" street and "El-hegas street" is a sustainable urban landscape. Very cleverly designed at the era of the Baron Empan, and beautifully integrated into the urban fabric, the metro offer service for most of the studies area. (See fig. 7-9).

2) The quality of the service offered nowadays by the metro is greatly deteriorating. The cars of the metro are very old, the efficiency of the current cars is not good and the average time between two metros is 45 min. making this service unreliable. The intersections of the metro lines with the perpendicular roads have a great contribution to the low speed of the metro (average speed of the metro is 20 km/h).

3) Metro stations are neatly situated on either side of the metro lines, providing shelter and safety for the public. (see fig. a, b)

4) Buses and mini buses offer service inside the area of study but failed to cover most of the study area. (see fig.7-9).

5) Bus stations are very poorly designed and not given enough space or shelter. (see fig.c).

• ***The symptom*** of the second urban landscape *is an empty transit in a high populated area.*

RECOMMENDATIONS

Heliopolis was designed in 1920 by the Belgiums to be a transit oriented development. Changes occurred over time and turned Heliopolis into an auto oriented one. The metro couldn't survive in good shape with the difficult surrounding development.

The remedy of the metro in Heliopolis is rehabilitation to increase its efficiency. This could be done by Improving the metro service by the following:

• Buy new metro cars to increase efficiency. Current ones are too old to provide good service.

• Give priority to metro at intersections with automobiles.

Upgrade the service of the metro and decrease the time interval between each metro car.

• Intensify active and mixed land uses at the transit stops.

• Measure transport by accessibility instead of traffic.

The remedy of bus service in the area is

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	2)using existing resources for mutual benefit
MEASURE	Number of resources used for more than one purpose, without negative effects on other resources.
LOCAL SYMPTOM	Underused recourses
POINTS OF DISCUSSION	• Green-spaces, public and private ones. • School playgrounds and mosque and church yards.

Fig. 7-11: green-spaces in "El-Korba"

Fig. 7-12: g

COMMENTS	RECOMMENDATIONS	
From ***the observation*** of the urban landscapes demonstrated above and listed below: 1) Deficiency of public green areas as a whole in the area as well as shared external spaces and playing areas in home patches, although the total green space presents 25% of the total area. This is because the majority of the gren-spaces are private ones. (See fig.7-5). 2) Scarce as they are, public Green-spaces in Heliopolis are not being used efficiently. Most public green-spaces within the neighbourhoods are fenced and closed in front of the public. 3) The main green public space in the area is located in a central place at the end of the high street of "El-Ahram", easily accessible with the metro, and bus. (See fig. c). 4)Most of the green-space in the area are private ones, whether front or rear gardens, none of which is used in local food production. (see fig.7-5,a b). 5)poor and small in size, school playgrounds and religious green-spaces are not sufficient for recreation or playing fields, and none of them is open to the public at any time of the day, or even on Fridays. ***The symptom*** of the above urban landscapes is underused green-spaces. ***The illness*** is non-regenerative green-spaces	• Increase the percentage of public green-spaces in the area. • Increase accessibility of the public green-spaces by removing the obstacles like fences and fees. • School sites could be vastly more utilized for numerous community functions spaces of playgrounds as parks in festivals and parking areas in day time for serving cinemas at night. regenerate Front gardens to enhance social relationship between residents. • The functional linkage between activities should be a key determinant of setting decisions. This will increase the potential for dual use of space, trip purpose sharing and multi-functional design	From ***the*** demonstra 1) Deficier area where the total ar 2) There i spaces in t 3)shared every hom and closed 4) school p green-spac time of the c). 6) some p public and .f), with g and the pe ***The symp*** underused ***The illnes***

	as a source in itself.
MEASURE	1- Waste generation per year 2-Percent of total recycled resources per year
LOCAL SYMPTOM	The existence of wasted resources.
POINTS OF DISCUSSION	Old and unused buildings and lands.

Table 7-4 : regeneration of wasted resources in Heliopolis and Nasr city

Fig. 7-9 : some wasted resources in "el-Korba"

Fig. 7-10 : some wa
"El-manteka el-oula

COMMENTS	RECOMMENDATIONS	C
The ***observation*** of the *urban landscapes* demonstrated above is listed below: • Situated on El-Ahram Street, Cinema palace, is one of the old desolated uses now in Heliopolis, which forms a wasted built up area and wasted land use as well (See fig. a). • New business center currently deprived municipal services for security reasons and violation of law (see fig. b). • Old residential building haunted and left in ruins (see fig. c). The common ***symptom*** in the above three cases is: *wasted built up areas and places some of them once used to function and now are haunted and left in ruins.* ***The illness*** is non-regenerative land uses	The urban landscapes in fig. a and b, being on a high street as "El-Ahram", should make the best use of local economic agglomeration on this street. A high street, should accommodate high densities and variety of uses. Cinema palace, if back in use, would probably add to the area's liveliness and economies. The research at this point could not determine the exact use that these two building might best have in the future, for this is the role of the self-correction system. After the process of monitoring the deficient land uses in the area, an evaluation could be reached for the best use for each of them. The urban landscape in fig. c, is an urban heritage of the late Heliopolis oasis. Reusing the building with preservation of its external features would be a kind of regeneration to it to get life back to it.	The ***observatio*** demonstrated ab • Situated on " land forms a was • Old residential ruins (see fig. a). • Vacant land i used as parking The symptom th is *wasted built u* ***The illness*** is n

MEASURE	• air pollution emitted in the neighbourhood to the maximum bearing capacity of the local environment. • Car Trips, Particulate and Carbon Monoxide percentage. • percentage of public transportation dependancy, • walkability
LOCAL SYMPTOM	The priority of private transportation over public one. increased car trips
POINTS OF DISCUSSION	Because of lack of direct measurements of ambient pollutants in neighbourhoods, symptoms must be used to get around this lack of data, to tie in other aspects of the area's health. symptoms are used to indicate increase in motorized means of transport, and increase in energy use. 1)Annual Per Capita Rides on local Transit 2)Pedestrian path

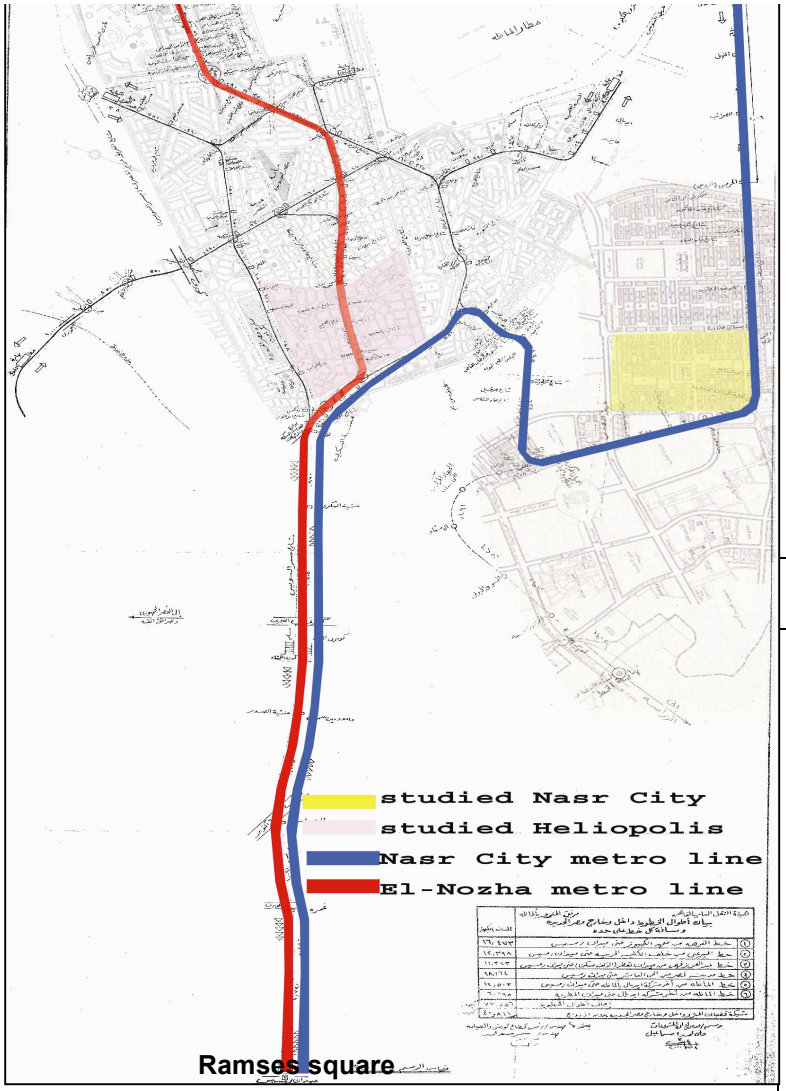
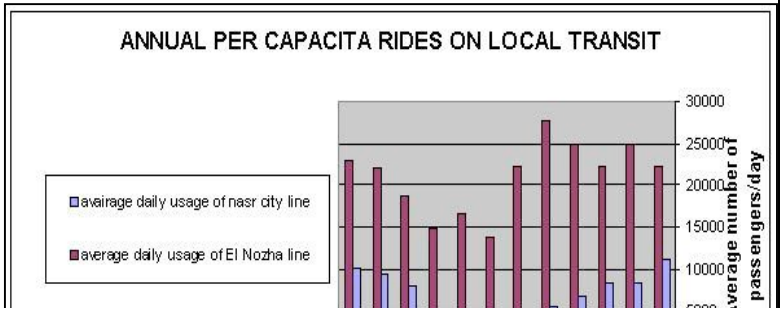


Fig. 7-15 : metro lines of El-Nozha with a length of 16.473 K.M and Nasr City line with a length of 18.164 K.M, and the two studied areas .



