

**LE CORBUSIER'S PRINCIPLES OF CITY PLANNING AND THEIR
APPLICATION IN VIRTUAL ENVIRONMENTS**

by

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Abstract

The objective of this thesis is to develop an approach to understanding the concept of 'Virtual City' by drawing information from the disciplines of architecture and city planning. The focus is mainly on exploring the concepts for planning virtual city environments. Based on principles developed by some of the eminent thinkers and town planners for real world cities, the thesis attempts to conclude that principles of modern urban planning can possibly form an effective strategy for the organization of information in virtual environments. A comparative analysis of Le Corbusier's planning principles is made in order to develop a metaphorical interpretation as the 'Virtual City Interface'. This is supported by some visual concepts developed in due course of the research.

The focus of this discussion is to explore the possibilities on enhancing the user experience by creating a real time environment of a city on the screen. Architects and planners play a very important role in understanding and defining the concept of a real place. This discussion embodies and augments thoughts and perceptions into developing a virtual city environment, by establishing a metaphorical connection between the architectural language and virtuality. For this, I have chosen Le Corbusier's Chandigarh, the only realized city out of his many planned cities, as the main example of study. Chandigarh will be studied in detail, followed by an interface that will constitute its planning and design principles as applied to 'Virtual Chandigarh'.

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Table of Contents

1. Introduction	1
2. Structure of Thesis	5
3. Le Corbusier and his work on Contemporary Cities: A Critical Perspective	9
3.1 A brief story of Le Corbusier	9
3.2 Visions on City Planning	15
3.3 Comparison of the visions of Le Corbusier and other Planners	22
4. Case studies of Three Cities	30
4.1 City for Three Million (Hypothetical)	30
4.2 Brasilia (Influenced)	33
4.3 Chandigarh (Implemented)	37
4.3.1 Edict of Chandigarh	37
4.3.2 Genesis of the City	39
4.3.3 Earlier Design	40
4.3.4 Le Corbusier's Plan	47
4.3.5 The Biological Analogy	49
4.3.6 Le Corbusier's Definition of use of Chandigarh	50
4.3.7 The Functions for Chandigarh as defined by Le Corbusier	51
4.3.8 The Buildings	54
4.3.9 Industry	59
4.3.10 The City Centre	59
4.3.11 Housing	60
4.3.12 Commercial Buildings	61
4.3.13 Summary of the Chapter	61

5. Virtual Cities: Concepts and Contexts	63
5.1 Introduction to Virtual World	63
5.2 A City Planning Perspective	65
5.3 What are Virtual Cities?	
5.3.1 Definition	67
5.3.2 Three-D Virtual Cities	68
5.4 Virtual Cities as Metaphors; a way of Interpretation	69
5.5 Comparisons: Similarities and Dissimilarities in the Real and the Virtual City	71
5.6 Perceiving the Virtual City	72
5.7 Essential roles of Architects and Planners as the Creators of the Environment	73
5.8 Designing the new Environment	76
5.9 Overview of the Design of Virtual Cities on Two Levels	
5.9.1 Macro Level Design	77
5.9.2 Micro Level Design	78
6. Case Studies of Virtual Cities currently existent on the Internet	81
6.1 Cybertown	81
6.2 Norstar Mall	83
7. Findings, Comparison and Summary of the Case Studies	85
7.1 Findings from the Case Studies	
7.1.1 Le Corbusier's Planning Principles	85
7.1.2 Positive and Negative aspects of Chandigarh	88
7.2 Summary of the findings	90

8. Conceptual Interpretation and Proposal based on Research	92
8.1 Interpreting Virtual City in a real context	92
8.2 Navigation in Complex Virtual Spaces	94
8.3 Spatial User Interface Metaphors	95
8.4 The Virtual City: Motivation and Basic Development Concepts	96
8.5 Why use a City Structure?	96
8.6 Elements of the City Environment	97
8.7 Existing City Metaphors	100
8.8 Description of the Information City Metaphor	
8.8.1 Structure	100
8.8.2 Elements	101
8.8.3 Containers	101
8.8.4 Links	102
8.8.5 Navigation and its Tools	102
8.8.6 Information Distribution	103
8.9 Using elements of Chandigarh to superimpose on the Virtual City	103
8.10 Implementing an Information City	104
8.11 Using a Graphical Virtual Environment	104
8.12 Building a City	105
8.13 Conclusions	106
8.14 Reflections on the future of Virtual Cities	109
Illustrations	112
Notes	139
Primary Literature Review	143
Bibliography	145

Appendix I - Various Browser Interfaces

157

Appendix II - CD ROM

164

List of Illustrations

1. City Map of Chandigarh existent today defined by the Municipal Boundaries as referenced from <http://chandigarh.nic.in/frcity.htm>
2. Master Plan for Chandigarh by Albert Mayer RAIC Journal, 1955 (Evenson Norma, Chandigarh, 1966)
3. The 'leaf plan' of Chandigarh by Mathew Nowicki Scheme 1, Evenson Norma, Chandigarh, 1966
4. The 'leaf plan' of Chandigarh by Mathew Nowicki Scheme 2, Evenson Norma, Chandigarh, 1966
5. Plan of Chandigarh from Capitol Project Office Drawing Evenson Norma, Chandigarh, 1966
6. Le Corbusier's study sketches for Chandigarh, Modular II Evenson Norma, Chandigarh, 1966.
7. Le Corbusier's study sketches for Chandigarh, Modular II Evenson Norma, Chandigarh, 1966.
8. Le Corbusier's study sketches for Chandigarh, Modular II Evenson Norma, Chandigarh, 1966.
9. Le Corbusier's study sketches for Chandigarh, Modular II Evenson Norma, Chandigarh, 1966.
10. Sector, Evenson Norma, Chandigarh, 1966.
11. Capitol Complex, Evenson Norma, Chandigarh, 1966.
12. Capitol Complex, Evenson Norma, Chandigarh, 1966.

