Developing parameters of design for an urban context and demonstrating them as a future design model

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I am profoundly grateful to my major professor Jason Alread for his supervision, support and encouragement. His guidance was integral and helpful throughout my studies at Iowa State University.

I would also like to thank Mikesch Muecke and James Bolluyt for their willingness to serve on my POS committee and for their valuable comments and guidance.

Last but certainly not the least, I express my deep gratitude to my parents for their sacrifices, love and support.
Many theories have been proposed to improve urban living conditions, but still they do not manage to solve these urban problems. In order to develop a model that can fill this gap, parameters for urban designs have been formed here using various readings and case studies. These are summarized in the thesis research to develop the design model. After selecting a site in Chicago and conducting analysis programs are proposed taking into account research parameters and the context around the site. These programs are studied and demonstrated in the site in the form of a design model. The design incorporates the previous study of parameters and integrates various theories on future design models into a proposed solution. This proposal is a model demonstrating the need to incorporate a wide array of parameters while designing the built environment. The model is referred as ‘an integrated approach to the built environment’, where the research conducted for this thesis on various design theories is taken into consideration.
INTRODUCTION

Since the early 1980’s, there has been a tremendous expansion of cities in population, infrastructure development and geographical extents. The migration of people from rural to urban areas, and the population sprawl from downtowns to midtowns to suburbs has increased rapidly. The United Nations projections for a world population of nine billion by 2050 could see as many as 75 percent of people living in cities.\(^1\) To meet the needs of the ever-growing population, there has been a huge demand on the infrastructure and resources of cities. As the Brundtland report\(^2\) suggests, if this situation is not addressed then urban contemporary issues such as traffic, pollution, congestion, pressure on infrastructure and scarcity of natural resources like food, water, open green space, clean air and so on will worsen and future generations will not be able to enjoy the benefits that we do. To add to the woes, this phase of development is coincidental with the alarming degradation of the natural environment and disastrous impacts of climate change. Cities contribute over 80 percent of the world’s carbon emissions\(^3\). Over the years in most of the world’s cities, the demographic pattern has developed where the bulk of the population lives in suburbs and travels daily to downtown for work. The share of transportation in carbon emission is 14 percent of the world’s greenhouse emission, 10 percent of which comes from road transportation and the remaining from rail, ship, and air\(^4\). This resultant situation demonstrates that the current system of planning has failed to address these contemporary urban issues and there is an urgent need to provide some solutions. Various theories like landscape urbanism, sustainable urbanism, ideas of garden cities and many more have tried to address many of these issues. To reap maximum benefits from these theories it is important to execute them on open sites with new construction. However, it is difficult to incorporate these theoretical frameworks into an existing city and address urban contemporary issues. A model is

\(^1\) [http://docs.lead.org/allcohorts/LeadMegacities.pdf](http://docs.lead.org/allcohorts/LeadMegacities.pdf), 06/11/2010


\(^3\) [http://docs.lead.org/allcohorts/LeadMegacities.pdf](http://docs.lead.org/allcohorts/LeadMegacities.pdf), 06/11/2010

\(^4\) [http://docs.lead.org/allcohorts/LeadMegacities.pdf](http://docs.lead.org/allcohorts/LeadMegacities.pdf), 06/11/2010
required to demonstrate the ways to provide respite from these urban issues. An integrated approach is necessary which can incorporate various theories into the current system of planning and construction. In order to develop a model in an existing urban context which can demonstrate the solutions, it is important that certain parameters be framed so that the model does not neglect the existing positive factors of the city while developing a vision for the future design. Thus, this thesis develops parameters for design in the urban context and demonstrates them with a design model. This project is termed the future design model, which incorporates existing theories, considers urban contemporary issues and develops concern for environment and climate change. Thus, it takes an integrated approach to the built environment.
CHAPTER 1: VARIOUS PARAMETERS

This chapter deals with extracting parameters from some of the readings, which were used in the class Arc 597, Seminar on built environment (fall 2009), at Iowa State University; to understand basic urban phenomenon and the intricacies of the city. These parameters are important to review while trying to understand the model for future design. The parameters not only widen the horizon in understanding the urban context but also highlight the importance of the existing features of the day-to-day lifestyle. They provide the directions and solutions, and act as guidelines in order to understand the urban situation. They are discussed as the following topics -

**Everyday Urbanism -**

Space exists everywhere, but adaptation of space into some kind of usable form with ownership patterns and day-to-day interaction with the public imparts value to the space. The ownership provides the power to the person/people owning the space. The responsibility of how the space is translated into the desired form for the larger vision lies with the architect/planner. The following point elaborates this idea.

**Democracy of spaces -**

Although the land is found everywhere its ownership and right to access is never meant for everyone. The political boundaries, ownership lines and legal issues deny accessibility to all kinds of spaces unless some formal procedures are followed. A space might be termed public; however, it may carefully ignore, negate and not welcome certain classes or categories of people. This is where democracy of space comes into question. Some places like shopping malls, street squares or recreation facilities, although termed public, may not allow homeless to enter or its mere nature may not be pleasing for high-income people to use. Similarly, some may be gender, religion, culture or occupation biased. Some spaces are so overwhelming that it can eventually sideline certain classes of people, or they end up becoming an aspiration value to them. The anticlimax is also possible, the
hierarchy or the diversity within the mass many times controls the working of the space if not ownership. The question remains, to whom does the space belong? Alternatively, who can use the space?

**Power and space -**

The land is owned by the government, private bodies or by corporations. As per the usage, it may be open to public or certain sections of society, which could be dependent on social hierarchy, gender dominations, religious groups and dominant vs. marginalized groups of people and so on. The hierarchies are constructed in various ways and ownership of land generates the domination of power structures in that space.

**Everyday public space –**

The space that we use every day for various purposes like transition and recreation is termed as everyday public space. These could be transportation infrastructure like roads, railways, footpaths, city walks, parks, front yards, various public squares and so on. These spaces, although they are taken for granted, many times play an important role in our day-to-day urban life. It is possible to see the, social, political, cultural and, to some extent, economic reflections of society in these spaces. These spaces keep on acquiring new meanings and definitions as per the user’s need and adaptation with time.

**Informal spaces –**

The informal space can be understood in various ways. The spaces whose ownership is not formalized, or those that are encroached upon, are referred to here as informal spaces. The predominant sector, which occupies this space, is slums and street vendors. These spaces develop their own economy and over a period become an integral part of that locality unless relocated. If their population is large, they become an important political and economic force and tend to dominate in that space.
Role of an architect –

If the space is eventually controlled by the dominant sector, then the role of an architect becomes very important. The design decisions are in accordance to what they conceive the space to be. The stand an architect needs to take is to consider the context of the space along with the imagination of the designers (architects) and the aspiration of the people. One cannot escape from being biased, but can choose to consider the larger number of issues, if required.

Generic City -

Spaces are built with small elements which, when combined, form the city. These elements combine in multiples to form megacities. It is important to understand the organization structure of the city in its basic form. The idea is elaborated in the following points:
Cities and Urbanism –

The idea of a generic city represents the notion that spaces continue to build something new all the time. Cities flourish and perish. A generic city is a collage of housing, high street malls, politics, social structures, edges, architectures, geographic identities, histories, infrastructures, cultures, a diverse population, skyscrapers, and so on. The urbanism, which develops due to this simultaneous effect and presence, constitutes the making of the city. These modules repeat to form large cities. It builds itself, destroys itself, and builds itself again.

Learning from Las Vegas and Idea of Spectacle –

The city wants to be seen and all the factors that go into making of a generic city want to be seen. There emerges a strong contest between these factors in order to be the spectacle in the city. One of the prominent examples can be Las Vegas, where with strong lights and huge billboards the various commercial entities try to capture as much attention as possible. The lighting is so powerful that the architecture at many points becomes overshadowed. In addition, to combat the high-end commercial market, the low-end commercial market tries to sell postcards of their various respective trades and compete in the market. This brings another aspect of the importance of lights, signage and billboards in the making of the city; they represent the aspirations, culture and the functioning of the society/place of that place. This signage takes the form of art and it is directed to the common people. Signs, symbols and billboards are another important part of the city and serve as a medium of communication in the urban context in its quest for becoming spectacle. They play an important role in the making of a city.

Mega cities –

Cities grow and transfer to become mega cities. The growth pattern of the city is such that it tends to sprawl outwards horizontally and simultaneously vertically. Horizontal growth gives rise to the suburbs, edge cities, satellite cities, etc. Vertical growth gives rise to the skyscrapers and the class

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division. Cities become global and their global connections outnumber the local connections. It is possible that the global image then slowly starts marginalizing the existing image of the local and the divide increases between global and local. To protect the native, it becomes important that the local characteristics be maintained in acquiring the global image.
**Design and Planning -**

This deals with some of the ways by which cities can be planned. The participatory design, zonal planning, mixed use planning and so on can be some of the ways in which urban cities can be planned.

**Participatory Design and respond to context –**

The design evolving out of the participation of people is referred as participatory design. It allows the existing usage pattern to continue keeping in consideration the aspiration and limitations of the people. The output is contextual and is very specific.

**Zonal Planning versus Mixed Use development –**

Zonal planning refers to cases where each zone of a town is assigned a particular function, like commercial, educational, housing, recreation and industrial and so on. This type of planning, although very organized, denies the ease of accessibility of the functions. Mixed-use development allows multiple functions to exist in the same area. This provides interaction between the various functions to happen faster. Housing, recreation, commercial and education can happen in the same area, which can allow ease of access to the places. In addition, it can reduce commuting time, required by traveling via various zones.
Urban Contemporary Issues -

The above parameters deal with the spaces and planning of the land, this parameter deals with the issues, which are being confronted by the most of the urban cities today. This part deals with an overview of some of the urban contemporary issues like migration of population, pollution and high density of vehicular traffic; energy crisis and climate change; and food and water crisis. There is a need to address these issues for a better urban living.