COMMENTS

The ***observation*** of the *urban landscapes* demonstrated is listed below:

• there is no data on the annual per capacita rides from every station, the only available data was for every line of the metro network. the number of yearly passengers using "El-nozha" line shown in the chart -which part of it runs inside the area- is almost the same in the years 1991 and 2002, although the population increases greatly. (fig.12).

• Pedestrian paths very well designed. They run along the main roads in the area, and they lead to the transit along the high street "El Ahram".

• The quality of the pedestrian environment is good. There is a clear separation between pedestrian path and motor roads. (fig. d, g). They provide amenity by very well interacting facades with the walking environment. (fig. e, c). They are quiet safe and sheltered. (see fig. f). Those located on the western or southern orientations are sheltered with arcades and those on the northern and eastern orientations are normally in the shade most of the day. (fig.a).

The symptom is decrease in transit use

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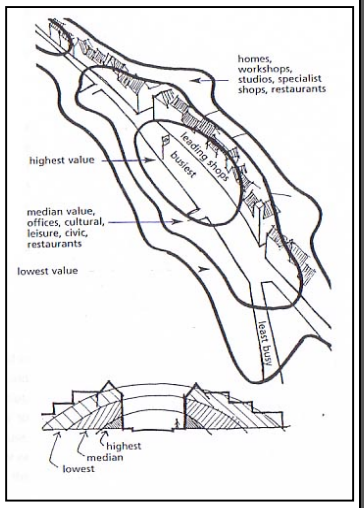
MEASURE	•ratio between net and gross densities. •densities distribution on high and minor streets.	HELIOPOLIS
LOCAL SYMPTOM	Cramming, visual blight, condensed minor streets.	
POINTS OF DISCUSSION	densities along high streets and internal streets  Fig. 7- 17: densities along sustainable high street	NASR CITY

Fig.7-18: panoramic view of El-Ahram street intersecting with "Ibrahim El-Lakany"st

Fig.7-19 : "Ibrahim Street with varies activities. The ground floor for shopping with a residential activities

COMMENTS

From ***the observation*** of the above urban landscapes;
Heights along the high streets " El-Ahram" and "Ibrahim El-Lakany" are, mostly, four to five stories (see fig. 7-14). Heights at " Ibrahim street" are also four stories (see fig. 7-15). On the other hand heights at some secondary streets like "Batrous Ghaly" street rise up to 10 stories with shopping centers at the basement level and the first and second stories (see fig.c).
The ***symptom*** is condensed activities at minor roads and average activities at high streets.
The ***illness*** is unbalanced densities.

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metro lines
especially a

Fig.7-20 : " El-Batrawy" street with various randomly distributed building heights

Fig.7-21 : minor street with various randomly distributed building heights

APPENDIX A: Self-sufficiency on Small Scale Development

Robert and Brenda Vale, 1975 have developed individual homes and small groups of houses that are entirely self-sufficient.
There have been attempts to build self-sufficient villages often in remote rural areas. There are more than a hundred of such settlements in Sweden alone and the Eco-village foundation has members in 21 countries across Europe, Russia, India, Australia and the USA. These settlements like Findhorn in Scotland , grow there own food, generate their own power, and recycle their waste, coming as close as possible to an environmentally human settlement. The development of autonomous houses, villages and even urban blocks, though a complex task, but still possible (Rudlin and Falk, 1999).

APPENDIX B: Thoughts on "Sustainability"

The term "Sustainability" as various meanings and definitions. Hard as it is to collect all what has been said about that term, the researcher was lucky enough to run across an on-line magazine, which summed up as much definitions for the term, from various personalities, all concerned about that topic. Below is an adoption of some thoughts on sustainability from that magazine.

John Belt **Department of Technology** **SUNY Oswego (New York)**	*Received 6 April 1998* I do agree with your statement that "sustainability" is an intriguing work that means so many things to so many people. Rather than try to define it in yet another narrow bias or broad view, I would like to relate my first thoughts in regard to reading your request to write a paragraph with one of the leads to a sentence beginning with one of the four "To me, sustainability..." leading line statements/paragraph. I hope this is of some value to you and qualifies per your request. "To me, sustainability means ...." COMPREHENSIVE (everything) "To me, sustainability is ...." ANTICIPATORY (future) "To me, sustainability implies ...." DESIGN (thinking) "To me, sustainability will ...." SCIENCE (knowledge) For those of you who study R.B. Fuller, you recognize that if the four responses are read down vertically it reads COMPREHENSIVE ANTICIPATORY DESIGN SCIENCE and is what Fuller used as his "design process". I would encourage this to be carefully studied against most textbook "steps of design process". Also please rotate each of my responses above to each individual "To me" statement. It seems to me that any combination will work very effectively in regard to problems that must be solved in order to develop sustainability. If this does not make sense to you I would encourage the study of each of these words via a dictionary as an exercise to sharpen the thoughts and then gauge that against the more popular steps or phases of design as process.
David Goldstein **Energy/Resource Analyst** **California**	*Received 2 December 1996* To me, the concept of sustainability is difficult to define because it embraces so many different disciplines and approaches to promoting environmentally acceptable economic growth. **Energy** From my perspective as an energy analyst, definitions of sustainability must focus on energy efficiency. There is a broad literature on energy-efficient construction techniques, and a growing literature on the use of recycled materials or other materials embodying low energy consumption and low environmental damage. In addition, I wish to focus a spotlight on the energy implications of patterns of urban development. In California, where significant progress has been made on the energy efficiency of the building itself, some 40% of overall energy use in the state is for transportation. This dominance of transportation is because of success in other areas; despite popular mythology, Californians actually use slightly less gasoline per household

than the U.S. average.

When energy first became a salient issue to Americans, the concept of energy efficiency was not the first to develop. Public discourse focused on behavioral ways to save energy: turning down thermostats, heating only some rooms of the house, etc. These methods do in fact work. But from a policy perspective, I believe we can and have achieved more long-run success by improving the energy efficiency of the building. Behavior can still count for variations of two-to-one (and even ten-to-one for efficient buildings in mild climates) for identical houses, but nevertheless, the average energy use of the efficient houses is predictably much lower than conventional houses.

The same phenomenon is occurring in transportation. While individual variations account for large differences, variations in urban infrastructure--efficiency of the city--reliably predict differences in average use of transportation energy. These differences are as large as five-to-one.

The Natural Resource Defense Council is doing some research to refine the statement of the dependencies of driving on neighborhood infrastructure, but our preliminary results, which are quite robust and won't likely change much, are that density (residential units per acre) is the primary determinant of driving, and that mass-transit access (levels of service) is the second most important determinant.

Driving is implicated in many of our environmental problems, including air pollution and the use of materials such as the impacts of concrete and construction material and fabrication for auto- dependent infrastructures. Also included are toxic run-off from large paved-over sections, threats to endangered species from suburbanization, and higher water use requirements due to urban sprawl. This in my opinion, is a major and largely overlooked area of sustainability.

Recycling

One part of sustainability concerns the recycling of construction materials at both the construction and demolition of buildings and the recycleability of other elements of the urban infrastructure (e.g., streets, sidewalks, etc.). Also, some attention must be paid to the ease of recycling materials used in buildings in everyday life, and the amount of resource needs that are generated in the first place. This is not my field of expertise, but it is an important area.

Toxics

Sustainable development should minimize or eliminate the use of toxic materials or the reliance on toxic materials as intermediates in the manufacturing process for consumer goods. (Again, this is not an area of my personal expertise)

Water

Sustainable development should minimize the use of municipal water supplies and waste water treatment. Some of this can be done by water efficient appliances in the home and in buildings. Additional progress can be made by climatically appropriate landscaping. Of course, higher density development inherently

	minimizes the need for water intensive landscaping. **Social Cohesiveness** Many advocates of sustainable development argue that sustainable development entails systems that are economically fair in the relationships between rich and poor and that promote healthy relationships between individuals and different ethnic and religious groups. Certainly, our current non-sustainable patterns of urban development exacerbate interethnic conflict and isolate the poor. **Process** Many advocates of sustainable development argue that the process of establishing policies for sustainability is as important as the product. They emphasize the importance of consulting communities and individuals, and of the use of participatory and democratic processes in developing economic and environmental policies.
Edward Mills **Professor** **Florida**	Received 25 October 1996 To me, sustainability will...provide a problem solving methodology to address the inherent conflicts created by the need to grow, with the need to be financially responsible, and the need to preserve our link with our environment. Public policy must be directed, over time, to include sustainability as a concept to follow in lieu of mitigation subsequent to action. The concept of sustainability will save us from ourselves and will come in its time.
Anonymous **Conference** **Respondent**	Received 25 October 1996 To me, sustainability is: In no particular order • Maximizing urban habitat opportunities/restoration of ecosystems as possible • Emphasizing demand side management on energy, water, land use, waste stream • Concentrates infrastructure: nodes and nodal connections • Local/Regional food production/managed for diversity/sustainability/"BMPs" • Exposing true costs of tourist industry/cost accounting/impacts • Managing wild food production for sustainable yields rather than for "sport" • Increase densities, reduce or eliminate use of suburban/sprawl/strip commercial model, increases in mixed use restaurant • Come to regard humans, their activities and the built environment as "natural" and refocus quality of life issues • Create for endurance • Use less stuff