13. Capitol Complex, Evenson Norma, Chandigarh, 1966.
14. The Assembly Evenson Norma, Chandigarh, 1966.
15. Plans of Chandigarh and Brasilia Compared, Superblock Comparisons from Architectural Forum November 1960. Masterplan Comparisons from Architecture in Australia, December 1959, Evenson Norma, Chandigarh, 1966.
16. Brasilia, Zoning layout plan taken from <http://www.civila.com/brasilia/index.html>
17. Contemporary City for Three Million, A hypothetical City proposed by Le Corbusier, The City of Tomorrow, 1929 p.172.
18. Contemporary City for Three Million, isometric view of the hypothetical City proposed by Le Corbusier, The City of Tomorrow, 1929 p.171.
19. The 'Voisin' Plan of Paris by Le Corbusier, The City of Tomorrow, 1929, p. 279.
20. Le Corbusier 'Response to Moscow'; the proposed city on the site of Moscow in relationship to the 'Green City' 1930, Foundation Le Corbusier, 20471, Jean-Louis Cohen; Le Corbusier and the Mystique of USSR, p. 140 -141.
21. Le Corbusier 'Response to Moscow'; the proposed city on the site of Moscow in relationship to the 'Green City' 1930, Application of the principles of Ville Radieuse, Foundation Le Corbusier, 20471, Jean-Louis Cohen; Le Corbusier and the Mystique of USSR, p. 142.
22. View; Cybertown Interface, an interpretation of a virtual city environment developed by Blaxxun Interactive. <http://www.cybertown.com>
23. Plan View; Cybertown Interface, an interpretation of a virtual city environment developed by Blaxxun Interactive. <http://www.cybertown.com>

24. Norstar Mall, a virtual city interface mainly devoted to online shopping experience enhanced by use of 3D navigation; an SKG Enterprise project

<http://www.norstarmall.ca>

25. Conceptual Navigation as explained for the initial concept of virtual city

26. Interpretation of the interface for the conceptual prototype of virtual city.

27. Conceptual prototype for the virtual city.

CHAPTER 1

Introduction

A town is a tool. Towns no longer fulfil this function. They are ineffectual; they use up our bodies, they thwart our souls. The lack of order to be found everywhere in them offends us; their degradation wounds our self-esteem and humiliates our sense of dignity. They are no longer worthy of age. They are no longer worthy of us. (Corbusier 1929)¹

A city! It is a grip of man upon nature. It is a human operation directed against nature, a human organism both for protection and work. It is a creation. Poetry also is a human act- the harmonious relationships between perceived images. All the poetry we find in nature is but the creating of our own spirit. A town is a mighty image, which stirs our minds. Why should not the town be, even today a source of poetry? (Corbusier 1929)²

Ever since Sir Thomas More introduced the word 'Utopia' in 1516 with his book by that name, the word has enjoyed many interpretations and incarnations.

Constantinos Doxiadis (Doxiadis 1966) in his analysis of 'Utopia' observes that some see it as a happy, ideal place, while others consider it as an impracticable place, its existence impossible. Often, the word is given both meanings simultaneously, creating more confusion. Patrick Geddes interprets Doxiadis that 'Utopia' could have originated in either of two Greek words: u-topia, meaning no-place, or eutopia, meaning good place. Considering both meanings valid and necessary, Doxiadis proposes a diagram that overlays them on two axes. On one axis he plots degree of zeal which progresses from place (topia) to no-place (u-topia). This is a measure of the possibility of realization, or perhaps of place-ness. On the other axis he maps degree of quality, which progresses from dystopia (bad place) to eutopia (good place). While this diagram is subjective, which Doxiadis admits, it is useful for considering the utopias that guide today's designers and planners in city planning.

The building of cities has a long and complex history. Although city planning as an organized profession has existed for less than a century, it can be observed that the roots of utopian city planning are very deep in the context of time. Taking the understanding of utopia, we can consider the effect Utopian thinking has had on the shape of cities in the twentieth century. Of the many, including Santa Elia's and Tony Garnier's significant works, there are only three that have probably commanded our imagination. These are Ebenezer Howard's 'Garden City', Frank Lloyd Wright's 'Broadacre City', and Le Corbusier's 'Radiant City'. All three utopias, conceived between 1890 and 1930, as a reaction to the unplanned and speculator developed, nineteenth century city, were an attempt to withdraw from short term solutions in favor of a comprehensive one (Fishman 1977). Each participated in a movement away from the dystopia of contemporary cities towards the potential eutopia of future cities. By investigating these visions, that is by understanding of the eutopian/dystopian and topian/u-topian dimensions of utopia, we can more clearly investigate how utopia and reality have come to coexist, and the nature of the compromise that allows this to happen.

In the context of utopian city and city planning, Le Corbusier is one of the pioneers who introduced the idea of living in a city that is actually planned, designed and then built. He forced people to think what it will be like to live in an environment that is predetermined. Ultimately he succeeded in actually building such kind of an environment.

Cities are necessarily the geographic centers of people, activities and services. The urban form and layout of cities are familiar to most people. Consequently, the virtual city is being useful as an interface metaphor for information and services on the Internet. Virtual cities provide an electronic hub of services, activities, information and people located at a single 'place' on one's computer screen, just like real cities are a focal point in geographic space.