Population Migration –

The world’s population over a period had been predominantly settled in rural areas. However, over the last few decades there has been a huge migration of people from rural to urban spaces.
In 1950, less than 30% of the world’s population lived in cities and this number grew to 47% in the year 2000, and it is expected to grow to 60% by the year 2025. The United States defines an urbanized area as a city and surrounding area, with a minimum population of 50,000. Cities with over 5 million inhabitants are known as megacities. There were 41 in the year 2000. This number is expected to grow as the population increases in the next few decades. It is predicted that by the year 2015, 50 megacities will exist, and 23 of these are expected to have over 10 million people.²

The shift in population from the rural to the urban was for various reasons such as better standard of living, search for employment, education, housing, economic growth, public amenities, aspirations to live in a bigger city and so on. This started having added pressure in the infrastructure facilities and demand for resources in the cities. It became difficult for the cities to cope with the increasing population to provide them with the basic resources. This resulted in increase in traffic, pollution, congestion, slums, reduction of open space, increase in cost of living, increase in pressure on amenities like hospitals, schools, recreation places, scarcity of water, food and so on. The downtowns started becoming overcrowded and there emerged another phenomenon of sprawl of people from downtown to midtowns to suburbs.

The article, Ford (1998) deals with increase in growth and importance of midtowns versus downtowns and suburbs in North America and Asia. The midtown as explained by the writer is the area in the city, which is intermediate between downtown and the suburbs. The excess populations sprawling in the outskirts of the downtown cause the rise of midtowns. In many cases, the establishment or existence of cultural centers and infrastructural development like sports venues, libraries, museums, neighborhood development, infill land development and universities and so on, play an important role in the creation of midtowns. These spaces behave like a magnet and attract many people into the cities. This is evident from many Asian cities, where a huge number of skyscrapers, hotels and office spaces exist which increase the economic development of the city.

Pollution and high density of vehicular traffic –

Over a period of time downtowns, midtowns and suburbs were created with a very blur boundary between them. The resultant patterns developed was the majority of the people started traveling from suburbs where they lived to midtown and downtown for work. This increased the traffic levels and in turn increased the pollution due to long distance traveling. Transportation was divided into two systems: public and private. Public transportation in the cities includes trains (subways, elevated), buses and taxis, while private transportation includes cycling, walking and motor vehicles (motorcycle, truck, and car). As cities grew, there was a rise in the income level of the people, which in turn resulted in the increase in car ownership. To provide ever-growing population with food and other resources, the transportation of goods increased on the roads. The transportation sector alone is responsible for 14% of the world’s green house gas emissions, 10% of which come from road transportation and the remaining from air, ship and rail.  

Energy Crisis and Climate Change –

Cities uses energy in a multitude of ways; some are obvious such as illumination, heating and cooling, power and electricity while others are less obvious, such as energy, which is hidden or embedded in the production of buildings, infrastructure, food, clothing and all the other things we use for our needs and desires like security, comfort and fulfillment. Of all these uses, providing electricity and heating is responsible for around one quarter of all human-induced greenhouse gas emission.

Over 70% of the primary energy, requirements of cities are met by burning fossil fuel oil, coal and natural gas and it is responsible for 60% of carbon emissions. Cities contribute over 80% of the world’s carbon emissions.  

Energy requirements met from fossil fuels has some major issues – they are non renewable and hence are becoming scare leading to price rise of fuels, and secondly it causes major carbon

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3 [http://docs.lead.org/allcohorts/LeadMegacities.pdf](http://docs.lead.org/allcohorts/LeadMegacities.pdf), 06/11/2010
4 [http://docs.lead.org/allcohorts/LeadMegacities.pdf](http://docs.lead.org/allcohorts/LeadMegacities.pdf), 06/11/2010
emissions leading to the destabilization of the global climate making certain parts of the planets inhospitable for living. As climate change becomes more apparent, it can lead to catastrophic effects.

**Food and Water Crisis –**

Increase in city populations has resulted in more people moving away from agriculture. Expanding cities also imply the transformation of the land use in its outskirts from agriculture to commercial, residential or industrial. Although food crisis is not a major issue in developed countries it is a big problem in developing and under developed countries. Efforts of the UN World Food Program (WFP) to meet immediate emergency shortfalls have risen from $3.1 billion in 2007 to almost $6 billion in 2008.\(^5\) Such radically elevated emergency demands will persist into future.

Similarly, the problem of water crisis is seen mostly in developing and under developed nations. A 2004 UN report suggests that around 1.1 billion people had inadequate access to water and 2.6 billion people lacked sanitation.\(^6\) Lack of water for drinking and sanitation largely affects poor who are forced to live in settlements where water supply is unavailable or intermittent.

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\(^6\) [http://docs.lead.org/allcohorts/LeadMegacities.pdf](http://docs.lead.org/allcohorts/LeadMegacities.pdf), 06/11/2010
Discussion -

The parameters thus range from ownership of the space, to the idea of a generic city involving day-to-day activities, to the planning of new towns, to understanding the current urban issues I have identified in the previous section. In all of the cases, one thing that remains common is the role of the architect and position they assume while providing the design solution. They may choose the design to be completely biased to certain groups of people, or create blurred lines between the spaces. They may consider the smaller details like signage and billboards as a part of the architecture. They may consider urban contemporary issues, or provide a responsive to solar design. The architect plays a very crucial role. It is this vision of an architect that helps to develop the future model, which can help to create better urban living conditions.
It is virtually impossible to remain unbiased and create architecture, which can make everyone happy. Nevertheless, there can be some blurred lines within the design solutions, which can allow the interaction between various groups of people. These blurred lines can be in the form of common public place, common infrastructure, mixed use planning and merging various functions like housing and office. The design solution has to not only look into the larger spaces of the city but also the smaller aspects of spaces used in day-to-day activities. Cities are formed of various factors and every factor has its own importance and charm. The design solution has to live up to the aspiration of the people and maintain the charm of the factors as discussed in the idea of a generic city. The design solution not only has to take into consideration food, water, energy, land and density crisis, but also has to take care of the planning aspects.

**Conclusions -**

A new model is required which would enable the incorporation of these factors and allow the necessary changes to happen which would be beneficial to the urban conditions. This new model is required to relieve cities from the problematic urban contemporary issues. It is required so that an
alternative system of transportation is developed. A new system of urban agriculture can emerge which will reduce the burden on rural agriculture. A new form of planning is required which can be incorporated into the existing urban system and help in the cause to reduce transportation and carbon footprints. A new model is required which can reduce the gap between the various sections of society and allow necessary interaction within the groups. A new model is required, which is eco friendly in design and produces energy for itself, partially if not entirely, a model that allows and encourages recycling of waste, water and other resources. This new model can emerge from current theories or by merging various theories with some innovative thinking. This new approach is referred to as the ‘future model’, which this design dissertation studied; and the various parameters above are the framework for which the design solution was provided.
CHAPTER 2: THEORIES AND CONCEPTS

To develop the future model, we have to go beyond any single theory or conventional systems of planning. The future concepts have to overcome the resistance to change. It has to re-examine the way ideas of urban design and planning are carried out. It has to ensure that it generates very little carbon footprint and causes minimal damage to the environment. It has to be sustainable not only for the environment but also for the socio-economic structure. The various theories and concepts, which have been studied considering the above parameters, are designing the future by Jacques Fresco, Landscape Urbanism, Sustainable Urbanism, Garden Cities; Eco-Master Planning by Ken Yeang, Urban Agriculture, and Vertical Farming. They are discussed below:

Designing the future by Jacque Fresco -

This reading talks about developing a new form of economy that is resource-based rather than currency-based. It calls to adapt technology for the execution of various futuristic ideas. The summary of the theory (obtained from the web address) is written below:

The reading starts with the necessity of accepting the change. He provides many historical examples that show how everything changes and that it’s all a part of an evolution process. Many historical changes that were proposed were thought to be a taboo in the society at the time, but later on, those changes were adapted as a practice. It is a natural human tendency to resist that, which is out of the norm because a feeling of discomfort is attached to it. He introduces some of the urban issues facing cities and suggests that it is important that one adopt scientific methods for planning and development of various infrastructure facilities like railways, agriculture, and health care and so on. The answers cannot be attained intuitively but by a rational means of thinking. He says that all the problems in the world are because of the imbalance that is caused in supply and demand. The examples given by him are that in a place where you get abundant seafood people share their meal with each other and live peacefully. It is important that we change the current system of thinking and

http://www2.thevenusproject.com/the-venus-project-introduction/about, 05/17/2010
reassess the basis of our economy. Currently the class structure of society is such that majority of the wealth and resources are in the hands of few people, while few resources and wealth are available for the rest of the people. This creates a tremendous imbalance resulting in urban issues like poverty, crime, congestion, and so on. Jacque Fresco defines money as just an interface between the need of a person and the ability of a person to get. Even though technology has played an important role in the development of society, it is only available to someone who has purchasing power. Although the technology is very important, it is not the complete solution. It is just an aid. If technology were able to provide the complete solution for current and future social living then there would be no scarcity of food, clothing and shelter. Technology is racing forward but our societies are still based on concepts and methods devised centuries ago. We still have society based on scarcity and the use of money. 852 million people across the world are hungry. Everyday more than 16,000 children die of famine; worldwide more than 1 million people live below international poverty line below $1 per day. A very small fraction of the people own most of the world’s wealth and resources. Thus, he proposes the need for a different form of economy, which he calls ‘Resource based Economy’. It means that all the resources are available to the human beings directly without any form of monetary interferences. The real wealth of any nation is not its money but the developed and potential resources and the people who work towards the elimination of scarcity for a more humane society. In an economy that is based on resources rather than money, we can easily produce all the necessities of life that can provide a very high standard of living for everyone. What is needed is an energy development strategy on a global scale requiring a joint venture of international planning on a level never achieved before. The end goal is not to make money in order to continue working but to achieve results that are freely and quickly available to the planet’s entire population. If we tapped the vast energy potential of the world’s oceans, occupying 71% of the earth’s surface, we could easily meet present and future energy needs for millions of years to come. Scientists predict that if we develop and harness only 1% of the geothermal energy available in the earth’s crust our energy problems would be eliminated. Geothermal energy can supply more than 500 times the energy contained in the world’s fossil fuel resource while reducing the threat of global warming. Geo thermal power plants produce very little
pollution compared to fossil fuels and emit no nitrogen oxide or carbon dioxide. To have a world without pollution and waste and yet retain parks playgrounds, art and music centers, school and health care available to everyone without a price tag, requires profound changes in the way we plan cities as well as our lifestyles. The design and development of these new cities emphasize the restoration and protection of the environment. It must be understood that technology without human concern is meaningless. The new cities would provide a total environment with clean air and water, health care, good nutrition, entertainment, access to information and education for all. The cities would function as evolving integrated organisms rather than as static structures because their design accommodates to change. This total environment will permit the widest possible range of individuality and creativity in them.