	• Go beyond preservation to restoration and renewal for "natural" systems as well as built environment • No more "developments"; only "enhancements" for economy/environment
Henn Rebane PE, Boyle Engineering Corp.	Received 25 October 1996 To me, sustainability has been added as an element to my professional code of ethics and rules of conduct as a licensed engineer. It is clearly a part of my pledge to protect the life, health and safety of the public.
Anonymous Conference Respondent	Received 25 October 1996 To me sustainability is: feeding, breeding, nesting, resting opportunities, suitably juxtaposed in time and space for all life stages operating above a Minimum Viable Population (MVP) level. The "built" o structural approach to design ignores this fundamental basis for sustainability. We place "feeding stations" for humans (grocery stores) without regard to the natural home range for humans. Little literature exists on habitat criteria for humans. The home range of an adult human is 30 minutes travel time. The MVP area requirement was met in preindustrial society typically within a 10 mile radius of a home range centroid (village). These preindustrial criteria convert almost exactly to home ranges based on time in our industrial/fossil fueled society.
Anonymous Conference Respondent	Received 25 October 1996 To me, sustainability means there'll still be a countryside for my children and my future grandchildren to enjoy.
Anonymous Conference Respondent	Received 25 October 1996 To me, sustainability is resource efficient existence!
Anonymous Conference Respondent	Received 25 October 1996 To me, sustainability means that which can be had, maintained, enjoyed or used in the future. Also, that which can have a different future use.

Table 7-11 : thoughts on sustainability
Source: adopted from on-line magazine

APPENDIX C: Guide lines to General Indicators for the Sustainability of the Neighbourhood form the three Dimensions of Sustainability

The following information is adopted from the institute for community health (ICH), USA, (2002), with some modifications

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A- Environment health

The aim of environmental indicators is to provide a basis to assess the environmental health of a community. Environmental indicators monitor the health of the natural environment while also illuminating trends when human actions are impacting environmental health either negatively or positively. These indicators enable individuals, policymakers, and stakeholders in the community to make decisions about their contribution to the environment.

1- Air Quality Indicators

Annual per capita rides on local Transit
Monthly record for the amount of coal burned
Total electrical use in neighbourhood by all sectors

2- Water Quality Indicators

measurement of pollution in running water in neighbourhood

B- Resource use

Resource use refers to the variety and amount of resources used within a community. These resources include, water, energy, air, and natural resources. The waste produced from using these resources is usually returned to the environment where more resources are consumed to control the deposits on the land, in the air and in the water.

Resource use indicators provide a means for tracking the amounts of resources used in a neighbourhood. By comparing residential usage to commercial usage, it may be possible to determine which sector would need to be targeted by conservation efforts. These indicators also allow for resource use to be monitored determining if there is a potentially devastating situation facing the community before it occurs.

1- Water

Gallons of water used daily per person
Gallons of waste water treated daily
Gallons of wastewater as a percentage of capacity

2- Energy

Residential consumption of electricity and gas as a percentage of total consumption

Commercial consumption of electricity and gas as a percentage of total consumption

3- Waste

Solid waste generation per person per year
Percent of total trash recycled
Percent of trash recycled per person per year

Consumer awareness programs within the community can help reduce the amount of water consumed per person each day and will allow for more growth in the community. The implementation of water conservation programs could also help the community in the event of a severe drought. If community members cut back their water demand now, fewer restrictions would need to be applied in the case of a water shortage.

Continued monitoring of solid waste production could help the community keep track of the amount of waste produced. The implementation of policies and programs concerning waste production would help control the amount of waste produced. Examples of indicators would ideally include the amount of recycling as well as measures being taken to control solid waste production.

C- land Use

1- Ratio of Land Consumption to Population Growth
This indicator demonstrates the rate at which undeveloped land is being consumed as compared to the rate of population growth. Inasmuch, this indicator essentially demonstrates how well the town is utilizing and managing its land resources in the face of an expanding population. At the same time, this indicator provides a direct look at the impact of population growth on the use and consumption of virgin land within town borders.

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2- Average Lot Size Per Single-Family Residential Unit
For reasons quite similar to the previous indicator, the average number of acres per single-family unit was measured. As the amount of land consumed per unit increases, less vacant land will remain to accommodate future population and development. As the amount of growth and development increases, large property sizes per unit will deflect this growth toward undeveloped lands such as open space, which frequently lie in areas not served by infrastructure. The result is natural resource consumption, heavy tax burdens, and declining environmental health. Therefore, a healthy community will display relatively small lot sizes and a relatively dense pattern of development.

3- Total Acreage of Vacant and Agricultural Lands
This indicator measures the total acres of vacant and agricultural lands. Each of these lands serves a number of critical environmental functions. For instance, vacant lands can provide space for recreation and serve as the habitat for local wildlife. Both vacant and agricultural lands absorb storm waters that replenish groundwater supplies, reduce the quantity of surface runoff, and maintain water quality by minimizing the discharge of pollutants and sediment into lakes and streams. Though the latter is truer for vacant than agricultural lands due to the chemicals associated with farming activities (such as fertilizers and pesticides), agricultural lands may discharge less harmful substances than do urban developments. For each of these reasons, this indicator is considered to be of great importance.

D- Housing

Housing indicators are important for several reasons. Housing indicators can measure simple facts like quantities and costs of housing. They also can identify a positive or negative relationship between the cost of housing and family income levels, and can provide information on the growth rate of a community. Lack of housing can also be shown through these types of indicators, since they can help identify needs for alternative housing. With information and statistics gathered through an indicator report, planners can identify problems in the community and then work to develop appropriate solutions.

Total number of housing units.
Average housing unit values.
Number of owner-occupied, renter-occupied, and vacant housing units.
Rental Cost.
Number of new residential structures (single-family, multi-family).
sales price of single-family home as compared to incomes of middle- and low-income families.
sales price of single-family home.

E- Recreation

Culture, arts, and other forms of indoor and outdoor recreation are important aspects of our lives. Recreation includes diverse activities such as visiting an art gallery, going to a concert, watching a baseball game, and backpacking in the wilderness. According to sustainability Indicators, a truly sustainable community nurtures the mind and the soul of the citizenry as well as the physical body. Recreation is also key in building and preserving social capital within the community, which is essential to sustainable development. Social capital is developed through creating networks, building trust, and sharing common interests.

1- Total park acreage as a percent of the total landmass

The total park acreage is a traditional indicator of the amount of land dedicated to parks and recreational activities. A more sustainable indicator is to measure the park acreage compared to the total landmass of the area. Acreage of parkland is an important indicator because it demonstrates how much open space has been set aside in a locale. When this percentage decreases, it indicates that the amount of open space has gone down. This information can be used to make decisions about preservation and land use.

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2- Park acreage per 1000 people

In order to maintain a healthy community, it is important that there is enough parkland for all the residents. Simply measuring the number of acres of parkland that are available does not consider space relative to population size. Measuring park acreage per 1000 people takes into account the number of acreage per person. A higher number will reflect more parkland for the residents.

3- Number of neighborhood parks
Neighborhood parks are very important to the health of a community. Often times these parks serve as a gathering place for the residents in the area, as well as providing outdoor recreation close to homes in the area. The number of neighborhood parks helps assess how many people have parks in their neighborhood. This can also be an important equity issue. By noting the location of these parks, the town can determine if all neighborhoods have equal access to a park. It would also be helpful to note if there are differences in the number of parks in low-income neighborhoods as compared to the number in other neighborhoods.

4- Total recreational trail miles
The number of trail miles measures an important recreational opportunity for residents, because trails can be used for walking, running, bicycling, and skating. Also, a high number may also reflect an alternative style of transportation, such as walking or biking, within the town due to more availability and access of trails

F - Transportation

The goal of this set of indicators is to promote evaluation and understanding of how transportation affects environment, society, and the economy in the community

Miles of Bike Trails
Number of Metered Parking Spaces in the center of a neighbourhood
Total Number of Vehicle Accidents per Year
Percent of Vehicle Accidents by Roadway Conditions
Daily Traffic Counts on Main Street
Total Number of neighbourhood Transit Rides per Year
Total Operating Expenditures for Transit per Year

G- Economy:
Economic indicators should reflect when an economy is functioning in good health. Some examples of economic indicators are retail sales or the unemployment rate. There are many parts to a healthy economy such as the labor market, commercial development, housing markets, and industrial production. Every economic indicator generally gives clues about the health of a certain area of the economy. A strong economy will allow the Town to provide better services to citizens and businesses and will help to make it a more enjoyable place to live and work

Gross Retail Sales
Number of New Building Permits
Number of Business Licenses Issued
Number of New Retail Developments
Unemployment Rate
Personal Income

H- Society:
Population Indicators

population indicators represent changes and fluctuations in both population size and composition. Further, information from population indicators can be used to evaluate the associations that exist between the number of people in a given area and the resources that they will require. Some examples of population indicators include the percent of the population over the age of 18 or the percent of the population greater than 65 years of age. As each of these strata may require different community services and facilities, their appearance and representation within an area can indicate the amount of public funds or the percentage of the public budget required to support their needs and demands. Annual population growth and median age could also be appropriately used as indicators of changing demand for local services.