The relentless expansion of computing technology into our workplaces and homes in the past 15-20 years is plain to see and widely acknowledged. What distinguishes the growth of the past 2-3 years is the uptake of networking technology which has been prompted largely by the development and popularity of the World Wide Web, allowing companies and individuals to create multimedia presentations of information and make them available to a potentially world wide market. In addition the advantages of e-mail and electronic file transfer are becoming more widely accepted leading both to wider connection to the internet and the application of internet technologies in private company intranets. (Dodge, Doyle, Smith 1999)

This thesis will essentially investigate how Le Corbusier perceived the ideas of organized city planning emphasizing on the Utopian planning ideals and how these perceptions became his principles of city planning. The research will then try to merge these principles of city planning by superimposing them upon today's ideas of Utopias in virtual environments, called as 'Etopias' with the letter 'E' being the symbolic of an electronic or a virtual environment (Mitchell 1995). This thesis will

conclude developing a conceptual model for that Virtual City Environment. To explain this idea more clearly, a detail description of the structure of this thesis and the study methodology follows in Chapter two.

CHAPTER 2**Structure of the Thesis****Chapter One**

Chapter one of this thesis begins with quotes by Le Corbusier and an introduction from C.A. Doxiadis. It recalls details from the past history of town planning and how the development of town planning took place. As well, it gives an overview of the recent developments and approaches in the areas of virtual worlds and virtual city planning.

Chapter Two

Chapter two describes structure of this thesis, stating the contents of these chapters in detail. The study methodology is described at the end of this chapter.

Chapter Three

This research is principally based on studying the concepts and principles of city planning by Le Corbusier and applying them to the context of virtual city environments; chapter three ventures into investigating those principles. It starts with an introduction of the life of the great architect-planner and discusses his vision for city planning. The chapter also describes principles and visions of other very eminent planners and thinkers of the same era.

Chapter Four

Chapter four thesis studies three cases of different cities whose principles and planning ideas could be superimposed in developing the ideal conceptual model of a virtual city. All three cities studied are related to Le Corbusier: two of them directly and one influentially. 'City of Three Million' is a hypothetical dream of Le Corbusier for an ideal city. 'Brasilia' shows the influence of Le Corbusier on the world of city planning with Oscar Niemeyer developing this city. 'Chandigarh', a city planned, designed and constructed according to Corbusier's dreams is the only city existent today, which implements his ideas in full. This chapter overviews all the features of these cities.

Chapter Five

Chapter five shifts the focus of this thesis by entering the amazing realm of virtual world. It begins with the exploration of the concepts of virtual cities by defining and analyzing them as interpreted metaphors. The chapter further proceeds to find similarities between the real world cities and virtual cities. It tries to place the role of architects and planners defining their roles as creators of this environment.

Chapter Six

Chapter six looks at two examples of virtual worlds, which are currently existent on the Internet and are being used by individuals from various parts of the world forming a virtual community.

Chapter Seven

The analysis, findings and conclusions from case studies of real cities and the virtual cities are put together in chapter seven. This chapter mainly tries to superimpose the ideas and principles of real world cities by Le Corbusier on the concept of Virtual City Environment and present them as findings for further development. Finally this chapter attempts to demonstrate that the ideas of Le Corbusier for planning can be utilized as principles for planning virtual city environments.

Chapter Eight

The eighth chapter is dedicated to reflecting the understandings derived in the previous chapter. This is where a conceptual metaphorical virtual city is proposed keeping in mind the principles of Le Corbusier. As if to prove that the principles of Le Corbusier can be applied in a virtual city, every element in Corbusier's real city is metaphorically compared and superimposed in the form of a virtual city element till a completed model is arrived at. The conclusion of the thesis finally addresses issues that could arise in a virtual city once it becomes a virtually habituated environment.

Study Methodology

This thesis is essentially divided into three parts: the past, the present and the future. The past forms part one of the research where theories and principles from the disciplines of city planning are drawn. Architect and town planner Le Corbusier's theories pertaining to cities he planned and designed are studied.

The second part of thesis is the study of current trends and scenarios existent in the context of virtual city environment.

The third part is a blend of the analysis of the first two parts and their amalgamation in order to develop a concept of a Virtual City of Future. This part tries to superimpose the theories of Le Corbusier studied in the first part over the current trends and concepts of virtual city environments and attempts to define a new architectural language for the Virtual World.

Chapters three and four, form part one, chapters five and six, form part two and chapters seven and eight form the last part three of the thesis.

CHAPTER 3

Le Corbusier and his work on Contemporary Cities: A Critical Perspective

The spirit of geometry produces tangible shapes, expressions of architectural realities: upright walls, perceptible surfaces between four walls, and the right angle, hallmark of balance and stability. I call it the spirit under the sign of set-square, and my description is confirmed by the traditional name of allantica given to Mediterranean architectural art, for allantica means antique based on set-square.....strong objectivity of forms under intense light of a Mediterranean sun: male architecture. (Corbusier 1929) ¹

3.1 A brief story of Le Corbusier

Charles-Edouard Jeanneret was born in La Chaux-de-Fonds, Switzerland, 1887.

Trained as an artisan, he traveled extensively through Germany and the East. In Paris he studied under Auguste Perret and absorbed cultural and artistic life of the city. During this period he developed a keen interest in the synthesis of the various arts. Charles-Edouard Jeanneret adopted the name Le Corbusier in early 1920s.

Le Corbusier was born in a small town in the mountainous Swiss Jura region. His life was marked by the harshness of these surrounding and the Puritanism of the Protestant environment. At 13 years of age, Le Corbusier left primary school to learn the enameling and engraving of watch faces, his father's trade, at the École des Arts Décoratifs at La Chaux-de-Fonds. There, Charles L'Eplattenier, whom Le Corbusier later called his only teacher, taught him art history, drawing, and the naturalist aesthetics of Art Nouveau.