Some of the imaginations of Jacque Fresco for the future model for cities are shown below –
The figure 8 shows the imagination for passenger trains where a compartment is lifted when the station is arrived, conserving the energy and being more efficient. The above figure 9 shows the imagination of self-sustained dwellings. The above figure 10 shows the marine city, which can be built and transported or towed to various water bodies. The figure 11 shows the imagination of self-sustained city for the future model. The figure 12 shows extensive use of solar technology for generating electricity. The above figure 13 shows the application of newer technologies operated by robots and automatic cranes.

**Conclusion** - The entire utopia presented is with the assumption that a resource-based economy would be the basis for the functioning of society. The theory has limitations in dealing with the existing urban conditions. He foresees the idea of sustainable development and tapping the renewable sources of energy as the key features for future development. The fact that various aspirations like

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8 http://www2.thevenusproject.com/technology/transportation, 05/17/2010  
9 http://www2.thevenusproject.com/technology/housing, 05/17/2010  
10 http://www2.thevenusproject.com/technology/cities-in-the-sea, 05/17/2010  
11 http://www2.thevenusproject.com/technology/city-systems, 05/17/2010  
12 http://www2.thevenusproject.com/technology/energy, 05/17/2010  
13 http://www2.thevenusproject.com/technology/construction, 05/17/2010
education, housing, open space, etc., can come without a price tag acts as one of the important outcomes of his theory. The production of resources governs the economy. He lays too much emphasis on technology. Technology plays an important role in the making of such a futuristic model. However, it acts like a tool to achieve the desired results and is not the ideological solution to the problems. He envisages cities as a continuous growing system, which has flexibility and scope for the future developments.

**Garden Cities -**

The theory of garden cities was proposed by Sir Ebenezer Howard (1850-1928) in 1898. The garden cities work on the idea that at any given set area only a certain amount of population should exist which is supported by infrastructure facilities, housing, industrial zones on the peripheries, public amenities, gardens and open spaces, boulevards and so on. The agriculture belt surrounds this area. Such a set area is termed a garden city. When the population starts increasing, another similar city is developed and the two cities are connected by railways and roadways. The merits of this theory are that the city is overloaded with demands of the population needs very infrequently. Most of the requirements are met within the city itself. The concentration is not vertical, but the garden city is balanced with open spaces, public amenities, housing and commercial zones. The planning is not about making it highly dense but about interconnected fragments. It ensures safe, healthy and comfortable living conditions. The planning diagrams are shown below:
The figure 14 shows the interconnection between various garden cities.

The above figure 15 shows the planning of a garden city where plots are allocated according to various functional purposes.

The above figure 16 shows the organization of various garden cities.

The above figure 17 shows the organization of a garden city.

**Conclusion -** The concept of garden city where infrastructure facilities are not concentrated and employment opportunities are distributed allows fragments to develop rather than development being concentrated at one place. This generates less congestion in the cities and reduces the density of population. In addition, incorporating agriculture helps to reduce the dependence on rural sectors. Thus, the idea of distributed development can help to generate better living and sustainable conditions.
**Sustainable Urbanism -**

Ideas like Sustainable Urbanism have emerged as proposals to save the cities from becoming worse, and to salvage the environment and conserve resources. It provides a solution, which does justice to planning, environmental, and social-cultural-political issues.

*Sustainability is defined as a constraint on present consumption to ensure that future generations will inherit a resource base or opportunity set no less than the previous generation inherited.*

Sustainable Urbanism can be understood from the four main sub groups – Social and Cultural Equity, Economic growth and Development, Environmental Protection and Management of Resources.

**Social and Cultural Equity –**

Social and Cultural Equity is best understood with the idea that Sustainable Urbanism should improve the functions of various diverse social systems, like caste, class, religion, various organization, age group, gender, and so on. Sustainable Urbanism enhances the quality and fair exchange within these systems. It means that Sustainable Urbanism promotes the advancement of society, preserves cultural heritage, and in addition, strengthens the agreed values and norms (national, international, conventions, etc) of the society. Political decisions play a very important role in maintaining the equity in Socio – Cultural aspects of the society. A policy influencing growth in one region can have severe negative impacts in other regions. For example, a policy to build a dam can be an extremely encouraging scenario for one region but it could be disadvantageous in another region where the river water is utilized for agriculture. Moreover, if there is a minority or very little power with the people of that section, it may not have much say in the decision of the policy. Nevertheless, this is not a rare phenomenon and seldom is the common justice achieved. As stated "As the system approaches ecological limits, inequalities are sharpening. Our inability to promote the common interest in

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sustainable development is often a product of the relative neglect of economic and social justice within and amongst nations."¹⁹

Sustainable Urbanism tries to achieve the unity between these arrangements. It surpasses the geographical boundaries like neighborhoods, regions, topographical constraints; legal issues like political jurisdictions, legal decisions; social barriers like caste and class systems, gender inequality, etc. and narrows the gap between them.

**Economic Growth and Development –**

*Economic Growth is measured by increases in real GNP per capita, or the total size of the economy. Development is a much more subjective concept. Development refers to a promotion of ideas like increasing welfare, improving the quality of the environment, even distribution of wealth and improving health and education. Sustainable Development is not only concerned with the continuing ability to increase income through economic growth, but also the ability to achieve other qualitative goals.*²⁰

Sustainable Urbanism can foster the economy growth in an urban set up. Ideas like urban agriculture, vertical farming, waste management, and recycling of resources, have the potential to generate a new set of revenue input system within the city. The idea of recycling of natural resources like water, energy and waste, ensures that everyone in the city is privileged to receive a good quality of water and everyone receives natural resources as per their requirements. As stated in the Brundtland Report, "Sustainable Development is not a fixed state of harmony, but a rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological developments, and institutional change are made consistent with present as well as with the future needs."²¹

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Sustainable Development is possible if everyone receives the basic human needs and equal opportunities to develop and achieve their aspirations, making sure that they leave adequate resources for their future generations as well. Sustainable Urbanism deals with the changes in the physical form of urbanism. The modifications could be changes in land use pattern from complete profit making to welfare units, recreational spaces, open spaces which can be utilized for urban agriculture or vertical farming, incorporation of waste management and utilization and recycling of natural resources at local / micro levels rather than at urban or macro levels. Without these physical changes, it is difficult to achieve Economic Growth and Sustainable Development within the Urban Context.

**Environmental Protection –**

Environment Protection is related to the physical environment like air, water, natural habitat, and ecosystems. Environmental protection is very important because we live in that environment and utilize the resources of the environment. Any harm to the environment has a direct impact on the human habitats.

> The various species are necessary for the effective functioning of the ecosystems and biosphere as a whole. The vital life processes carried out by nature including stabilization of climate, protection of watersheds and soil, protection of nurseries and breeding grounds and so on are very much important. Conserving these processes cannot be divorced from conserving individual species within the natural ecosystems. Managing species and ecosystems together is clearly the most rationale way to approach the problem of extinction of species leading to the distortion of eco systems.\(^{22}\)

Sustainable Urbanism with its idea to incorporate local species in the landscape provides a solution to protect and raise the species within the locality. Appropriate land use patterns would allow the natural habitat to grow and develop. Incorporation of hydrology within the systems rather than shutting them off completely will provide a much-needed interface for the development of species. In addition, the

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hydrology can be incorporated within the urbanism and the entire urban system can work as a single sustainable entity. The air, water and noise make the bulk of the pollution. Due to rapid industrialization and excessive increase in the vehicular traffic, emissions into air have increased many folds. The process of urbanization has slowly waned the understanding of scarcity of fresh water. The demands of increased populations and the desire for higher standards of living have brought with them much greater requirements for fresh water. Last but not the least the most important aspect of Environmental Protection is Global Warming. Cause and effects of global warming are well known. Sustainable Urbanism tries to minimize the environmental pollution by considering all the various factors into the design of the urban or micro level of architecture.

**Management of Resources -**

Management of Resources means efficiently managing the resources in a way, which can be utilized for future generations as well. The demand of resources like electrical energy, water, other natural resources, etc. has increased tremendously due to an extreme increase in industrialization. This has led to an uneven distribution of energy and the consumption of resources many folds. Sustainable Urbanism encourages the use of renewable sources of energy like wind, solar energy, etc. and recycling resources like water, solid - wastes, etc. It promotes the idea of energy usage from biomass. This form of Urbanism promotes the idea of developing food crops within the locality with the concepts of urban agriculture and vertical farming. Development of crops within the urban fabric can save tons of fossil fuels, which is utilized in transportation of the food crops. Designs of the urban fabric in response to the climate add to the saving of the energy utilized for HVAC and lighting. HVAC is one of the main contributors to the global warming and energy consumption. Sustainable designs integrates the concepts of passive solar design, recycling of waste, minimizing waste, promotion of renewable sources of energy, urban food production methods and provides a solution to the ever growing demand for resources.
Conclusion: Sustainable Urbanism promotes socio-economic system of development in the urban fabric. It strives to maintain the conditions and resources for future generations. It not only concerns the environment but also the various ecosystems. It is important to incorporate the ideas of Sustainable Urbanism when designing the model for the future.