1- Change in Population

Population change is measured, as population size has serious implications for the provision of services. This measure is also important since it can indicate the perception and attractiveness of the community as a place to live to those residing outside of town boundaries. Further, measuring population change is important for determining the relationship that exists between both capacity and financial resources and population change.

2- Number of Individuals by Age Group

This measure is particularly important as the results have serious implications for the demand for certain community services and facilities. For example, a community with a large base of residents between the ages of 5 and 18 will require an adequate number of schools and classroom capacity. A community with a large population above 65 years of age will have a high demand for healthcare facilities. Without information derived from this measurement, community officials are limited in their ability to plan and prepare for the demands that will be placed on public services and facilities.

3- Percent Change of Age Groups

This measure can be used to indicate how well funds are being distributed to certain services and facilities as compared to the relative change in size of the population base. Further, this measure can indicate any shifts in funding that need to be made in order to fulfill the changing needs and/or demands of a local population.

4- Population Density

Overall population density is important as it illustrates a number of individual issues. For instance, the degree to which land resources are being consumed in

an efficient manner can be determined by evaluating the change in population density over time. Further, an analysis of population density allows conclusions to be drawn regarding how well infrastructure expenditures are being utilized. Each of these is important in measuring the health of community.

Education:

Education has long been a part of the public agenda at all levels of government and is a solid measure of community health and vitality. Most of a child's life revolves around school and learning. The education indicators reflect how successful the neighbourhood's public school system is in preparing children for college and careers as well as examines alternative and adult learning opportunities in the community.

Graduation Rate
Operational Costs/Student
Student/Faculty Ratio
Number of Students Who Graduate to College
failure Rate
Adult Education Opportunities
Number of Alternative Learning Opportunities

Public safety

Public safety indicators are important because they help define a community's current character. Do people feel safe? Are they safe? What are the biggest dangers or the most dangerous areas? Answers to these questions can lead to policies to improve, change or continue projects that move the community or neighborhood toward their future goals.

For example, after a public safety survey, a neighbourhood realized that most people don't feel safe letting their children walk or ride their bikes around the community after dark. This means that parents drive their children to and from sports practice, friends' houses, school programs, etc. This contributes to more vehicle miles, higher demand for gasoline and more air pollution. If people felt safer, their children could walk or ride bikes or public transportation—saving fossil fuels and reducing air pollution as well as reducing the chance of traffic accidents.

Number of violent crimes
Number of non-violent crimes
Number of traffic injuries to cyclists/pedestrians per 1,000 people
Percent of residents who feel safe and secure

APPENDIX D: Aspects of sustainable development

Information below is adopted from "Commission of enquiry", (2000).

A- Ecological Sustainability

1 Strongly restricted use of non-renewable resources

Non-renewable resources (i.e. iron ore or mineral oil) should only be used in the same measure in which a substitute of equal value consisting of renewable resources is created, or a heightened productivity of the non-/renewable resource.

2 Restricted use of renewable resources

The rate at which renewable resources are consumed should not exceed their rate of regeneration

3 Limited discharge of substances in the environment

The entry of substances in the environment should be oriented on the load-bearing capacity of the environmental media.

4 Orient intervention in the environment on the tempo of natural reaction time

The tempo of human intervention (or harmful action) in the environment must be in sync with the ability of relevant natural processes to react.

5 Avoid danger and risks to humanity

Danger and unjustifiable risks to human health through human influence are to be avoided.

B Economical Sustainability

Ecological aspects have dominated the discussion concerning sustainability - after all, the environment is our elementary basis for life. But a concept based foremost on ecological sustainability falls short. Economical resources must also be preserved; room to maneuver for future generations must be preserved in this manner as well. Additionally, ecological sustainability will only be achievable for societies which practice economically sustainable behavior

1 Organize manner of economy for the long-term

Economical structures and manner are to be organized for the long-term; to this end, they must correspond to the demands of stabile systems (see chapter 2).

2 Preserve real capital

The real capital of a nation (such as infrastructural facilities and buildings) is to be at least preserved.

3 Preserve immaterial capital

The immaterial capital of a nation (such as the standard of education) is to be at least preserved.

4 Stabilize monetary value

The value of money is to be held stabile; therefore inflation must be prevented.

5 Clearly restrict new debt or avoid it completely

Corresponding to the third and fifth principles, new debt is to be clearly restricted. Ideally, each generation must at the very least preserve its own real capital, as well as the immaterial capital which it receives from its parent's generation, and then pass it on to the next generation. Indebtedness is then only for extraordinary circumstances necessary; and the financial expenditure is to be spread across multiple generations.

7 Use resources efficiently

Maintaining the function of the state and the meeting of needs must be carried out efficiently. That is: in order to achieve defined goals, as little resources as possible is to be used; the most extensive achievements possible are to be brought about with existing resources.

8 Cost transparency and real value are to be assured

All economical services and obligations are to be produced in a cost-transparent manner, in which all expenses are to be brought into consideration (including external costs). This requirement has proven itself as a prerequisite for healthy economical structures (principle 1), for the efficient use of resources (principle 7), as well as for ecological sustainability.

9 Levy taxes according to ability to pay; maintain willingness to be productive

The amount of taxes which citizens and businesses have to pay must be oriented on their economical ability to pay. At the same time, it must be secured that the amount of taxes levied upon taxpayers does not - or only minimally - inhibits their willingness to be productive (basis for their economical ability to pay).

C Social Sustainability

If the previously drawn up principles concerned the environment, economy, and the organization of systems, then social sustainability binds people and society to the topic. The principles of social sustainability clarify the roll of the individual and the organization of society. Furthermore, in that the principles are directed towards the goal of a stabile society, future generations also profit from the preservation of social order.

1 Insure self-determination and human rights

Society must insure human rights and self-determination of citizens.

2 Guarantee security and justice

A trustworthy and independent system of justice, which insures the freedom and self-determination of the individual as well as human rights, is to be put into place.

3 Strive for high quality of life

Society must strive toward a high quality of life for all of its citizens, which is to be demonstrated not only in material welfare.

4 Facilitate equality of opportunity and perspectives

Society must offer all of its members as much equality of opportunity and perspectives according to their individual talents and living situation as possible.

5 Include citizens in social decision-making (participation)

Citizens must participate in the preparation of social decisions with their ideas and wishes, and should be able to begin their own initiatives.

6 Promote autonomy

Society must promote the autonomy of its citizens and enable them to provide for their own security against the risks of life.

7 Support solidarity and self-help

Society must support solidarity and self-help.

8 Guarantee fundamental social protection

Society must provide fundamental social protection for people in need, in case personal provision and solidarity systems prove inadequate.

APPENDIX E: Retention and Detention ponds

The pattern of drainage in a watershed evolves in response to surface flow of water. Over time, this pattern attains equilibrium with site forces; this equilibrium provides opportunities for the site to do work for humans. Changes to the equilibrium adversely affect this ability and therefore should be avoided. In order to fully utilize this water resource, development should avoid reshaping the land near the drainage way (fig.7-26). Stream banks should remain undisturbed when possible. The form and surface cover should be retained to continue resisting the forces of surface flow. Development usually replaces permeable ground conditions, such as woodland or meadow, with impervious ones, such as concrete and buildings. This causes a significant increase in water volume and usually velocity as well which upsets the equilibrium, and causes disruptive changes. To avoid these unwanted changes, and designer can introduce detention and retention reservoirs sized to accommodate the increases in water volume generated through development (fig.7-27) (John Motlock 2001).

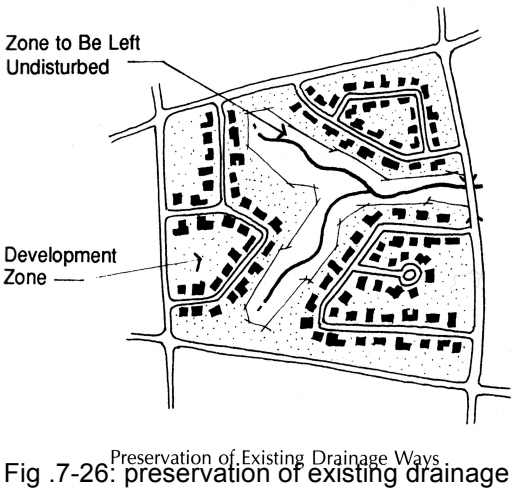

Fig .7-26: preservation of existing drainage ways

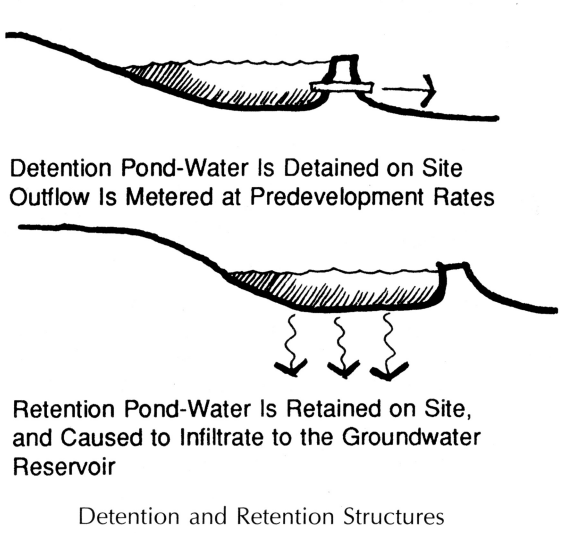

Fig.7-27: detention and retention structures
Source: John Motlock 2001

APPENDIX F: Degree of Imperviousness

One easily quantifiable environmental indicator of the health of urban watersheds is the degree of imperviousness in any given urban development. Substantial research indicates a consistent correlation between the amount of impervious surface in an urban watershed and the health of its riparian habitat. Impervious surfaces can be defined as anything that prevents the infiltration of water into the soil: this includes rooftops, roads, driveways, patios, parking lots and sidewalks.
Impervious surfaces collect and accumulate pollutants from the atmosphere, vehicles, construction, and various urban activities. Because it flows off the land from a variety of sources, and not from municipal storm-water infrastructure, such runoff is considered one of the leading threats to water quality. Rainfall, snowmelt, and irrigation carry the contaminated residues of human use — including nutrients, metals, hydrocarbons, phosphorus, bacteria, fertilizer, and pesticides — and, following gravity, transport these pollutants to the nearest water body (Golden Shira B. 1999).