It was L'Eplattenier who decided that Le Corbusier, having completed three years of studies, should become an architect and gave Le Corbusier his first practice on local projects. From 1907 to 1911, on L'Eplattenier's advice, Le Corbusier undertook a

series of trips that played a decisive role in the education of this self-taught architect. During these years of travel through central Europe and the Mediterranean, he made three major architectural discoveries. The Charterhouse of Ema at Galluzzo, in Tuscany, provided a contrast between vast collective spaces and 'individual living cells' that formed the basis for his conception of residential buildings. Through the 16th-century; Late Renaissance architecture of Andrea Palladio in the Veneto region of Italy and the ancient sites of Greece, he discovered classical proportion. Finally, popular architecture in the Mediterranean and in the Balkan Peninsula gave him a repertory of geometric forms and also taught him the handling of light and the use of landscape as an architectural background.

At the age of 30 he returned to live in Paris. There his training was completed a year later when he met the painter and designer Amédée Ozenfant, who introduced him to sophisticated contemporary art. Ozenfant initiated Le Corbusier into Purism, his new pictorial aesthetic that rejected the complicated abstractions of Cubism, and returned to the pure, simple geometric forms of everyday objects. In 1918 they wrote and published together the Purist manifesto, Après le cubisme. In 1920, with the poet Paul Dermée, they founded a polemic avant-garde review, L'Esprit Nouveau. Open to the arts and humanities, with brilliant collaborators, it presented ideas in architecture and city planning already expressed by Adolf Loos and Henri van de Velde, fought against the 'styles' of the past and against elaborate nonstructural decoration, and defended functionalism.

The association with Ozenfant was the beginning of Le Corbusier's career as a painter and as a writer. Ozenfant and Le Corbusier (then still known as Jeanneret) together wrote a series of articles for L'Esprit Nouveau that were to be signed with pseudonyms. Ozenfant chose Saugnier, the name of his grandmother, and suggested for Jeanneret the name Le Corbusier, the name of a paternal forebear. The articles written by Le Corbusier were collected and published as 'Vers une Architecture'. Later translated as Towards a New Architecture (1923), the book is written in a telling style that was to be characteristic of Le Corbusier in his long career as a polemicist. "A house is a machine for living in" and "a curved street is a donkey track, a straight street, a road for men" are among his famous declarations.² (Le Corbusier 1929). His books, whose essential lines of thought were born of travels and lectures hardly changed at all in 45 years, constituted a bible for succeeding generations of architects.

L'Esprit Nouveau was the springboard for Le Corbusier's entrance into practice. In 1922 he became associated with his cousin Pierre Jeanneret, and together they opened a studio. The association of the two cousins lasted until 1940. It corresponds to the first of the two main periods, separated by World War II, that can be distinguished in Le Corbusier's work; the second period covers the years from 1944 to the architect's death in 1965.

The years from 1922 to 1940 were as remarkably rich in architecture as in city planning projects. As was always to be the case with Le Corbusier, unbuilt projects,

as soon as they were published and circulated, created as much of a stir as did the finished buildings. In the Salon d'Automne of 1922, Le Corbusier exhibited two projects that expressed his vision for the social environment and contained the gem of all the works of this period. The Citrohan House displays the five characteristics by which he defined his conception of what was modern in architecture five years later. Its characteristics were pillars supporting the structure, thus freeing the ground beneath the building; a roof terrace, transformable into a garden and an essential part of the house; an open floor plan; a facade free of ornamentation; and windows in strips that affirm the independence of the structural frame. The interior provides the typical spatial contrast between open, split-level living space and the cell-like bedrooms.

The ideas for city planning set forth at the Salon d'Automne, an annual semi-official exhibition, were taken up again and developed in 1925 at the Exposition des Arts Décoratifs in Paris, in a pavilion that was to be a "manifesto of the esprit nouveau." In this little duplex-flat, the interior walls violently colored under the influence of the painter Fernand Léger, Le Corbusier exhibited his first collection of industrially produced furniture. During these years, in fact, Le Corbusier's social ideals were realized on two occasions. One of which was in 1925-26 when he built at Pessac, near Bordeaux, a workers' city of 40 houses in the style of the Citrohan House. It was a scorn for local tradition and the unconventional use of color, which provoked hostility on the part of municipal authorities who refused to provide a public water supply. Pessac was thus deprived of inhabitants for six years, and Le Corbusier did

not forget this affront. By 1930 the organization had become oriented toward city planning theory. Le Corbusier, as secretary of the French section, played an influential role in the five pre-war congresses and especially in the fourth, which issued in 1933, a declaration that elaborated some of the basic principles of modern architecture.

The end of the 1930s saw such famous projects as the master plans for Algiers (1938-42) and Buenos Aires (1938); the building for the Ministry of Education and Health in Rio de Janeiro (1936); and an infinitely expandable museum for Philippeville (1938), in French North Africa. There was also a trip to the United States (1935), where Le Corbusier was already famous.

Le Corbusier's diverse activities corresponded to his chosen life-style. Unlike his colleague Walter Gropius, he was not a teacher but the boss who shut himself up alone in his office. His collaborators who had come from all over the world and some of whom would later become famous, worked outside in the long hall that served as a studio. Le Corbusier came to his office only in the afternoons.

Le Corbusier thought that he would finally be able to apply his theories of planning in the reconstruction of France. He prepared in 1945 two plans for the cities of Saint Dié and La Pallice-Rochelle. At Saint Dié, in the Vosges Mountains, he proposed regrouping the 30,000 inhabitants of the destroyed town into five functional skyscrapers. These plans were rejected, but they subsequently circulated throughout the world and became doctrine. With the unlimited support of the French

government, Le Corbusier was given the opportunity to construct a large (private) housing complex in Marseille. It was a residential complex that embodied his vision of a social environment.

The Marseille project (unité d'habitation) is a vertical community of 18 floors. The 1,800 inhabitants are housed in 23 types of duplex (i.e., split-level) apartments. Common services include two 'streets' inside the building, with shops, a school, a hotel, and, on the roof, a nursery, a kindergarten, a gymnasium, and an open-air theatre. The apartments are conceived as individual 'villas' stacked in the concrete frame like bottles in a rack. It was completed in 1952, and two more unités were built at other locations in France, at Nantes and Briey, as well as others in West Berlin.