Landscape Urbanism –

Landscape Urbanism was first anticipated in the Landscape Urbanism symposium and exhibition in 1997, originally conceived and organized by Charles Waldheim, and has been further articulated through a range of publications. Landscape Urbanism is explained with four ideas, provided by James Corner in the article ‘Terra Fluxus’, Processes Over Time, the Staging of Surfaces, The Operational or the Working Method and The Imaginary.

Processes over time –

The processes over time are understood as the idea that urbanization has more factors in its working than the modernist notion of buildings. The processes of Urbanization – capital accumulation, deregulation, globalization, environmental protection, and so on are more significant than for the shaping of urban relationships than are the spatial forms of urbanism in and of them. The idea is neither the built forms nor the landscape in their individuality are responsible for the effective functioning of the urban but the integrated approach where both of them are looked as a single entity in urbanism. The interaction and inter relationship of built form and organisms account for development of ecology or adds to the idea of ecology. As stated by the cultural geographer David Harvey –

The struggle for designers and planners is not with spatial form and aesthetic appearances alone but with the advancement of more socially just, politically emancipator and ecologically sane mix of spatial – temporal production processes, rather than the capitulation to those

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processes imposed by uncontrolled capital accumulation backed by class privilege and gross inequalities of political power.\textsuperscript{25}

Thus one can understand that the ecology is not the alone criteria but the idea of social - political - cultural equity also plays a very important role.

**Staging of Surfaces –**

The staging of surfaces deals with the idea of a plane. The ground plane is not merely the ground plane but it can also become the intermediate or top planes within the systems. It suggests to re-understand the programming of functions and to re-think the idea of plane of just being the horizontal surface. *This suggests contemporary interests in surface continuities, where roofs and grounds become the same; and this is certainly of great value with regard to conflating separation between landscape and building.*\textsuperscript{26} This allows urban growth in population, development of various demographical patterns and interactions within the existing systems. Thus, the surfacing not only re-looks at programming of the functions but also looks in positioning them.

**The Operational or Working Method –**

The idea of Landscape Urbanism needs to be incorporated into the day-to-day basis of urban life. It should not stop at the establishment of the system or at the building of infrastructure. It should be a part of the conventional practices of all the disciplines in terms of build environment.

*There is no shortage of critical utopias, but so few of them have made it past the drawing board. It is both tragic and ironic that as designers we are all ultimately interested in the density of building but that most who actually accomplish this can do so through the typically unimaginative and uncritical techniques of designs as a service profession. On the other*
hand, the visionaries it would seem are as always provocative and interesting, but their utopias continually evade the problem of an operative energy.\textsuperscript{27}

It is important for contemporary designers and planners to take an integrated approach and provide proposals to the developers in order to make a better habitable urban condition. The conventional system of practice of creating the built environment is highly one-dimensional. It has penetrated deeply within the professionals and professions of built environment. Landscape Urbanism should be incorporated into conventional systems of working and an integrated approach is required for the masses in day-to-day activities.

**Imaginary –**

The imaginary is the fourth of the part in Landscape Urbanism. As stated by James Corner, *The failing of the twentieth century planning can be attributed to the absolute impoverishment of the imagination with regard to the optimized rationalization of development practices and capital accumulation.*\textsuperscript{28} The imagination of the urban planning or design is the key to the betterment of the urban fabric. The elements of urban structure like housing, need to socialize, necessity of food, common recreational facilities, transportation and other forms of civic infrastructures, etc. always existed right from the inception of civilization to now, but the manner in which they are imagined and incorporated into the society has varied from one generation to another. Every generation imagines these structures to become more efficient, more productive, more aesthetically appealing and this gives rise to the growth of the society. Thus, this imagination is about considering the present and taking in to account the future. In addition, it is possible if there is an aspiration for the future, which is provided by the imagination for the future.

**Conclusion:** There is a need to imagine an integrated approach within various disciplines of planning design or various systems of the urban fabric, which work independently. This imagination is required

to make sure that the future generations of cities do not encounter the same barriers as the current ones in order to enrich the urban living experience.

**Eco Master Planning -**

This part presents the idea of eco-planning as understood from Ken Yeang’s writing. He addresses the issues of environment, water, public amenities and socio-economic welfare using four types of infrastructure. They are green infrastructure, blue infrastructure, grey infrastructure and red infrastructure. They are discussed as below:

**Green Infrastructure –**

Green infrastructure is the system of interconnecting surrounding areas and open spaces within the site. Within this system, there is interconnectivity between various habitats. The green infrastructure is not limited to the site but can be applied at an urban scale. It delves into resource management like sustainable management of land, ecosystems and water resources; sustainable management of production of energy and food crops; pollution control, climate amelioration and increased porosity of land cover. It is integrated with other infrastructures like blue, grey and red infrastructures. Thus, green infrastructure is designed taking into considerations and integrating social and economic aspirations of the built development and communities with the environmental benefits of biodiversity.

**Blue Infrastructure –**

Blue infrastructure is a sustainable drainage scheme for the management of surface water runoffs and management and conservation of water within the built environment and its context. It takes into account appropriate usage of rainfall within the site using various techniques like retention ponds and bio swales filter drains, permeable surfaces and so on. Blue infrastructure can function as wetlands. Thus, blue infrastructure is designed to be sensitive to environmental and local community needs of water, to provide a habitat for the growth of wildlife in urban watercourses, enhance natural ecological
processes and to provide aesthetic and educational amenities in the form of wetland habitats; which are increasingly under threat from regional development.

**Grey Infrastructure –**

Grey infrastructure deals with all the engineering systems required for the functioning of humans in any urban development like roads, drains, sewerage, electricity, IT, telecommunications, firefighting systems, street lighting and solid waste disposal. The grey infrastructure is designed to make these engineering systems green and carbon neutral. It rethinks and reinvents the way in which the transportation networks are established resulting in minimum carbon footprints, for example – clearly defining cycle routes, pedestrian routes, and minimal impact on site and topography while designing highways, roadways, railways and bridges. For grey infrastructure to be fully effective for eco-master planning, it is important that it gets integrated with built environment fabric and it is carried out in tandem with other infrastructure like green, blue and red.

**Red Infrastructure –**

Red infrastructure is comprised of the spaces part of built forms like public realm and recreation spaces, pedestrian networks, and governmental, social and economic systems. It is interwoven with the other three infrastructures – green, blue and red. It suggests the design of the built environment is similar to ecosystems, where all the waste is recycled. The red infrastructure not only considers the socio-economic factors but also design considerations, aesthetics, materials used, the ways in which the built fabric is assembled, adaptation of buildings over time and recycling of building components and materials.

**Conclusion -**

Eco – Master planning, is explained using four infrastructures green, blue, grey and red. The success of these infrastructures lies in integrating all four of them together to design a built environment that is interwoven and behaves like an ecosystem. This allows the development of the built environment without the destruction of natural habitat; instead, they become an integral part of the development.
Eco – master planning also suggests the idea of breaking away from the convention of positioning functions in ground planes. Thus as stated by the author, “Eco master planning is the environmentally benign and seamless biointegration of the four infrastructures – green (eco), blue (water), grey (engineering) and red (human) - of buildings, enclosures and hardscapes, at the physical, systematic and temporal levels.”

**Urban Agriculture -**

Urban agriculture can be briefly defined as the growing of plants and the raising of animals within and around the cities. The most striking feature of urban agriculture, which distinguishes it from rural agriculture, is that it is integrated into the urban economic and ecological system: urban agriculture is embedded in -and interacting with- the urban ecosystem.29

Thus, this system incorporates the use of urban residents as laborers, urban resources like organic waste as compost and urban wastewater for irrigation. It generates a direct link with the urban consumer, directly affects the urban ecology, generates an urban food system, and generates breathing space in the dense localities.

The advantages of urban agriculture can be understood as follows:

**Economic –**

Urban agriculture develops another system of economic development in the urban fabric. It generates entrepreneurial activities and creates job opportunities. The job opportunities can go beyond agricultural activities to processing, packaging and marketing. In countries where women do not have much job opportunities urban agriculture can act as an activity that can allow them to be a part of economic welfare.

**Social –**

Social benefits that can emerge from urban agriculture are development of open breathing spaces with farms within the urban system. This helps in better living against closely packed buildings. It helps to generate economic development (as discussed above). It encourages participation of

29 [http://www.ruaf.org/node/512](http://www.ruaf.org/node/512), 05/17/2010
women, increasing the household income. Participation from women helps in increasing their roles in the welfare of the society. It helps to reduce food scarcity. If practiced on wide scale, urban agriculture can help to develop food security in the cities. It can reduce dependency on rural agriculture and can help to reduce pressure on them.

**Environmental –**

Food production within the city helps to reduce the transportation of food from the rural sectors. This helps in the saving of fuel and reduction of emission of gases via transportation, resulting in decreases in overall carbon footprints. Waste generated within the urban realm can be re used in urban agriculture as compost or manure or for agricultural purposes. This supports the recycling of waste and makes the system much greener. The excess water is percolated in the ground helping ground water recharge.

The disadvantages and difficulties of urban agriculture can be discussed as:

a. The use of wastewater for irrigation without careful treatment and monitoring can result in the spread of diseases among the population.

b. Cultivation on contaminated land can lead to health hazards.

c. Since urban agriculture is practiced in an urban context, there can emerge large instances where the farms are along roadside. This exposes them to direct continuous pollution.

d. Due to small available plots, efficiency can be less than rural agriculture.

e. The pressure to convert the land into a real-estate value would be large in the cities.

**Conclusion -**

Urban agriculture is extremely beneficial in the urban realm and it has too many advantages to discard from the urban context. Technology can play its role in monitoring and growing vegetation in contaminated land and treatment of the waste from agriculture. Adequate planning and policies can reduce the impact of pollution and pressure on urban agriculture. Given the ever-growing nature of cities, it becomes even more important to speed up its incorporation in the cities. Urban agriculture
thus needs to be interwoven for social – economic development of the city, simultaneously serving the environment for its betterment.