APPENDIX G: Control

Controlling emissions and pollution is about technologies that capture emissions before they are emitted into the air, or even take emissions out of the air once they are already there control is essential because even with alternate and more efficient energy methods that are available, emissions are still there.

Controlling emissions could be done by various methods, some of them are listed below:

A- Catalytic Converters

All vehicles should be equipped with catalytic converters. As most of the time fuel combustion is an incomplete process, it creates a lot of emissions. The role of catalytic converters is to aid the combustion process and convert what are viewed as more harmful pollutants into 'less' harmful pollutants before they are expelled into the air via the exhaust pipe.

There are a number of other features within automobiles that manufacturers have created to cut down emission levels. These features include fuel filler caps, purge valves, vapor storage canisters, and dual walled exhaust pipes. (AirHead.org and Center for Neighborhood Technology,2002).

B- Sinks:

The concept of a natural "sink" is essentially based on the idea that there are several naturally occurring phenomena that take CO2 out of the air by their very nature. Because of this, they are considered natural "sinks" for the emission. (AirHead.org and Center for Neighborhood Technology,2002).

Parks and other public landscapes serve multiple purposes. Some of the following guidelines may help maximize their ability to serve as CO2 sinks:

- Provide as much pervious surface as possible because soil and woody plants store CO2.
- Maximize use of woody plants, especially trees, as they store more CO2 than do herbaceous plants and grass.
- Increase tree stocking levels where feasible, and immediately replace dead trees to compensate for CO2 lost through tree and stump removal.
- Create a diverse assemblage of habitats, with trees of different ages and species, to promote a continuous canopy cover.
- Select species that are adapted to local climate, soils, and other growing conditions. Adapted plants should thrive in the long run and consume relatively little CO2 through maintenance
- Group species with similar landscape maintenance requirements together and consider how irrigation, pruning, fertilization, weed, pest, and disease control can be minimized.

- Compost litter fall, and apply it as mulch to reduce CO2 release associated with irrigation and fertilization.
- Where feasible, reduce CO2 released through landscape management by using push mowers (not gas or electric), hand saws (not chain saws), prunes (not gas/electric shears), rakes (not leaf blowers), and employing local landscape professionals who do not have to travel far to your site.
- Consider the project's life span when making species selection. Fast-growing species will sequester more CO2 initially than slow-growing species, but may not live as long.
- Provide a suitable soil environment for the trees in plazas parking lots, and other difficult sites to maximize initial CO2 sequestration and longevity.

APPENDIX H: The Aeolian Roof

Derek Taylor, 2000, mentioned a new technology used on top of roof houses to make the best use of solar energy and wind energy all at the same time. This technology is known as the Aeolian Roof, fig. 7-28. It utilizes dual pitch or curved vaulted roofs in which the ridge is highly curves. A small distance above the ridge is located a wing like surface and devices for extracting energy form the wind are located in the opening between. The combination of roof shape and wing induces an acceleration to the air flow enabling relatively small devices to extract more power. Initial calculations indicate that an Aeolian Roof is capable of generating a high proportion of the electricity requirements of a low energy house is combined with PV roof cladding, a house could potentially achieve autonomy. The Aeolian Tower is similar to the Aeolian Roof except that it is vertically aligned and attached to the corner of a tall building. This potentially provides a means of generating hundreds of kilowatts of electricity in an urban community.

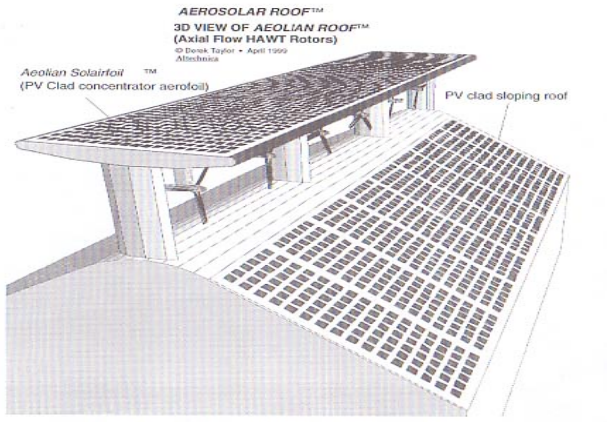

Fig. 7-28: Aeolian Roofs
Source: Derek Taylor, 2000

APPENDIX I: Combined heat and power

This is highly efficient energy production plant. It supplies electricity and heat(often distributed by community heating schemes). Recent advances in the technology are leading to increased spreading of CHP, for example, "micro scale" CHP: a plant little larger than a large boiler. Some plants can use a mixture of fuel sources, including waste to generate power (Barton et al.,2003).

APPENDIX J: Greenhouse Gas Emissions from Urban Travel

A study undergone by Fisher Susan,2000**,** develops a model of GHG emissions from personal urban transportation given variations in neighbourhood characteristics, including community and housing design, socio-economic makeup, and locational factors. The results provide valuable insight into how communities can be designed and planned to reduce GHG emissions from passenger travel in urban areas.

The following part is adopted from Fisher Susan, 2000, with some modifications, to explain her research scenarios:

The main purpose of the study is to develop a user-friendly quantitative tool to make the mathematical model easy to use in evaluating development proposals in terms of GHG emissions. The user inputs data on the characteristics of the neighbourhood and the tool forecasts the annual per-household GHG emissions from transportation.
In this study, the results supplied by the tool are used in discussing the sustainability of nine neighbourhood scenarios that embody a wide range of contrasting locational and neighbourhood design characteristics.
This model was applied on the Greater Toronto Area (GTA). Data on vehicle ownership, automobile vehicle-km of travel (VKT), and passenger-km of travel on public transit (PKT) per household in the (GTA) were obtained from the 1996 Transportation Tomorrow Survey (TTS). This rich data set is based on a sample of 115,000 households (a 5 per cent sample) in the GTA.

I- Key Variables Influencing Auto Use and GHG Emissions

The results of the multivariate analysis reveal a number of insights about the effect of different neighbourhood characteristics on household vehicle ownership and auto and transit travel intensity. Overall, socio-economic and locational variables tend to have a stronger influence than neighbourhood design variables.

Socio-Economic Variables:

• The variable with the strongest influence on auto VKT was the number of vehicles per household.
• To a lesser extent, the number of people in the household also strongly influences VKT; the number of people per household is the strongest predictor of PKT.
• The average number of adults per household is the strongest predictor of auto ownership per household.
• Household employment income was the second most important indicator of household vehicle ownership, whereas individual worker income seems to be a better predictor of auto VKT than household income. As income increases, auto use and ownership increases.

Locational Variables:

• Distance to the Central Business District (CBD) has a strong influence in all three sub-models. This is the second strongest explanatory variable, after vehicle ownership, in the auto VKT model. The model parameters suggest that, for every kilometer a household moves away from the CBD, weekday VKT per household increases by approximately 1.0 km.
• An increase in the number of jobs within a 5-km radius of the neighbourhood centroid can greatly reduce auto VKT per household as can a high degree of land-use mixing (i.e. combining residential uses and jobs in an area).
• Increasing local transit-vehicle-service hours tends to reduce household vehicle ownership and increase transit PKT per household. Having close access to a rapid transit station slightly decreases auto ownership levels and VKT per household.

Neighbourhood Design Variables:

• An increase in housing density (the number of housing units within a 1-km radius of the neighbourhood centroid) moderately decreases vehicle ownership and increases transit travel.
• A high degree of mixing structural housing types in a neighbourhood can slightly reduce auto ownership, while increasing the average size of a neighbourhood's housing units (in rooms/unit) can slightly increase auto ownership levels.
• Neighbourhoods with a curvilinear road layout tend to have slightly increased auto ownership levels; those with a rural grid road type have slightly higher auto VKT levels, all else being equal.
• An increase in the number of intersections per road-km in a neighbourhood slightly reduces auto VKT, presumably because it improves connectivity for walking and cycling trips.
• Increasing neighbourhood employment moderately reduces household transit PKT.
• The presence of local shopping opportunities slightly reduces household auto ownership levels and reduces transit PKT and has an indirect moderating influence on auto VKT levels and GHG emissions.
• The presence of wide arterial roads either within the neighbourhood or on its periphery, slightly increases auto use.
• The presence of bike lanes and recreational paths slightly reduces auto use.