In 1951 the government of the Punjab named him architectural advisor for the construction of its new capital, Chandigarh. For the first time in his life, Le Corbusier was able to apply his principles of city planning on a metropolitan scale. Totally without reference to local tradition he designed the Palace of Justice, the Secretariat, and the Palace of the Assembly. Unfinished concrete, with windows sheltered by enormous concrete sunshades, the sculptural facades, swooping rooflines, and monumental ramps are principal elements of his architecture, which immediately influenced architects all over the world. He built the National Museum of Western Art in Tokyo (1960), the Carpenter Visual Art Center at Harvard University (1964), and designed an Exposition Pavilion in Zürich that was constructed posthumously.

From 1922 Le Corbusier worked with his cousin Pierre Jeanneret. During this time, Le Corbusier's ideas began to take physical form, mainly as houses which he created as "a machine for living in" and which incorporated his trademark five points of architecture.

Le Corbusier did not fare well in international competition, but he produced town-planning schemes for many parts of the world, often as an adjunct to a lecture tour. In these schemes the vehicular and pedestrian zones and the functional zones of the settlements were always emphasized.³ The way in which Le Corbusier perceived city planning in his very own style is discussed further in this chapter.

3.2 Visions of city planning

Better known by his professional name, Le Corbusier was a twentieth-century architect and planner of planetary ambitions. At one time or another he designed buildings or proposed city-planning schemes for Paris, Stockholm, Geneva, Barcelona, Moscow, Marseilles, Algiers, Sao Paulo, Rio de Janeiro, Buenos Aires, and Chandigarh, India. Le Corbusier promoted hugeness, hierarchy, and centralism in city structure, and was tremendously influential in leading other modern architects in the same direction. He called for "universal...total city planning," urging "let's make our plans...on a scale with twentieth-century events.... Huge!" (Scott 1999)⁴

In his designs for a new "business city" for Buenos Aires, for instance, the full plan can be discerned only from a great distance. Buenos Aires was pictured in his drawings as if seen from many miles out to sea. In his vast housing scheme for

90,000 Rio de Janeiro residents, the project was seen as if from an airplane miles high. Le Corbusier proposed that the project would behold a six-kilometer-long highway elevated 100 meters, enclosing a continuous ribbon of 15-story apartments. The new city towers over the old. Le Corbusier also proposed remaking the center of Paris into a modernist city of 3 million; in his schematic, vehicles on major avenues were but dots. Upon viewing some small rural properties from an airplane, he addressed them as "infinitely subdivided, incongruously shaped plots of land...tiny holdings that render the miraculous promise of machinery useless."⁵ The result is waste; inefficient, individual scrabbling. He was offended by un-orchestrated disunity, and wished to impose new order from a bird's-eye view.

Le Corbusier's proposed cities could be anywhere: free of context, history, or tradition. He had no patience for environments that had grown up independently over time. "A city should be treated by its planner as a blank piece of paper, a clean table-cloth, upon which a single, integrated composition is imposed". His new cities were supposed to be organized, serene, forceful, airy, ordered.⁶

It was in this context that Le Corbusier was drawn to the USSR and the developing countries and their powerful rulers. There, he hoped, the high-modernist social engineer would not be cramped as in the West, where a dispersion of power among many competing groups and individuals made it possible to practice only what he called an 'orthopedic architecture'.

In the Corbusian city human needs were scientifically derived at. The subjects for whom the plan was made were not thought to have anything valuable to contribute. Le Corbusier suggested that master designs could powerfully reshape a society, but for that to happen the designer needed to be prepared to act ruthlessly. He warned that in ancient Rome, where "the plebes lived in an inextricable chaos of abutting (warrens)...police activity was extremely difficult."⁷ He noted that St. Paul of Tarsus was impossible to arrest while he stayed in the slums and the words of his sermons were passed like wildfire from mouth to mouth.⁸ By this Le Corbusier meant that a planner should dictate the planning process of a city regardless of the context, culture or need. He was of strong opinion that organically developed cities lead to chaos, which is difficult to control. That is why he cites the examples of ancient Rome.

It is impossible to read Le Corbusier or see his architectural drawings without noticing his craving for simple, repetitive lines, and complexity. "The human mind loses itself and becomes fatigued by such a labyrinth of possibilities. Control becomes impossible," he explained. "I eliminate all those things", he said, stating, among other things, that "I insist on right-angled intersections."⁹ Le Corbusier welcomed prefab construction of houses and office blocks from parts built in factories. He called for the standardization of all building elements. Door frames, windows, bricks, roof tiles, even screws should conform to uniform prescriptions. The new standards should be legislated by the League of Nations, and a universal technical language should be compulsorily taught throughout the world, Le

Corbusier's followers urged in a 1928 modernist manifesto. Le Corbusier insisted that all measurements, all ventilating standards, all lighting, all equipment and appliances, and all domestic aesthetics should be the same for all latitudes and all needs. "We must find and apply new methods... lending themselves naturally to standardization, industrialization, tailorization." he wrote in 1929.¹⁰ He believed that by living with the standardized norms of construction, a city environment could be made much disciplined.

One of Le Corbusier's central design themes was strict separation of societal functions. There would be separate zones for workplaces, residences, shopping and entertainment centers, and monuments and government buildings. Where possible, work zones were to be further subdivided into office buildings and factories. This principle became standard urban-planning doctrine in Western countries for most of the century.

The logic of rigid segregation of functions is that it is far easier for a planner to shape an urban zone if it has just one purpose. When several or many purposes must be considered, the variables that the planner must juggle begin to challenge the mind. Le Corbusier liked to control all variables. He calculated the air, heat, light, and space requirements of humans and settled on 14 square meters per person, but reckoned that this could be reduced to ten square meters if such activities as food preparation and laundering were communal.