**Vertical Farming -**

Vertical farming is developing agricultural production in urban high rises or in buildings dedicated to farming termed as farm-scrapers. Various techniques can be incorporated like artificial lighting, greenhouses, Aeroponics and Hydroponics. One disadvantage of vertical farming is that the energy required for artificial lighting is far too high. Eliminating the need for artificial lighting can be one of the solutions in the design of farm-scrapers to save energy from artificial lighting. The advantages and disadvantages of vertical farming are similar to urban agriculture. Vertical agriculture forms an integral part of the urban agriculture system, hence is beneficial in the urban context and should be a part of the future model for the cities.

**Discussion -**

The above theories help us fulfill the needs for various parameters as understood in the previous chapter. Most of the theories urge the integration of all the factors: social, economical, political, cultural, resources and everyday activities, thus providing a solution to urban contemporary issues; designing the future need for developing a resource-based system. Garden cities call for distributed rather than concentrated planning. Landscape urbanism and sustainable urbanism not only focus on socio-economic structure but also upon the need to re-imagine the functions at various ground planes. Eco-master planning with its various infrastructures hit upon the aspects of human, green, water and engineering and suggests the design to function like an ecosystem, generating minimum waste and emphasizing recycling. The concepts of urban agriculture and vertical farming help to understand the necessity of incorporation of farming in the urban realm. The above theories thus provide guidelines to develop the model for the future designs of urban spaces and architecture.
**Conclusion -**

In order to provide solutions to urban contemporary issues like migration of population, reducing the density of vehicles and population, energy crisis and climate change, and food and water crisis; it is important that certain measures like fragmented planning, urban agriculture, resource management are adopted, which can help to provide answers to the issues. The design and planning should be in tandem with developing the infrastructure and integrating them with human, green systems, engineering and water. The idea of ‘generic city’ is understood with the various facilities for socio-economic structure along with public amenities. Everyday urbanism is the successful integration of all the above aspects behaving in unity to produce a design working like an interdependent system similar to an ecosystem.

This design dissertation deals with how successfully the above model is incorporated into a site and how effectively the future parameters are satisfied.
CHAPTER 3: SITE SELECTION, SITE STUDY AND PROGRAM DEVELOPMENT

This chapter is divided into three parts. The first part deals with site options and carrying out site study in the selected option (option 3). The second part deals with developing a program considering the site study and context. The third part deals in proposing the programs taking into account various parameters and theories as discussed in the previous chapters. The programs are also generated from the site study.

Chicago is chosen for site selection due to its richness in architecture. Chicago has some of the best architecture in the world and has the tallest building in the USA. It is one of the biggest and highly dense cities of the world. The diverse culture in an urban setting with wonderful architecture provides one of the best opportunities to demonstrate the model for the future.

Site Options and site selection -

Three sites were selected based in downtown having some historical and urban context. The site options are discussed below:
The figure shows, the top view of the site, measuring 60x170 m (approx). The site is surrounded by park on the north, rail line on the east, mixed-use development along west and park along the south.

Location – At S. Michigan avenue & E Roosevelt road

The above diagram shows the context along the site, Chicago river to its extreme west, to colleges and universities in the north and south, Logan monuments and Buckingham Fountain in the east. Mixed use development all around the place.

The figure shows an aerial view of the site, showing the scale of the buildings and landscape around it.

Central Station, it has now become a rail yard and a public park displaying installations of leg sculptures in the park, around the site.

Site is highly undulating in nature. The site is flanked by trees in its corner.

Since site is located in downtown, it is accessible by CTA buses and railways.
The figure shows top view of the site measuring 265x760m (approx). Roosevelt road forms the northern boundary. Mixed use development along north, east and south. Chicago river and metro line lies along west.

The figure shows the context of the site with mixed used development around it. Important landmarks around it are Shed aquarium, Field Museum and Burnham Park Harbor along the east, public and private schools in the south.

The aerial view of the site shows the scale of the buildings and landscape around it. It also shows the path of the Chicago river along the site.

The site is slightly undulating in nature and it is covered by wild vegetation. The site is a barren plot and has electric poles along its northern edge. The site lies below the road level of the W. Roosevelt and S. Clark road avenues. CTA bus, rail and metro station is nearby.

The two pictures show (adjacent and above), the mixed used development along the site.
Option – 3

Option 3 was selected due to site features like high rises and congress pathway along the north, Chicago river in the east, river city complex along the south that has developed the water terminal transport for small boats and, mixed use development along the east.

The image shows the top view of the site measuring 100x235m (approx). The Congress pathway lays to the north, mixed used development along east, Chicago river along west and river city complex along south.

Location – The site is located along W. Harrison Street and S. Wells Street.

The above figure shows the location of the site with its larger context. There are important landmarks around the site like Sears Towers, Chicago Stock Exchange building and other range of high-rises. They are along the northern part of the site.

The aerial view shows the important high rises along the northern part of the site.

The aerial view shows the Chicago river along west and congress pathway along the northern boundary.

The site is of undulating nature and has a boundary of trees along the edge of the river. The site is currently an open plot for sale. CTA bus lines, rail lines and metro station are nearby.

The figure shows one of the buildings of the mixed-use pattern along the east side of the site.
Site Study for the selected option - 3

Site panorama showing taken from the south edge of the site, showing the scale of the buildings and landscape around it.

**Transportation Network** – The site is well connected with roadways, railways, metro and bus service.

The above diagram shows the traffic map around the site during the daytime.

The above diagram shows the traffic pattern during the nighttime.
Site Study for the selected option - 3

**Street Characteristics** - The street size around the site is mostly for two lanes with parking on both sides. This leaves very little space in case of any breakdown. This situation results in high density of vehicular traffic in the roads.

<table>
<thead>
<tr>
<th>Two lanes and parking along the road on the eastern side of the site</th>
<th>The pattern continues in the northern part of the side along the high rise zone</th>
</tr>
</thead>
</table>

At some places, there is one way traffic.

**Building Types** – Old and new buildings exist within the same block or the area around the site. Age of the buildings may vary from 2-3 years to around 50 years. The functions within the buildings vary, as it is in a mixed-use development.

<table>
<thead>
<tr>
<th>Old buildings like Dearborn station</th>
<th>New development along the Chicago river</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building dedicated to parking</td>
<td>Old building and new building next to each other</td>
</tr>
</tbody>
</table>
Site Study for the selected option – 3

**Open Spaces** – The areas around the site do not have a public space. Most of the open space has been utilized by parking. In many cases, there is alley space between buildings. The area requires public open space around it.

<table>
<thead>
<tr>
<th>Open space occupied by the parking</th>
<th>Smaller areas have been encroached by the parking</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Some open spaces become redundant in winter due to snow.</th>
<th>Very little space between two buildings resulting in negative spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Image" /></td>
<td><img src="image4" alt="Image" /></td>
</tr>
</tbody>
</table>

**Occupation / functions** – Due to mixed-use development in the site, residential, commercial and retail form the functions in the buildings. However, commercial forms the dominant section in these areas. Renting out apartments, condominiums, office spaces, and so on is also an important aspect in the area.

<table>
<thead>
<tr>
<th>Real Estate and renting the space is one of the important occupations around the site.</th>
<th>Offices of varying nature are the primary function in the area.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Image" /></td>
<td><img src="image6" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Retail in the ground floor with commercial or residential on the above floors is the typology of the buildings around the site.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7" alt="Image" /></td>
</tr>
</tbody>
</table>
### Site Study for the selected option – 3

<table>
<thead>
<tr>
<th>Institutions around the site</th>
<th>Chicago Stock Exchange building in the northeastern part of the site</th>
<th>University along the northern part of the site</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the northeastern part of the site</td>
<td>University along the northern part of the site</td>
<td>Pictures taken from the southern part of the site</td>
</tr>
<tr>
<td>University center along the northern part of the site</td>
<td>School along the northern part of the site</td>
<td>Some site pictures – Pictures taken from the southern part of the site</td>
</tr>
</tbody>
</table>

The institutions around the site range from finance buildings to university to schools to colleges.
**Site Analysis and Program Development** -

The site study shows that the area requires certain public infrastructure, has the potential to develop a transportation system using the river along the west and needs to ensure that it does not generate excessive vehicular traffic. The development of programs can be discussed as below –

**Public Space** – Although the area around the site has some breathing space in the form of parking lots, it lacks public open space.

**Mixed-use development** – Mixed use development patterns need to be continued while deciding the program for the site.
Chicago skyline – The site need not compete with the skyline along the northern parts, but be limited to the mid rise height as observed in the other buildings around the site.

High density traffic and built up – Due to the high density of vehicular traffic and higher number of office buildings around the site, a new system of program needs to be introduced which reduces the transportation and simultaneously provides employment opportunities.

Opportunity to develop alternate mode of transport system – As seen in the river city project, which is in the southern part of the site, its design allows the scope for the development of water transport in the city. This can help to develop an alternate means of transport; can help to promote tourism and forms of trading of goods in the city.

Proposed Programs -

Live-work apartment’s complex -

The proposal for live-work apartments provides employment opportunities within the least transportation distance. Since the complex needs to cater to diverse sections of the society, it needs to have different types of apartments. Since this complex is envisaged to also have community development, common spaces are required where the work-section in the complex can be used for a variety of purposes like meetings, waiting rooms, storage, audio – visual room for training purposes and so on.
Vertical farming –

The concept of vertical farming is proposed as a part of the urban agriculture process. This would help to generate employment and it can be a part of economic development. The waste generated from the building can be processed and used for varying purposes in farming.

Office Building –

A part of the project is proposed for office purposes. These offices, apart from its regular usage, can be used for varying purposes like processing, packaging, and other necessary activities for the products grown in the vertical farms. It can be also used for trading of goods that happen via river transport.

Aqua transport development –

The Chicago River is used for internal transport of goods and tourism. To continue the trend, a small ship and boat terminal is proposed so that a new form of transportation is developed. This transportation can be incorporated and used for trading of farm products grown and processed within the complex.

Exhibition –

Public exhibition is proposed to demonstrate the various green systems, workings of the water terminal, vertical farming, and to spread awareness about sustainable developments.