Appropriate factors were applied to predicted values of weekday auto VKT and weekday transit VKT to calculate annual GHG emissions. The final models, based on the multivariate regression approach, were incorporated into an easy-to-use spreadsheet tool. All of the variables described above can be manipulated by a user of the tool to test a variety of development proposals in terms of GHG emissions from personal travel. **The tool is capable of establishing the relative difference between 2 or more neighbourhoods in any large metropolitan area**, although the absolute GHG estimates may not be exact.

II-Neighbourhood and Urban Context Scenarios
Nine contrasting neighbourhood scenarios were subjected to analysis using the model executed within the spreadsheet tool. These nine neighbourhoods are combinations of the three neighbourhood designs and three urban contexts. The three urban context scenarios generally correspond well to the Inner Area, Inner Suburbs, and Outer Suburbs of the Toronto Census Metropolitan Area. These are located 5 km, 10 km, and 30 km from the Central Business District, respectively, and have varying access to employment and transit. The neighbourhood design concepts are as follows:

• **Neighbourhood 1: Conventional Suburban-Type Development**
This neighbourhood concept reflects the characteristics of modern suburban developments, with typical low-density single-use residential patterns. Streets generally consist of curves and cul-de-sacs extending out to wide auto-oriented arterial roadways.

• **Neighbourhood 2: Medium-Density Development**
This neighbourhood concept tends to have a mix of single detached houses on medium-sized lots, low rise townhouses, and mid-rise residential apartment buildings. Such neighbourhoods typically have a higher number of persons than jobs, but still have significant opportunities for self-containment in terms of local employment. The road layout is mainly curvilinear, but with some continuity and connectivity for transit vehicles and pedestrians.

• **Neighbourhood 3: Neo-Traditional Development**
This neighbourhood concept represents a return to communities that are more "friendly" to pedestrians, bicyclists, and transit users. Such neighbourhoods have a mix of housing typologies including apartment buildings and closely spaced housing units. There is a much greater presence of non-residential uses (grocery stores, retail shops, schools, and employment complexes) in this neighbourhood concept than in the first two neighbourhoods.

Figure 7-23 shows graphically the annual GHG emissions for the nine different neighbourhoods as predicted by the model, making it easy to see that both the urban context and the neighbourhood design context have a significant effect on GHG emissions from travel.

However, it is valuable to note the relative influences of locational and neighbourhood design variables. Changing the neighbourhood context from the Outer Suburbs to the Inner Area decreases GHG emissions by 36 per cent to 60 per cent for the various neighbourhoods, whereas keeping the urban context the same and adopting the compact, mixed-use, pedestrian-oriented design decreases GHG emissions 24 per cent, to 50 per cent.

As a result, neighbourhoods with neo-traditional neighbourhood designs located in the Outer Suburbs produce more GHGs than the neighbourhood with land-intensive suburban-type design located in the Inner Area. The former

neighbourhood generates about 20 per cent more annual GHG emissions from travel than the latter.

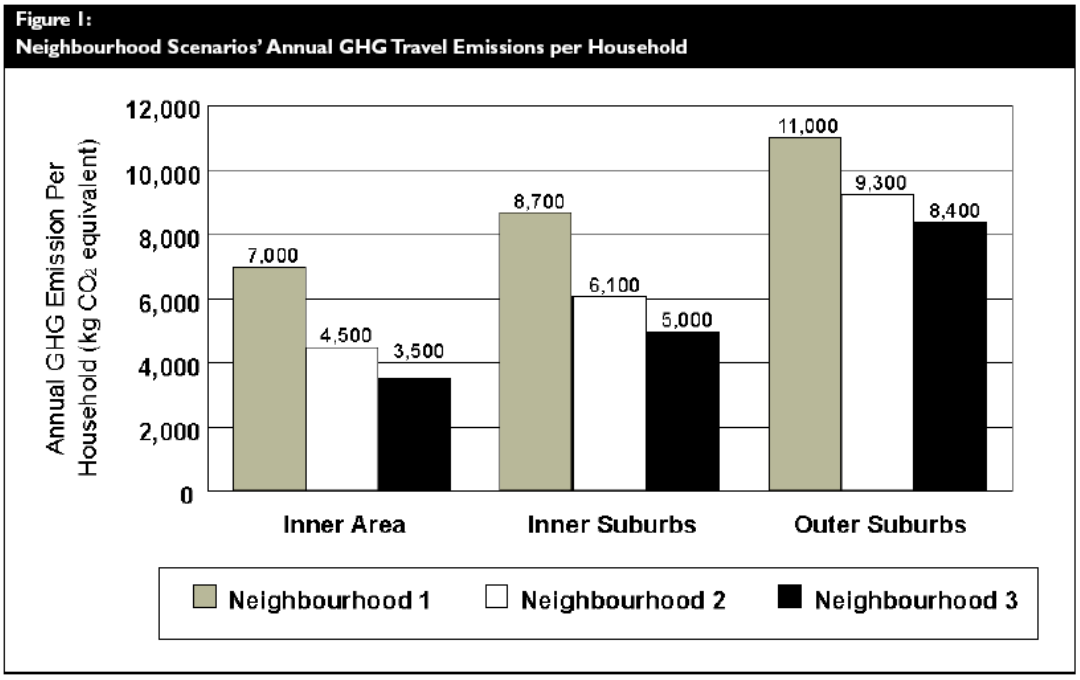

Fig. 7-29: chart for neighbourhood scenarios' annual GHG travel emissions per household
Source: Susan Fisher,2000

APPENDIX K: New urbanism

The TDM encyclopedia, 2002, define "New Urbanism" (also called New Community Design, Neo-traditional Design, Location Efficient Development and Transit Oriented Development) as a set of development practices to create more attractive and efficient communities. These can significantly improve Accessibility and reduce per-capita automobile travel. The encyclopedia specified some design features for the "new Urbanism Neighbourhood". Some of them are listed below:

New Urbanism Neighborhood Design Features

1. The community has a distinct center. This is often a plaza, square or green, and sometimes a busy or memorable intersection. A transit stop should be located at this center.

2. Buildings at the center are placed close to the sidewalk and to each other, creating an urban sense of spatial definition. Buildings towards the edges are placed further away and further apart from each other, creating a more rural environment.

3. Most dwellings are within a five-minute walk (a quarter mile) from the center. Streets are designed for walking and cycling, with sidewalks on both sides, bike lanes where needed, good crossings, traffic calming features used to control motor vehicle traffic speeds, and other features to `encourage non-motorized travel.

4. There are a variety of dwelling types. These take the form of houses, row houses, and apartments, such that younger and older, singles and families, the poorer and the wealthier can find places to live. Density averages 6-7 units per acre or greater.

5. There are places to work within and adjacent to the neighborhood, including shops, office buildings, and live-work units.

6. There are shops sufficiently varied to meet common household needs, such as convenience stores, a post office, a bank machine, and a gym.

7. A small ancillary building should be permitted within the backyard of houses. It may be used as a rental apartment, or as a place to work.

8. There should be an elementary school close enough so that most children can walk from their dwelling. This distance should not be more than one mile.

9. There are parks, trails and playgrounds near every dwelling. This distance should not be more than one-eighth of a mile.

10. Thoroughfares within the neighborhood form a continuous network, providing a variety of itineraries and dispersing traffic. The neighborhood

has multiple access routes connect to adjacent neighborhoods. These access points may be highlighted with a gateway or signs.

11. Thoroughfares are relatively narrow and shaded by rows of trees that slow traffic and create an appropriate environment for pedestrian and bicyclist.

12. Parking lots and garage doors rarely end of front the thoroughfares. Parking is relegated to the rear of the buildings and usually accessed by alleys or lanes.

13. Certain prominent sites are reserved for public buildings. A building must be provided at the center for neighborhood meetings.

14. The neighborhood should be self governing, deciding on matters of maintenance, security, and physical evolution.

APPENDIX L: Biodiversity

Biodiversity is:

> *"… the variety and variability of life - the diversity of genes, species, ecosystems – but it is the interactions between these living components that is of primary concern".*
> *"Biodiversity is the variety of all living things; the different plants, animals and micro organisms, the genetic information they contain and the ecosystems they form. Biodiversity is usually explored at many levels -, species diversity, ecosystem diversity. These levels work together to create the complexity of life on Earth"*
>
> *(Beer et al., (2000).*

APPENDIX M: Food production

The principle for food in neighbourhoods is to assist communities in making "local food links": linking growing, buying, cooking and enjoying. Implementing this approach will have an effect on how neighbourhoods are planned and developed. This is accentuated through the concept of "food miles" which refers to the distance food has to travel from where it grows to where it is purchased and then on to where it is consumed. Food transportation by road has been the fastest growing transport sector and major contributor to air pollution and hence to ill-health (Barton *et al*. 2003).

APPENDIX N: Calculating net benefits form plant material

The following part is adopted from Gregory et *al,* (1998) to explain how plant material have on-site and off-site benefits, and how could the net benefits of plant materials be calculated.