The very first of Le Corbusier's design principles was his dictum that "The Plan (always capitalized in his usage) is a Dictator." It would be difficult to exaggerate the emphasis that Le Corbusier placed on making an entire city bend to one single, rational plan. He repeatedly contrasted traditional cities (products of dispersed power and evolution across history) with the city of the future, which would be consciously formulated from start to finish by one designer.

Le Corbusier's doctrine required total centralization. In his cities, a centrally located core performed the "higher" functions. "From its offices come the commands that put the world in order. In fact, the skyscrapers are the brain of the city, the brain of the whole country. They embody the work of elaboration and command on which all activities depend. Everything is concentrated there: the tools that conquer time and space; telephones, telegraphs, radios, the banks, trading houses, the organs of decision for the factories: finance, technology, commerce."¹¹ The center does not suggest much less consult; it issues commands. The authoritarianism at work in this modernist view stems from Le Corbusier's love of the order of the factory.

In a factory, he effused, "There is a hierarchical scale. Workers accept it so as to manage themselves like a colony of worker-bees: order, regularity, punctuality, justice, and paternalism. The urban planner is to the design and construction of the city as the engineer is to the design and construction of the factory; a single brain directs both. And the centralized hierarchy doesn't stop there. The city is the brain of the whole society. "The great city commands everything: peace, war, and work.

Whether it is a matter of clothing, philosophy, technology, or taste, the great city dominates and colonizes the provinces: The lines of influence and command are exclusively from the center to the periphery of the city. " ¹²

Le Corbusier believed that at the apex of society, there should be a modern philosopher-king who applies scientific truths for the well being of all. Naturally, the king executes his guidance through his master planner; the person who uncovers these scientific truths. In his book The Radiant City (published in 1933 and republished in 1964), He explains; "I drew up plans, after analyses, after calculations, with imagination, with poetry. The plans were prodigiously true. They were incontrovertible. They were breathtaking. They expressed all the splendor of modern times." ¹³

Because there is a single, true answer to planning problems, no compromises are possible. Le Corbusier was aware that his kind of root-and-branch direction requires authoritarian measures. "Once his calculations are finished," Le Corbusier wrote of the planner, "he is in a position to say...It shall be thus!" ¹⁴

What drove Le Corbusier's captivation with the Soviet Union was the prospect that a revolutionary, high-modernist state might prove hospitable to a visionary planner. After building the headquarters of the Central Union of Consumer Co-operatives (Centrosoyuz), he proposed, in plans prepared in only six weeks, a vast design for rebuilding Moscow in line with what he thought were Soviet aspirations to create an entirely new mode of living. He referred often to Sergei Eisenstein's films celebrating

tractors, centrifuge creamers, and huge farms, and promised comparable machine-led transformations of Russian cities however even the Soviet Union was not interested in his sweeping centralist ambitions. Stalin's commissars found his plans for Moscow too radical. The Soviet modernist El Lissitzky attacked Le Corbusier's Moscow as a "city of nowhere...a city on paper, extraneous to living nature, located in a desert through which not even a river must be allowed to pass (since a curve would contradict the style)." As if to confirm the "city of nowhere" charge, it is said that Le Corbusier later recycled his design—simply removing all references to Moscow—and presented it as a plan for central Paris.

Finally, under the patronage of Jawaharlal Nehru in 1949 in India, Le Corbusier found a state authority that would give him a free hand. Nehru invited him to finalize the design and supervise the construction of Chandigarh, his new capital of the Punjab. Nehru was a centralizing modernist himself, and wanted a capital that would dramatize the beliefs of the new Indian managerial elite. Le Corbusier's modifications of initial plans drawn up by other modernist architects added even more monumentalism and linearity. For instance, he replaced the housing that had been planned for the city center with an 'acropolis of monuments' on a site of 220 acres at a great distance from the nearest residences. In place of large curves, Le Corbusier substituted a rigid grid. (Scott 1999) ¹⁵

In order to have an idea of how the visions of Le Corbusier for city planning were unique and different, the chapter further investigates visions of two more city

planners, Ebenezer Howard and Frank Lloyd Wright to make a comparative point of view.

3.3 Comparison of the visions of Le Corbusier and other planners

The plans of different visionary planners such as Ebenezer Howard, Frank Lloyd Wright, who designed at the same time around Le Corbusier have been unique in their own sense.

Howard proposed redirecting urban growth into new towns that would surround existing cities. These towns were called Garden Cities. Within this overall decentralized nature, each Garden City would have its own centrality, but be connected by transportation lines to the original city. In order to exclude the greedy and inconsiderate practices of the speculative developer, and the suburban sprawl they were producing even then, all land in these new towns would be communally owned, requiring collective decisions upon its use.

Frank Lloyd Wright proposed a more thoroughly decentralized city. In his parable of the Wanderer and the Cave Dweller in The Disappearing City, Wright contrasted the murderous Cave-Dweller, or city liver, with the adventurous nomad. He proposed that "the city of the future would be without walls, a city of the Wanderer, where mobility had brought freedom." (Fishman 1977) Wright's 'Broadacre City' was semi-rural, with the homestead considered the conceptual center. Urban facilities in this proposed city were separated by vast natural and agricultural environments, and were connected through the use of automobiles and personal helicopters.