Retail and cafeteria –

Retail space is proposed which can sell products manufactured in the building and provide services for various green building systems. Cafeteria and restaurants can act as supporting infrastructure to the entire complex.
Public bridge and island –

A public bridge is proposed along the length of the river that takes you across the site. It has two stops, one along the proposed peninsula and other along the proposed island in the river. This bridge enriches the experience along the river and helps to unify the land and water.

Development of tourism –

Exhibition spaces, water rides, walks along the bridge and demonstrations of the relatively new concept of vertical farming can act as a tourist attraction that can promote tourism.

Public space –

A common public space can tie together the above public functions. In addition, it can help to provide breathing space in the high-density zone.

Conclusion -

Thus, program development undertakes the scopes and possibilities to develop the model that can fit into parameters discussed in the above thesis research and provide a vision for the future. The following chapters will show the case studies, process and results of the model and possible discussions and conclusions.
CHAPTER 4: CASE STUDY

The projects chosen for case study undertook an approach, which not only addressed the need of functions like offices, housing or similar requirements, but also incorporated various aspects like public space, ideas of sustainability, infrastructure facilities and so on. These projects are as follows:

**Macau waterfront by Ken Yeang -**

The project is located in Macau, China. The place has a subtropical climate with subtropical vegetation and rain forest. The project is designed with Ken Yeang’s eco master planning infrastructures – green infrastructure which deals with the vegetation, grey infrastructure that deals with the infrastructure facilities and amenities, blue infrastructure that deals with efficient utilization of water resources and red infrastructure that deals with spaces interacting with human interface like homes, offices, and public gardens and so on. The diagrams\(^{30}\) below show how all the infrastructures have been inserted in the site.

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This master planning strategy lays fingers into the aquatic ecosystem. The various functions incorporated are residential, commercial, retail malls, office towers and casinos. The project is sensitive to protect the aquatic marine environment before and after land reclamation. Buildings are designed to optimize the use of solar energy.

**Green Infrastructure –**

Green Infrastructure runs across the site and between the fingers. The continuous ecological corridor promotes the growth of flora and fauna species. The green infrastructure links the entire site and generates a smooth flow from the built areas into the existing forest areas. Green infrastructure also runs in the building. Thus, green infrastructure is designed and incorporated in the project from the micro scale of buildings and homes to macro scale within the entire site, also linking the forest around it. The application of various other infrastructures can be discussed as below:

**Grey Infrastructure –**

The project is envisaged to re-imagine the possibilities of urban waterfront as a source of public space for recreation purposes. The project stretches the beach until the forest and the half-seascape half-landscape spaces are developed. This is intended to maximize interaction between the pedestrians, buildings, waterfront and green spaces. The resultant is an urban-scale water playground for public enjoyment. The entire transportation system is well planned with various drop-off zones, limited traffic zones; primary, secondary and service roads. The grey infrastructure is integrated with the green infrastructure.

**Blue Infrastructure –**

Like green infrastructure, blue infrastructure extends and runs across the site via canals and crevices of the reclaimed land. The aqua corridor is extended into the land areas thereby increasing the space that would habitat more marine species. Blue infrastructure develops interesting interfaces at various places with the various infrastructures within the site area.
**Red Infrastructure –**

The various forms of red infrastructure created are the iconic tower that sits on the edge of the finger and has a view of the entire waterfront, marina housing having a different typology where half of the bungalows sit in the land and half project into the water; residential towers sitting on the edge have dock facilities. The orientations of the residential towers are such that it gives an uninterrupted view of the waterfront. Various community spaces like convention centers, exhibition areas, public plaza with operable roofs, aquarium, waterfront boardwalk, recreation parks and so on are provided in the project. The red infrastructure is integrated with green and blue infrastructures. The grey infrastructure connects all of them. The red infrastructure provides facilities to celebrate the existing festivals, events and envisages development of new activities. This ensures the cultural and social exchange between the people.

The diagrams below show how these various infrastructures are incorporated in the site. It also helps to understand the integrated approach, which is taken to design the site.
The diagrams below show how various infrastructures (green, blue, red and grey) are incorporated in the site.

Red Infrastructure – The above diagram shows red infrastructure having indoor and outdoor spaces.

Grey Infrastructure – The above diagram shows the various organizations of roads in the grey infrastructure.

Green Infrastructure – The above diagram shows the vegetation running across the site and connecting all the infrastructures.

Blue Infrastructure – The above diagram shows incorporation of water bodies into the site that links the spaces of site.

**Passive solar design –**

The entire site is designed taking into account the climatic conditions. All the common spaces like corridors, elevator lobbies, staircases and toilets are naturally ventilated. It has various features like a roof tower to optimize natural ventilation. At macro scale, it tries to reduce the energy consumption and thereby reduces carbon emissions.

**Conclusion –**

The project at the macro scale integrates various aspects like vegetation, aqua, infrastructure and amenities, and public facilities into the design taking an integrated approach. It generates very blurred lines between them and the interfacial spaces increase the interaction between various elements. The project at macro scale is designed to reduce the consumption of energy thereby contributing to the process of green design. Thus, the project forms an important part of the case study demonstrating the unification of various elements at macro scale.

**Dutch Expo Pavilion by MVRDV -**

The Dutch Pavilion for the Hanover Expo 2000 (1997 - 2000), represents an urgency of the ecological theme.\(^{32}\) The pavilion develops a relationship between artificial and natural. It lays emphasis on merging landscape in the built form. The project is composed of various elements and these elements are connected or dependents on each other. The elements are a matrix of various functions and various sustainability features. The building can be understood in the following way:

The above figure\textsuperscript{33} shows a view of the building.

The above diagram\textsuperscript{34} shows the analysis of the building with functions and design features.


Each of the design feature which are positioned at various floors is described with the views\(^{35}\) as -

**Rooftop** – On the roof is a deck that cuts across the space to connect the elevators to the staircase. The deck acts as a bridge over the roof pond where there is a grass covered VIP room and 6 sixty feet windmills that generates electricity for the building. The roof pond imposes a convex ceiling on the floor below.

The adjacent diagram shows a view of the roof.

**Rain Floor** – The Rain floor is where visitors reach next as they cascade down the building. The water screen acts as a façade for the floor. Water from the roof pond pours over the roof edge in sheets that temper the conditions, block out insects and purify the air on the rain floor. The floor also has auditorium in it as a functional element.

The adjacent image shows the water screen as a façade element.

**Forest** – The water curtains on the above floor refresh the lush vegetation on the forest level. The space is triple height allowing ample sunlight for the trees and plants to grow.

The adjacent image shows the forest incorporated in one of the floors.

\(^{35}\) [http://www.mvrdv.nl/#/projects/publicbuildings/065expo2000](http://www.mvrdv.nl/#/projects/publicbuildings/065expo2000), 01/15/2010
**Pots** – The pot floor is the extension of the forest where the pots house the roots of the trees above it. The fusion of nature and technology is quite literally expressed here, as the pots become screens upon which words and images are projected. Thus, the functions and green elements are merged together.

**Glass House** – The giant pots from the pot floors are miniaturized and multiplied on the glass house floor into thousands of pots of red and yellow flowers displayed on tables. Flowers are one of Holland's most important exports. The entire flower zone is open around the glass box allowing maximum light into the space.

The adjacent image shows the view of the flower zone in the building.

**Dunes** – Sand Dunes make up the majority of the North Sea coastline of the Netherlands. The Dunes Floor was originally slated to be the site for the use of biomass as a secondary alternative fuel source for the pavilion.

The adjacent image shows the incorporation of dunes in the building at the lowest floor.
Water, vegetation, human comfort, energy production and developing local economy form some of the key features of the design model. The Dutch Pavilion is thus able to integrate nature, use technology and incorporate functions to present a project that supports the idea of an integrated approach to the built environment.

**Conclusion for the case studies –**

Each of the above two projects takes landscape, water, socio – cultural - economic aspects, infrastructure and amenities into consideration in designing the project. The scale of each of the projects is different, but it is able to unify various elements into one system. This shows that irrespective of the scale of the project and functions, it is possible to have an integrated approach to the built environment.
CHAPTER 5: DESIGN – PROCESS, LIMITATIONS AND OUTCOME

This chapter discusses the procedure of transforming ideas and developing programs into a design model. It has three stages – design process, design limitations and design outcome.

Design Process –

In order to translate the parameters and program into a design model, it was important that a process was followed which allowed explorations and some technical understanding in developing the design. The design process for the final model had a few stages. They are as shown below:

Climate study –

The climate study plays an important role in passive solar design. Chicago, 41°50’ N and 87°47’ S, falls in the temperate zone with hot and cold climate. The temperature goes below the freezing point frequently in winter. It has strong winds, especially in winter, blowing from the west.

The table below shows the primary and secondary wind directions during different times of the day and different months of the year. The wind blows predominantly from the west during most parts of the year. Hence, it becomes important to ensure that the spaces are protected from the extreme winds. Thus, the orientation of the building has to be east west, so that there is minimum exposure to strong winds. The design and orientation of the building has to take into account that winds are also captured from the west and east in summer. This can ensure reduction in cooling loads in summer and help to conserve energy.
<table>
<thead>
<tr>
<th>Months</th>
<th>Wind Direction (P = Primary, S = Secondary)</th>
<th>P</th>
<th>S</th>
<th>P</th>
<th>S</th>
<th>P</th>
<th>S</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Winter – Predominant Wind Direction – From West</td>
<td></td>
<td>NW</td>
<td>SW</td>
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<td>December</td>
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<td>January</td>
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<tr>
<td>Spring – Predominant Wind Direction – South West and North east</td>
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<td>March</td>
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<td>April</td>
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<tr>
<td>Summer – Predominant Wind Direction – South west and North east</td>
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<td>Fall – Predominant Wind Direction – From West</td>
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<td>November</td>
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</tbody>
</table>

The graph below generated by Ecotect software, shows temperature, relative humidity, wind speed, direct and diffuse solar rays and cloud cover. The highest average summer temperature is around 40 C and the lowest it goes around – 30 C. Thus there is a huge difference between the summer and winter temperature.
The climate of Chicago is extreme with hot summers and very cold winters. Hence, it becomes important that the building responds to the climate and the form of the building facilitates a reduction in cooling and heating loads and helps to save energy.