The community can benefit from cleaner air and water, as well as social, educational, and employment/training benefits that can reduce costs for health care, welfare, crime prevention, and other social service programs.
Reductions in atmospheric CO2 concentrations due to trees can have global benefits. To capture the value of all annual benefits (B), we sum each type of benefit as follows:
B = E + AQ + CO2 + H + PV
where

- E = price of net annual energy savings (cooling and heating)
- AQ = price of annual air quality improvement (pollutant uptake

and avoided power plant emissions)

- CO2 = price of annual carbon dioxide reductions
- H = price of annual storm-water runoff reductions
- PV = price of annual property value and other benefits

Similarly, tangible tree planting and care costs accrue to the property owner (irrigation, pruning, and removal) and the community (pollen and other
health care costs). Annual costs for residential yard trees (CY) and public
trees (CP) are summed:
CY = P + T + R + D + I
CP = P + T + R + D + I + S + C + L + A
where

- P = price of tree and planting
- T = average annual price of Class 2 pruning
- R = price of tree and stump removal and disposal
- D = average annual price of pest and disease control
- I = annual price of irrigation
- S = average annual price of repair/mitigation of infra-

structure damage

- C = average annual price of litter/storm clean-up
- L = average annual price of litigation and settlements

due to tree-related claims

- A = Average annual price of program administration,

inspection, and other costs.

Net benefits are calculated by subtracting total costs from total benefits (B–C).

APPENDIX O:

The following description of the sustainable transportation system is adopted from the European Union Council of Ministers of Transport

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A sustainable transportation system is one that:

- Allows the basic access and development needs of individuals, companies and society to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations.

- Is Affordable, operates fairly and efficiently, offers a choice of transport mode, and supports a competitive economy, as well as balanced regional development.

- Limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and uses non-renewable resources at or below the rates of development of renewable substitutes, while minimizing the impact on the use of land and the generation of noise.

Transportation Association of Canada (TAC),1999

The Transportation Association of Canada proposes that a sustainable transportation system has the following characteristics:

(a) in the natural environment:

- limit emissions and waste (that pollute air, soil and water) within the urban area's ability to absorb/recycle/cleanse;
- provide power to vehicles from renewable or inexhaustible energy sources. This implies solar power over the long run; and
- recycle natural resources used in vehicles and infrastructure (such as steel, plastic, etc.).

(b) In society:

- provide equity of access for people and their goods, in this generation and in all future generations;
- enhance human health;
- help support the highest quality of life compatible with available wealth;
- facilitate urban development at the human scale;
- limit noise intrusion below levels accepted by communities; and
- be safe for people and their property.

(c) In the economy:

- Be financially affordable in each generation;
- Be designed and operated to maximize economic efficiency and minimize economic costs; and
- help support a strong, vibrant and diverse economy.

APPENDIX P: Factors Affecting Accessibility

The following information is adopted from the TDM encyclopedia, 2002, with some modifications.

Mobility

Mobility refers to physical movement. In general, increased mobility increases access. All else being equal, the faster you can travel the more destinations you can reach.

In 5 minutes a pedestrian can typically walk about 3 city blocks, and so can access up to 36 square blocks of area. In the same time period a cyclist can travel about 8 blocks and so can access a 256 square block area, while a motorist traveling at 25 mph can travel 25 blocks and access 2,500 square blocks.

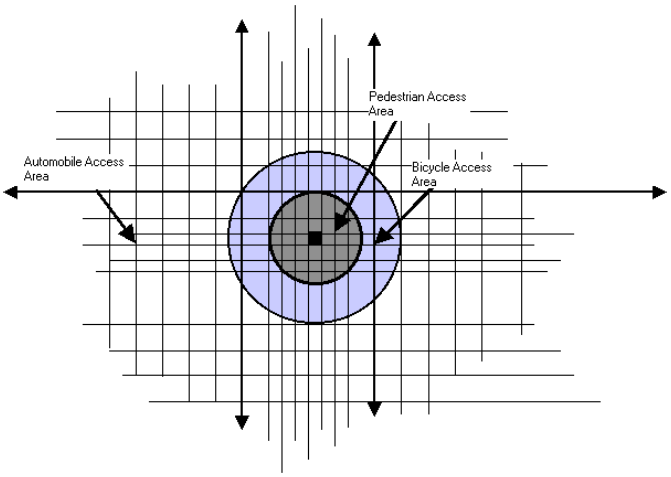


fig. 7-30: Mobility, Increased speed can result in a proportionally larger increase in accessible area.

Transportation Choice

Transportation Choice refers to the quality of transportation services available to an individual or group, taking into account their differing needs and abilities. In general, increased Transportation Choice tends to improve access. The TDM encyclopedia lists various types of transportation and compares some of their attributes in the table below. Different modes have different requirements, constraints and abilities. For example, walking is affordable, but is constrained by its low speed, and the requirement for physical ability and suitable walkways.

	Speed	User Cost	User Requirements	Land Use	Facilities
Walking	Low	Low	Physical ability	Clustered	Walkways
Cycling	Medium	Low	Physical ability	Med. density	Paths/roads
Public Transit	Medium	Medium	Minimal	Clustered	Roads/Rails
Intercity Bus and Rail	High	Medium	Minimal	Any	Roads/Rails
Taxi	High	High	Minimal	Any	Roadways
Private Automobile	High	High	License	Any	Roadways
Ridesharing	Moderate	Low	Minimal	Any	Roadways
Car-sharing	High	High	License	Any	Roadways
Telecommunications	NA	Varies	Equipment	Any	Equipment
Delivery Services	NA	Medium	Availability	Med. density	Roadways

Table 7-12 compares the attributes of different modes.

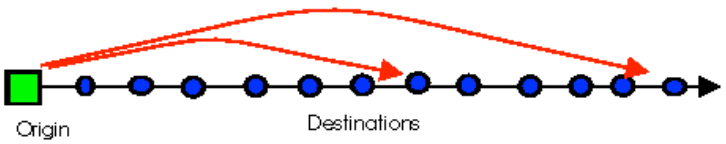
Because of these differences, accessibility must be evaluated for each type of user and trip. For example, a strategy that improves access for low-income college students (e.g., improved cycling conditions, transit discounts) may be unsuitable for middle-income elderly non-drivers, who may benefit more from improved taxi service or door-to-door shuttle buses.

Land Use Factors

Land use accessibility refers to how the location of destinations and transportation facilities affect travel distances and ability to reach destinations. Land use patterns affect transportation in various ways . A more accessible land use pattern means that less mobility (physical travel) is needed to obtain goods, services and activities, and that people have good transportation choices to choose from.
The more dispersed your destinations, the more travel is required to reach them (Fig 7-31). If destinations are close together, you can reach them by walking, and since most transit trips involve walking links, it makes transit travel feasible.

Fig 7-31 Accessibility From A Location At One End Of A Roadway

More dispersed destinations increase travel requirements, reducing accessibility. An edge location also reduces accessibility.



Accessibility increases if you live in the middle of the road, (Fig 5-3) because this reduces the average distance that needed to reach destinations.

Fig 7-32 Accessibility From A Location In The Center Of A Roadway

A more central location reduces travel requirements, increasing accessibility.

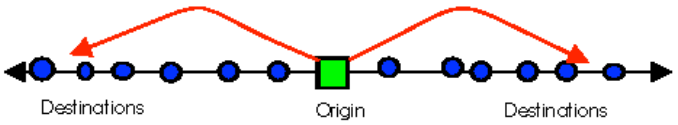


Fig 7-33 Accessibility From A Crossroads

Locating at a crossroads reduces travel requirements, increasing accessibility.

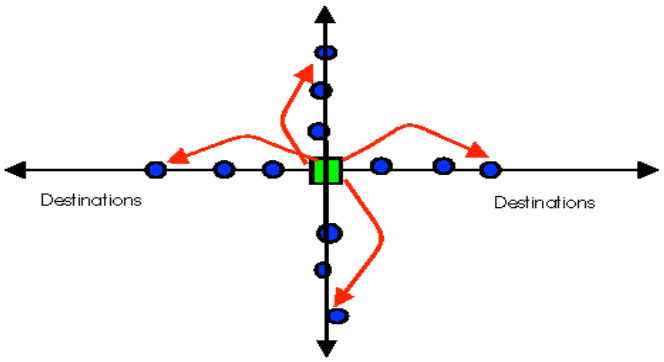
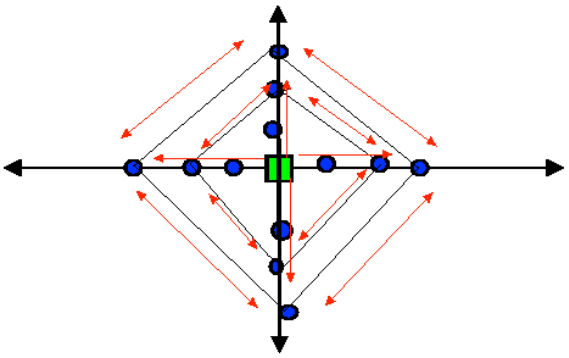


Fig 7-34 Accessibility From A Crossroads With Connections

As the number of roadway connections increases so do route options, increasing accessibility.



Density, Clustering and Land Use Mix

Density and clustering tend to increase accessibility, but other factors are important. A large multi-story building may have a high residential or employee density, but if located in an isolated suburban location, it may have poor accessibility.

Density affects accessibility. Higher density areas rely more on walking, cycling and transit, and less on driving. In such conditions, clustering and the quality of pedestrian conditions are important transportation factors. Areas with low densities, single land uses, and more dispersed destinations are automobile dependent.

Clustering of transportation facilities and services also tends to increase transportation convenience and accessibility. For example, insuring that abundant parking facilities are located close to destinations is a common way to improve vehicle access. Similarly, clustering transportation services together, such as automobile and bicycle rentals located at airports, rail and bus terminals, improves access by facilitating connections between different modes.