In 1935 Wright published a plan for city design which in many ways can be seen as almost the direct opposite of the theory of Le Corbusier's City for Three Million. Wright in his introduction to the plan states: "All regimentation is a form of death, which may sometimes serve life but more often imposes upon it." (Wright 1935). Wright's ideas went beyond the design of cities to proposing radical change in the way that people lived and were governed. These ideas stemmed from advances in technology which were becoming widespread at the time. They also echo some of the debate surrounding modern telecommunications. Wright's believed that the increasing ubiquity of the automobile and developments in electronic communication could lead to an effective dissolution of the city in favor of more widespread, decentralized communities. He proposed that all families should be allocated a plot of land of a minimum size of one acre. Each family would own, at least one car and most houses would contain some sort of laboratory or workshop, making working from home commonplace. The large number of houses built on small plots of land for individually owned purpose would produce an environment containing a great deal of variety. The county architect was supposed to oversee the area. Wright thought that this would produce a distinct character underlying the individual designs at the county level but would also produce a large variety of architecture across the country.

A major part of Wright's model provides for elimination of large scale government in favor of the county government, which would own and manage all of the essential services for the area. In proposing this Wright claimed that it would lead to a greater

sense of responsibility for these services within the community as the ownership is close-by and accountable. All needs and services such as food, power and education would be produced and consumed locally. Despite the differences between these ideas of individual space and organic community development as compared to Le Corbusier's intense, standardized, high rise developments; there are some similarities in the plans. For example the way in which they both focus to a large extent on the provision of high speed integrated road networks, and also in the division of the space into designated areas, although there are great differences in their scale.

As with Broadacre City, Le Corbusier's Radiant City was founded on technological advances. But he rejected Howard's belief in cooperative control and Wright's admiration of individual creativity. Le Corbusier believed that only a dictatorial way of planning and design was equipped to "inaugurate the age of harmony" and dedicated his 1935 book to discussion of this context called The Radiant City.

Le Corbusier developed a theory of city planning in the 1920's, which has been very influential throughout the remainder of the century. The most striking element of Le Corbusier's approach is its strict adherence to geometric form, regularity and standardization. In his description of 'A Contemporary City of Three Million Inhabitants' (Le Corbusier 1929) he states: "The city of to-day is a dying thing because its planning is not in the proportion of geometrical one fourth. The result of

a true geometrical lay-out is repetition, The result of repetition is a standard. The perfect form." ¹⁶

The result of this vision was a proposal for a large scale redevelopment of a large area of Paris, which was a city based on a strict grid pattern with cells containing his (in)famous 'skyscrapers in the park' and large high-rise developments within areas of open space creating a high population density in the center of the city. At the very core of the space was the main station which was located at the intersection of main North-South and East-West roads and is the center of the urban and national rail links as well as the focal point for "aero-taxis." The road system itself was segregated depending on the type of traffic, with freight running underground.

Perhaps, for this study, the most important point from Le Corbusier's design is the way that the rest of the city is laid out. Each element in the city has a defined location. The huge central station surrounded by huge skyscrapers for business whose lower floors house restaurants, theatres and similar establishments, an area for municipal buildings, universities and museums, the park, which may be eaten into by the city if necessary. On the other side of the city was the industrial quarter. Near to the main road artery were the residential quarters contain blocks of flats, and the whole city was surrounded by a 'protected zone' separating it from the suburban garden cities. The main point to emphasize was that everything had its place and was strictly segregated. Le Corbusier stated that: "Unless we replace our current (for the time) haphazard arrangements there is no salvation." ¹⁷

Although each city planner represented a different set of values, within their own logic, each was utopian. Wright's city espoused American notions of mobility and space, and the value of individuality. Le Corbusier and Howard pursued the opposing values of benevolent imperialism and community control from European and English perspectives, respectively. All three were planned fully decentralized cities that genuinely embraced the well being of their citizens. The cities shared an internal perfection borne from the single-minded attention of their authors. The goal of each utopia was to present a better place to live, and hence more utopian place, than the cities of the day. But these utopias were unrealizable, as might be suspected from the over ambitiousness of their designs and failed attempts to emulate them. Early implementations of Howard's Garden Cities in England, such as the cities of Letchworth and Welwyn, resulted in neighborhoods that appeared similar to Howard's utopia, but politically or economically never attained his cooperative ideal. Le Corbusier's vision could not muster the political support, particularly in democratic countries, that his cities of monolithic towers required. Wright's city has been espoused by North Americans, but in a brutally condensed form: suburban houses crammed together without Wright's large territories of untouched nature in between. None of the utopias came to be fully realized in real places; they were and are 'utopian' without place. Howard's, Wright's and Le Corbusier's ideal cities shared the defining qualities of pure utopias. They were perfect, yet unable to be built and yet, the ideas that their cities epitomized became the foundation for urban planning in the twentieth century.

It is interesting to notice that these theories studied in the thesis give quite contrasting views of the development of city planning. Although both were developed relatively early in the century, both have been influential. This thesis asks as to what ideas could be extracted from these theories and that how these ideas might apply to a virtual world. The highly centralized and structured model of Le Corbusier has the potential to provide an environment through which it is easy to navigate, especially once the model on which the layout is based is known. This model was developed in the context of a highly centralized mode of the use of cities, with major businesses erecting their headquarters in skyscrapers at the center of the city while residents moved to the suburban outskirts.

In the virtual city the users are freed from many of the constraints of the real world and as of today, there has been no established model of city use. It may be that the balance of social to business, use of the virtual environment will be significantly different from that of the real city.

On the other hand, the individualist model of Wright is more organic and free. Consequently it could also be said that there is nothing to stop the virtual city planners allocating spatial resources to individuals and businesses and watching the city grow organically. However there is also a drawback to this model that the organic development might lead to a chaotic condition and may become difficult to manage in the due course.