**Form exploration –**

As understood from the climate study, the winters are extremely cold and the summers are hot. Chicago has strong winter winds and the predominant wind direction during the year is from the west and northeast. Hence, the orientation of the building was developed along an east-west axis. It was necessary that built up areas have maximum exposure to the south sun. Therefore, the strategy was to capture the southern sun and make sure the wind is channelized in the building as per requirements in summer and winter. This would result in less utilization of energy for heating and cooling purposes.

The various forms explored and the reasons they were chosen or discarded are as follows:
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Plan</th>
<th>3D – View</th>
<th>Comments</th>
</tr>
</thead>
</table>
| 1.      | ![Plan 1](image1.png) | ![3D View 1](image2.png) | - The initial idea was to separate functions like working space and living space, and have a connection between them.  
- This also supports the idea of live work apartments.  
- However, this strategy was discarded because it did not facilitate enough exposure of the facades to the sun. |
| 2.      | ![Plan 2](image3.png) | ![3D View 2](image4.png) | - To increase the exposure of the southern façade to sun, the heights of the buildings were varied.  
- Although the connection between them could be established by this strategy, it did not generate enough scope for the natural light to enter the building. |
| 3.      | ![Plan 3](image5.png) | ![3D View 3](image6.png) | - To ensure the building receives maximum sunlight, the buildings were tilted slightly to develop a combined effect of natural sunlight, exposure to the southern sun and minimum effect of wind.  
- The connection was easy to establish.  
- This was still not as effective and satisfactory especially on its northern boundaries. |
| 4.      | ![Plan 4](image7.png) | ![3D View 4](image8.png) | - This strategy managed to satisfy all of the above needs.  
- However, it failed to generate open spaces around it.  
- Open spaces were an important part of the project as they formed public spaces.  
- These public spaces were envisaged for social and culture exchange. |
<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Plan</th>
<th>3D - View</th>
<th>Comments</th>
</tr>
</thead>
</table>
| 5.     | ![Plan Image](image1) | ![3D View Image](image2) | • This design strategy using height variation was able to satisfy the above conditions.  
• It also managed to generate a central open space, but it failed to be satisfactory enough which necessitated more inquiry for the form of the building. |
| 6.     | ![Plan Image](image3) | ![3D View Image](image4) | • Combining the fourth and fifth plans resulted in the finalization of the form.  
• It provided the maximum exposure of the facades to the southern sun.  
• The form also managed natural lighting with various courtyards acting as light wells.  
• Due to north-south connection, it blocked the undesirable wind and resulted in a high impact of cooling wind on the building.  
• Wind factor is later managed by generating voids in the buildings. |

**Organization of functions –**

After the form was finalized, it generated the necessity to organize functions like developing public space, arranging apartments, office buildings, vertical farm, water terminal, and other activities. This arrangement was worked out in the following manner:
<table>
<thead>
<tr>
<th>Sr. No</th>
<th>View</th>
<th>View</th>
<th>Comments</th>
</tr>
</thead>
</table>
| 1.     | ![Option – 1 – Site Plan](image) | ![Option – 2 – Site Plan](image) | • The site plan was developed taking into account a water terminal, developing public space along the river, and positioning islands.  
• The Second option was chosen because it provided a richer experience with the river, along with a better positioning of the islands. |
| 2.     | ![Doubly loaded corridor](image) | ![Option 1 – Centre organization](image) ![Option 2 – Corner organization](image) | • A double loaded corridor system was adopted to maximize the number of residents.  
• A green zone was to be a part of the units. The decision was to incorporate green zones in the center organization or in the corner organization patterns.  
• A Center organization was chosen since it was more effective. It allowed more green zones with an equivalent number of housing units. |

**Design Limitations** – The limitations of the design can be discussed as follows:

**Demonstration** – The proposed number, area and sizes for apartments, offices, public space, vertical farming and green zone, do not come out of any demographic survey or any specific occupancy study or research. Rough estimates were used as a demonstrative model explaining the idea.

**Details** – The design inquiry never goes into exploring or generating the building details. It acts more like an architectural conceptual model with ideas being explored.
Constructability – The design dissertation considers a conventional understanding for the constructability of the building and assumes certain *rules of thumb*, but it does not get specifically into the inquiry of the feasibility and practicality of the design proposal. It also negates the issue of finance in the whole consideration.

Design Outcome –
The design outcome is the combination of various elements into the site. The various elements are live – work apartments, vertical farming, development of a water terminal and public space. This arrangement is organized in the site in the form of a building complex incorporating the Chicago River within the site.

The resultant complex is a set of three buildings stacked upward towards the north. The northern building is the highest, with forty-eight floors, 3 meters each in height. The building in the center has twenty-five floors with the initial four floors 3 meters high and the rest 4 meters high each. The southern building has sixteen floors, 3 meters each in height. The central building is dedicated to office and commercial purposes. The upper and lower buildings are residential apartments with smaller office spaces. The vertical farm zones connect all three buildings. The first four floors of the entire complex are dedicated to parking. There are islands, bridges and open-spaces in the north to be used as public space. The water terminal is at the entry-level facilitating tourism and other forms of transportation activities. The bridges are open to the public, which connects to islands across the river; these help to enrich the experience along the waterfront.

The various building elements, architectural diagrams and drawings are elaborated below (All the plans have north in the upward direction unless specified):
The above diagram shows the entry-level plan, incorporating river into the site and developing public space in the form of open space, islands and bridges. It also shows footprints of the buildings at the plinth level.

The above diagram is the view from the north.

The above diagram is the typical floor plan of the three buildings with green zones in the residential quarters.

The above diagram is the typical floor plan for the buildings with no green zones in the residential quarter.
The above diagram shows the west elevation of the building. It also shows the hierarchy in heights of the buildings allowing maximum exposure of the southern façade to the sun. One can also see the voids in between the buildings acting as vertical farms.

This diagram shows the typical entry in all the buildings.
Live Work Apartments – In order to reduce carbon footprints by cutting down on transportation distances, reduce density of population and support a distributed form of development; live work apartments are proposed. Some key features of the apartments are as follows:

Modules – To cater to diverse sections of society, a variety of modules are proposed - studio apartments, one bedroom living, two bedroom living and three bedroom living apartments. Small workspaces (5m x 4m) are inserted within the modules to promote small-scale entrepreneurial or other forms of work activities.

Flexibility – The different modules are adjusted in the grid (10m x 9m and 9m x 9m). The grid allows the customization of modules into multiple variations. This also provides more flexibility in generating design options for customizing workspace and living space.

Common Space – To encourage entrepreneurial activities, and support workspaces in the apartment complex, common spaces are provided on every floor. This common space can be used for functions like training and meeting purposes. They can be distributed at various floors as per the requirements.

Office Building – The office building (central building) is envisaged to be used for a variety of commercial purposes like supporting farming and trading activities, processing, packaging for the crops grown in the vertical farms and other forms of production purposes. Apart from these, it can also be used for regular office activities. Different sizes for offices are proposed in order to increase its flexibility for various space requirements.

Amenities – Various amenities for recreation purposes like garden spaces and gym activities are featured in the live work apartment complex.
Live – Work Apartments (Resident and Office building)

The above diagram shows the topmost building’s typical floor plan for the floors – 5th, 7th, 11th, 13th, 15th, 19th, 21st, 23rd, 25th, 27th, 31st, 33rd, 35th, 40th, 42nd, 46th, 48th.

The above diagram shows the lowermost building’s typical floor plans of the floors – 5th, 7th, 11th, 13th, 15th.

The above diagram shows the part of the building with different modules of apartments, green zones, common rooms for entrepreneurial activities and circulation spaces.

The diagram shows the interior view of the common rooms.

Live – Work Apartments (Resident and Office building)
The above diagram shows the plan for the intermediate building, which is an office building. This is the typical floor plan for the floors 4th and 5th.

The above diagram shows the typical floor plan for the office floors – 11th, 12th, 17th, 18th, 21st.

The above diagram shows the typical floor plans for the floors 9th, 10th, 15th, 16th, 19th, 20th, 24th, 25th.

The above diagram shows the view from the south east showing the arrangement of three buildings with the central building as the office building.

This diagram shows the interior view along one of the workspaces in the office building.
Conclusion for Live-Work apartment complex – The live work apartment complex provides employment opportunities with least possible travel distance. This helps to save transportation fuel and helps to reduce the density of population and carbon emissions. It also encourages entrepreneurial or work activities, which adds to employment opportunities.

Vertical farming – Vertical farming adds to the cause of urban agriculture and all of its advantages. Its application in the design can be understood as follows:

Green zones – At regular intervals in resident and office buildings, green zones are dedicated where vertical farming can be carried out.

Farm Floors – At regular intervals, entire floors and roofs are dedicated to vertical farming. This adds to the farming output and helps to reduce the density of occupancy.

Perennial production – The green zones and farm floors are covered in operable windows. This makes farming possible even in the extreme winters.

Recycle of waste – Various components of farming like manure and water are used from the recycling systems in the building. The waste generated due to farming activities is also recycled and re-used within the complex.

New Techniques – Various techniques like Hydroponics and Aeroponics can be used to ensure the maximum output in the vertical farms in farm floors and green zones.
Vertical Farming and Green Zones

The above diagram shows the typical vertical farm floor. There is a corridor space, which connects all the three buildings and helps in the transition within the three buildings. In different floors, the center portion of the office building is used for recreation and recycle of waste.

The above diagram shows the green zone location in the resident buildings. They are used as vertical farms. Some can be converted into gardens and act as an open space for the residents.

This ensures adequate sunlight for the growth of crops.

The above diagram shows the location of vertical farms along the various floors of the building.

The above sectional diagram shows the location of vertical farm floors.