Land use mix refers to the types of destinations that are located together. Some areas have just one land use type, such as residential, commercial or industrial. Mixed land use can mean that retail shops are located within a residential neighborhood, or residential units are located in a commercial center or industrial area.
Of course, some types of destinations are unsuitable for clustering, such as junkyards and wilderness parks, but many common destinations can locate close together. (Fig 7-35) illustrates how accessibility increases if the destinations you visit frequently are clustered together into a commercial center, mall or campus. (Fig 7-36) illustrates how multi-story buildings can stack destinations on top of each other to achieve even greater densities. Accessibility tends to be greater on lower floors than on higher floors

Fig 7-35 Accessibility With Clustering Of Destinations
Clustering destinations makes it easier to reach several activities in one short trip, increasing accessibility, particularly by walking and public transit.

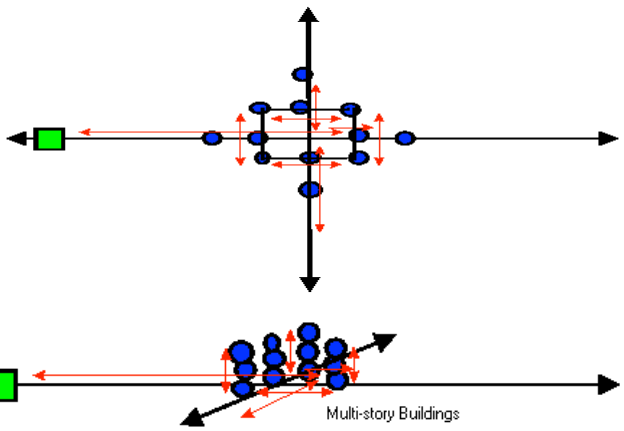
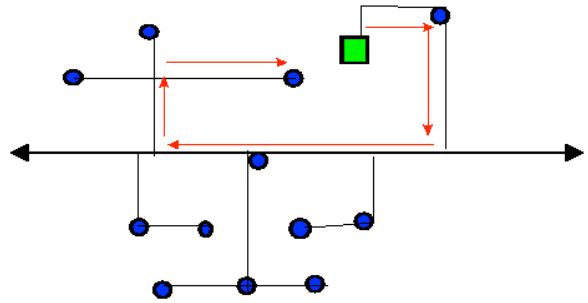


Fig 7-36 Accessibility With Vertical Clustering
Vertical clustering (multi-story buildings) can increase accessibility.

v- Roadway Network

The layout of roads and paths affects accessibility. (Fig 7-31) illustrates a typical modern road network, with many dead-end streets connected to a major arterial or highway. This is called a *hierarchical* road system because traffic is channeled from minor roads onto major roads. There are no direct connections between minor roads, so most trips involve travel on an arterial. This pattern reduces access (it requires longer trips to reach destinations) and it increases traffic congestion on major roads. It also tends to be unfriendly to non-motorized travel because destinations are scattered and there are many wide arterials with high traffic speeds and volumes.

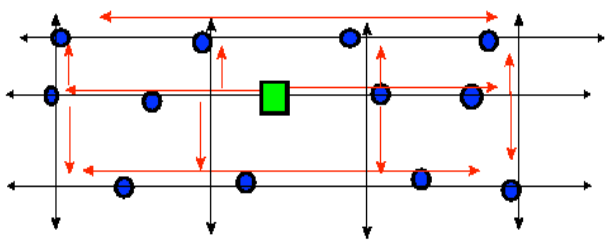
Fig 7-37 Accessibility With Hierarchical Road Network



A hierarchical road network channels onto a few major arterials, even for between destinations that are locatec to each other. This tends to increase congestion, increase trip distances, r travel choice and reduce accessibility type of roadway design is comm suburban communities.

A traditional grid street system illustrated in (Fig 7-37), provides greater accessibility because streets are more connected, which allows you to travel directly to destinations. There are few wide arterials, more intersections and lower traffic speeds, which helps to create a street environment better suited to walking and cycling. Although this reduces traffic speeds, travel times are often shorter than with a hierarchical roadway pattern because there are more direct routes. A grid street system also tends to be more flexible, because the system will not fail if one link is blocked.

Fig 7-38 Accessibility On Grid Road Network

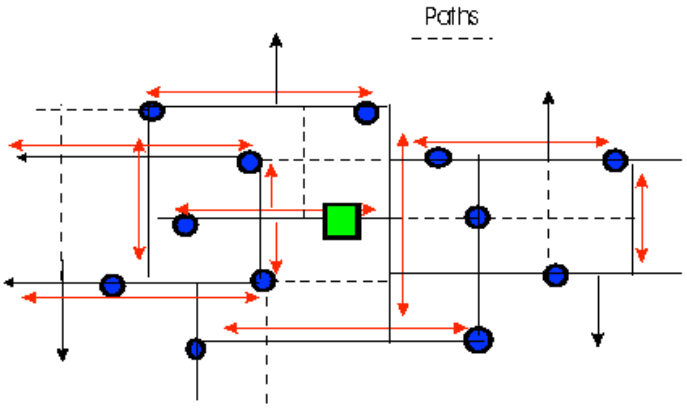


A grid network has many connected roads, providing multiple, direct route choices. This tends to reduce trip distances, increase travel choice, reduce congestion, and increase accessibility. This type of roadway design was common in older communities

.

However, most people prefer living on a street with minimum traffic, which is why housing on the dead-end streets of a hierarchical road system tends to be more valuable than on standard grid streets with uncontrolled traffic.

Fig7-39 Accessibility On Modified Grid Road And Path Network



A modified grid network has many connected roads designed with short blocks and T-intersections to limit traffic speeds. Paths create shortcuts for walking and cycling. This provides good accessibility, creates a more livable neighborhood and encourages non-motorized transportation.

An alternative approach is to create a "modified-grid" pattern, with short, connected streets, as illustrated in (Fig 7-39). This limits traffic speeds and volumes while still allowing direct routes between destinations. This can be improved further by incorporating pedestrian paths and shortcuts (dashed lines) that improve access for walking and cycling. Traffic Calming can be used to control excessive traffic speeds and volumes, particularly through older neighborhoods that have a straight grid street network.

In brief, these are the principles affecting accessibility when planning road network of a given site:

- A hierarchical street system with traffic channeled onto a few high-speed arterials, tends to reduce access, increase congestion and create urban landscapes that are unfriendly to non-motorized travel.
- A grid or modified-grid street system provides more direct access to destinations.
- Pedestrian paths and shortcuts can encourage non-motorized travel.

APPENDIX R: Gross and Net densities

Gross density: The overall density of a neighbourhood or settlement, including parks, schools, commerce, roads and infrastructure (Barton at al., 1995).

Net density: A defined area of housing (or commercial)area alone, excluding all other uses (Barton at al., 1995).

APPENDIX S: Design guide for Hulme, Manchester

The key elements of design guide for Hulme, Manchester, to bring closer to the reader the urban landscape of our future sustainable housing.

Streets

- Buildings should front onto streets
- Streets are for walking
- Should be "eyes" to the street
- Doors on to streets should be at no more than 15m intervals
- Residential ground floors should be 450mm above pavement level.

Integration

- Housing should not look like estates
- All uses accommodated within an integrated pattern of streets
- Streets should contain a variety of uses
- Space should be left to accommodate later uses

Density

- Housing should average 90 units/hectare
- Development should be along main routes and focal points first and this should be at the highest density

Permeability

- All streets should lead to other streets
- Streets should encourage through movement
- There should be a variety of routes available
- The grain of streets should be finer around modes of activity

Routes and transport

- Public transport should be planned as an integral part of the street layout
- Street design should reduce vehicle speed rather than ease traffic flow
- On-street parking is encouraged
- The impact of the car should be minimized
- The abuse of on street parking should be avoided
- Traditional crossroads are encouraged
- Safe routes for cyclists should be provided

Landmarks, vistas and focal points

- Development should optimize existing vistas and create new ones
- Corner building should consolidate the urban composition
- Major street junctions should be designed as "places"
- Civic and community buildings should be located around public spaces
- Existing landmarks should be incorporated into the urban structure
- Public art should give character to urban spaces

Definition of space

- Building lines should create unbroken urban edges
- Where buildings are set back from the street, they should have a public presence.
- There should be a clear definition between public and private space
- Street, squares and parks should be clearly defined by appropriately scaled buildings and trees
- Building elevations should be scaled to the proportions of the street

Identity

- Existing buildings should be enhanced to avoid the feeling that everything is the same age
- Large buildings should not distort the scale of streets
- Buildings should respond to location
- Different materials and finishes are encouraged
- Diversity of design solutions is encouraged

Sustainability

- Design for change of use is encouraged
- New buildings should be designed for low maintenance
- Existing trees should be retained and new street trees provided
- Maintenance burdens of open space should be considered
- Urban nature conservation measures should be considered

	- Space for segregate waste storage should be provided
	- The scale of buildings should reflect hierarchy
Hierarchy	
	- character if different types of streets

Table 6.3 key elements of design guide for Hulme, Manchester
Source: Edwards, (2000)

APPENDIX T: Job Ratio

> *"This is calculated by dividing the number of local jobs in an area by the number of people working/work-seeking. A score of over 1 indicates a high proportion of jobs."*
>
> *Stead, D. 1993*

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