The above diagram shows the blow up view of the vertical floor. One can see the intermediate connections and triple height of the vertical farms.
Vertical Farming and Green Zones

View along the connecting corridors showing farm floors along the sides.

View of the green zone with a garden in it.  View of the green with a vertical farm in it.

View showing vertical farming extending to roofs.
Conclusion for vertical farming –

It is possible to incorporate vertical farming in a dense urban context and benefit from the concept of urban agriculture. Thus, it becomes an important part in the future urban design model with its advantages outweighing the disadvantages.

**Water terminal** – To continue the trend of using the Chicago River and develop alternative mode of transport, a water terminal is provided in the design complex. This terminal is envisaged in the following ways:

**Complementing office and farms** – To complement the functions in the office building and facilitate transportation of various farm products, a water terminal is proposed within the building complex. It also acts as a support system for these activities.

**Tourism** – Various tourism activities can be carried out from the water terminal, which can add to the economy and promote tourism.

**Alternate Transportation** – This can be developed as an alternative transportation within the city. Water taxis can be used for traveling within the city.

<table>
<thead>
<tr>
<th>Water Terminal</th>
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<tbody>
<tr>
<td>The above diagram shows the infrastructure facilities and development for the water terminal.</td>
</tr>
<tr>
<td>The above view shows the integration of the Chicago river into the building and utilizing it for the public infrastructure.</td>
</tr>
</tbody>
</table>
Conclusion for water terminal – The development of public infrastructure within the design of the building complex is possible. It can also help in supporting the growth of economy; facilitate movement of goods and people. Thus, it becomes an important element for the future design model.

Development of public space – To generate breathing space, public space is proposed in the design complex. The various forms of public space developed in the project can be understood as follows:

Open space – The open space is proposed in the northern part of the complex. This space works as both public space and a buffer space between the built up area and the road.

Bridge, peninsula and island – A public bridge is introduced along the length of the river and parallel to the site, which passes through the proposed peninsula and an island. This generates an experiential walk along the river. The peninsula and the island add to the experience along the river. They also act as a public space.

Exhibition space – An exhibition space is proposed which can be open to the public (or with minimal entry fees). It can demonstrate various techniques for sustainable design, waste recycling, urban agriculture, trade activities and so on. The exhibition space is envisaged to make people aware and spread the ideas of the future design model with the parameter formed, the building complex acting as a live demonstration.
Development of Public Space

The above diagram shows the location of public spaces – they are northern part of the site, bridges, peninsula and island.

The above view shows the view from the northern space towards the peninsula.

The above view shows the view from the exhibition space in the first floor into the river and island.

**Conclusion for public space** – Public space can be integrated into the built environment and be used for various activities like developing an awareness campaign, social and culture exchange within various groups of people and generating more green areas in the dense localities. Thus, development of public spaces at regular intervals is extremely beneficial for a healthy urban environment. Hence, it forms an important part in the future design model.
**Sustainable Design features** – In order to reduce carbon footprints, energy use; promote recycling and reuse of waste and water; and generate electricity; the design features incorporated are:

**Orientation of the building** – The design complex is oriented along the east-west direction so that it can minimize the impact of strong winds blowing from the west. This would also ensure maximum utilization of southern and northern sunlight. The southern light can be helpful in winters and northern light in the summers.

**Day lighting** – The entire complex is divided into courtyards, which act as light wells. The corridors are partially lit by natural light.

**Ventilation** – All the rooms have provisions for natural ventilation. All the living rooms on the western, eastern and northern façade have the provision for cross ventilation. The heated air in the housing can pass from the apartments into the corridor where it is pulled up by the stack effect. The stack effect air is discharged from the farm floors.

**Sunspaces** – Sunspaces are provided in the southern facade, so that the rooms remain warm during the winter.

**Thermal Mass** – The water body that is incorporated inside the site acts as a thermal mass and can help to radiate heat in the winter or can make air cooler in the summer. This helps to develop a microclimate within the site. However, the upper floors do not get the benefits of developing a microclimate.

**Waste management** – Space has been dedicated to the water and waste recycling. In addition, concepts of bio retention to recycle water and vermicompost to recycle waste can be used.
### Sustainable Design features – Stack effect, natural ventilation and sun spaces

The above diagram shows the location of sunspaces and position of stack effect. They both are placed back to back in the southern façade. The sunspaces also have a green zone in them to enhance the impact of sunspace.

<table>
<thead>
<tr>
<th>Diagram 1</th>
<th>Diagram 2</th>
<th>Diagram 3</th>
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</thead>
<tbody>
<tr>
<td>The air is pulled into the stack room from the corridors and discharged via farm zones. It is also possible to generate cross ventilation through the building. Thus, the stack effect is created and natural ventilation is/can be induced in the building.</td>
<td>The above view taken from the corridor, shows the vent located in the upper part of the door. The air is pulled into the stack room via these vents where it is pulled upwards and discharged via farm zones.</td>
<td>The diagram shows the functioning of the sunspace. The sun's heat is trapped into this space, which is later utilized to warm the adjacent room via heat transfer and heat exchange. During summers, the outer door can be open and allowing natural ventilation for corridors and adjacent rooms. Thus, the sunspace helps to reduce the cooling and heating loads.</td>
</tr>
</tbody>
</table>
### Sustainable Design features – Orientation of the building, light wells and façade exposure

The above diagram shows the positioning of light wells in the building. The staggering of the buildings along the east-west direction helps to generate the light wells and minimizes the façade exposure towards the west. This helps in reducing the impact of the strong winds blowing from the west. The different heights of the building allow maximum exposure of the southern façade to trap most of the sun’s heat in winter. This helps in maximum utilization of day lighting.

### Sustainable Design features – Thermal Mass and Waste Management

The water body that is in and around the site acts as a thermal mass. Due to heat exchange, it cools the surrounding environment during winter and warms during winter.
Below are some views of the building complex:
Conclusion for Sustainable design features – The passive solar design approach is extremely essential given the context of depleting energy resources. It helps to conserve energy resources and there is a possibility of generating power like solar and wind energy. Another important feature of sustainability is waste management. It facilitates recycling of resources thereby reducing the pressure on essentials like water. It helps to create less waste and contributes to reuse of resources. Moreover, it also results in better living conditions. Thus, it forms an important aspect for the future model design.
CHAPTER 6: DISCUSSIONS AND CONCLUSIONS

Based on the initial research and design outcome, there emerges a scope of discussion and some conclusions can be reached. This chapter deals with the discussions and conclusion.

**Discussions –**

The parameters were formed by reviewing certain theories of design. There were overlaps within the theories suggesting the importance of certain aspects like sustainability, development of public space, reducing density, tackling urban issues, economic growth, social and cultural exchange and so on. The parameters took into consideration the overlap within these theories. The programs were generated out of site context and parameters that were formed in the previous chapters. The design outcome and its relation to parameters and site context can be understood from the matrix below:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Site Context</th>
<th>Proposed Programs / Strategies</th>
<th>Design Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Everyday Urbanism</strong></td>
<td>High density area</td>
<td>• Public space&lt;br&gt;• Awareness space</td>
<td>• Public garden&lt;br&gt;• Island, bridges&lt;br&gt;• Exhibition space</td>
</tr>
<tr>
<td>• Social, cultural, economic</td>
<td></td>
<td></td>
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<tr>
<td><strong>Generic City</strong></td>
<td>Chicago river</td>
<td>• Transportation hub&lt;br&gt;• Scope for economic growth</td>
<td>• Water terminal&lt;br&gt;• Alternate transportation&lt;br&gt;• Development of Tourism</td>
</tr>
<tr>
<td>• Elements of the cities like infrastructure, amenities, etc.</td>
<td></td>
<td></td>
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<tr>
<td><strong>Design and Planning</strong></td>
<td>Mixed use development</td>
<td>• Reduction of transportation&lt;br&gt;• Work opportunities distributed</td>
<td>• Live work apartments&lt;br&gt;• Offices, retail</td>
</tr>
<tr>
<td>• Mixed use vs. Zonal planning</td>
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<tr>
<td><strong>Urban Contemporary Issues</strong></td>
<td></td>
<td>• Incorporation of waste management techniques&lt;br&gt;• Green design buildings&lt;br&gt;• Urban agriculture</td>
<td>• Waste and water recycle systems&lt;br&gt;• Vertical farming&lt;br&gt;• Passive solar design building&lt;br&gt;• Live Work apartments</td>
</tr>
<tr>
<td>• Energy crisis&lt;br&gt;• Pollution, density&lt;br&gt;• Crisis of resources like food, water, etc&lt;br&gt;• Population migration</td>
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Thus, the future design model is one that takes an integrated approach to the built environment. The diagram below is the result of the project, showing the integration of the theoretical models and technical approaches researched during the thesis process.

The above diagram gives a pictorial snapshot of the relation between design outcome and parameters formed.

**Conclusion –**

Cities are growing and population within the cities is exploding, resulting in a high density of population. To meet the needs of the ever-growing population, there is a huge pressure on infrastructure and natural resources. Pollution has spread unchecked with the increase in transportation. The dependency on the rural sector has increased for food products. The cities are
becoming more and more global due to diverse population. In order to maintain healthy relations between people, it is important that there emerge some form of social and cultural interaction between them. However, inadequate public spaces limit this interaction. This situation is coincidental with climate change and the depletion of natural resources at an alarming rate.

Hence, an ‘integrated approach’ is required, which takes into account various factors while designing the built environment. The focus is not on generating a higher number of residential or commercial spaces. Instead, the focus is on generating apartments, which are self sufficient with energy, water and some food requirements. The waste is recycled and reused effectively. The focus is also on developing employment opportunities within the vicinity so that the overall distance of transportation is reduced. The design approach should be able to develop open spaces, which can allow interactions between various groups of people. The design should be able to contribute to the economic development of the place and development of public infrastructure.

It is possible to develop better urban living conditions. There is a need to re-imagine the approach to the condition of city dwelling. The strategy proposed here is an ‘integrated approach to the built environment’ using a research based future model for design.
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