Other theories from city planning also make important contributions to this discussion. The first comes from the noted architect Christopher Alexander. In his 1965 paper "A City Is Not a Tree", ([Alexander 1965](#)), he argues that modern cities have been designed from scratch along highly structured lines. He further states that being well defined and nested areas for particular uses (the tree of the title) are in many cases seen by their inhabitants as being sterile and uninteresting places to live. However, older cities which have developed gradually, and where the boundaries between different areas are more blurred, are perceived to be more interesting and vibrant environments. What underlies this perception is the way that the latter situation encourages the inhabitants to interact with different environments and the people who move within them. This broadening of experience helps to make the space a more pleasant place to live. Despite this the city planners must also consider the important contributions that well defined districts can make in the city. In his seminal book '[The Image of the City](#)' Kevin Lynch ([Lynch, 1960](#)) recognizes districts which have a distinct character as being one of the major features which planners use when forming a mental map of the layout of a city. It must also be asked as to what chaos might ensue if a city has an almost random scattering of different types of buildings and spaces.

The requirement that emerges from this review of resources is the need for a balance between complete freedom to build anything, anywhere, the creation of a pleasant space, and the need to produce an understandable and relatively well ordered environment.

The above discussions about the planning visions of Le Corbusier are further enhanced by studying specific details in case of three different cities as this thesis moves into chapter four. This chapter principally discusses three cities of which two have a direct contribution from Le Corbusier where as the third has been highly influenced by his planning ideas and principles. The chapter tries to bring out salient features of Le Corbusier's planning ideals.

CHAPTER 4**Case Studies of three cities:****4.1 City for Three Million (Hypothetical)**

City of Three Million is defined as a vast landscape of identical skyscraper monoliths that appealed to the aggressive urban futurism of the twenties. This was a time when proposed cities were often rendered with such an ethereal touch that they seemed to emerge from dreams, often filled with massive organic looking complexes, with buttresses and skyways like tendons and muscles stretching off of the buildings skeletons. Hugh Ferriss's 'Metropolis of Tomorrow' (Ferris 1925, re-issue 1998), for instance, was a pictorial prophesy of the ultimate metropolis, where consumerism and futurism were in perfect balance and people lived in the sky, literally, surrounded by aerial gardens, dirigibles, golf courses, and restaurants. It was the quintessential document of the prosperity of the 1920s, as well as a personal manifesto of visionary urbanism. In it, Ferriss drew and discussed the American skyscraper and presented his romantic vision for an ideal city of the future.

Though few of these proposals have had practical applications, the City for Three Million presaged the low-income housing projects to which Le Corbusier devoted much of his career, and which lie on the outskirts of nearly every major city today. It was a perfectly ordered metropolis where nothing of the old remained.

Transportation was clean, organized, and partially invisible. Subways would run beneath the vast city of towers and planes would land in the center, cutting

seamlessly among the buildings on their way in. "I relied on the sure paths of reason," Le Corbusier wrote of his design, "...and having absorbed the romanticism of the past, I felt able to give myself up to that of our own age, which I love. My friends, astonished to see me so deliberately passing over immediate considerations, said, all this is for the year 2000! Everywhere journalists wrote of it as the city of the future. Yet I had called it a Contemporary City. Contemporary because tomorrow belongs to nobody." ¹

Le Corbusier's City for Three Million was, like many of his creations, predicated on the idea that great modern cities could only function if order and efficiency were at the heart of the city. He believed that one should aim for efficiency first and then follow it up with noble aesthetic design. He also believed that social unrest was largely tied to a lack of buildings suited to the needs of workers, arguing that good design could rescue societies from social unrest; the choice, he said, was "architecture or revolution." In his words, a simple phrase suffices to express the necessities of tomorrow: "We must build in open." ²

He was very sensitive to the subject of planning and believed that the City of his time (today) was dying thing because it was not geometrical. To build in open would be to replace the haphazard arrangements present in those conditions, which was all what was existent as of that time, by a uniform layout. He believed that unless this was accomplished, there would no salvation.

Le Corbusier firmly believed that the result of a true geometrical layout would be repetition. The result of repetition was a standard, the perfect form that is the creation of standard types. For Le Corbusier, a geometrical layout meant that mathematics played its role in planning and design. He claimed that there was no first rate human production that did not have geometry at its base. For him, building was the only economic activity that had so far been resisted by industrialization. It had thus escaped the march of progress with the result that the cost of construction had gone abnormally high.

Talking about the Aesthetics of the City, Corbusier said: "The plan of city for three million is a direct consequence of purely geometric considerations. A unit on a large scale inspires everything. No two streets are in any way alike. This is where the magnificent Contrapuntal Symphony, the forces of geometry come into play." ³

(Illustrations 17, 18)

4.2 Brasilia (Influenced)

Le Corbusier's intellectual influence on twentieth-century architecture was vast. Planners and designers around the globe undertook projects along the lines he set out in his manifestos and at the international architectural congresses he organized. Perhaps the closest thing to a high-modernist city in existence today, built fully according to Le Corbusier's principles, is Brasilia. The idea of constructing a capital in the South American continent's interior wilderness was the pet project of Juscelino Kubitschek, Brazil's populist president from 1956 to 1961.

Kubitschek directed architect Oscar Niemeyer, a longtime Brazil Communist Party member influenced by the Soviet version of architectural modernism, to organize a design contest for the new city. Architect Lucio Costa won this design contest. Both Costa and Niemeyer worked wholly within the doctrines laid out by Le Corbusier. In the empty site supplied by the president they had the 'clean tablecloth' Le Corbusier had always coveted. No private-property owners intruded; no competing visions needed to be negotiated with. The utopian, progressive city would evolve from a unitary plan on land owned entirely by the state, with all contracts, commercial activity, and zoning placed in the hands of the government planning agency Novacap.

In Brasilia's elaborate central plan, housing, work, recreation, and public administration were all segregated into different zones, as Le Corbusier demanded.

The plan made not the slightest concession to residents' habits, desires, or traditions. Brasilia provides no clue to its own history; it could have been anywhere.

Brasilia is a state-imposed city. Many aspects of life that would elsewhere have been left to the private sphere were minutely organized. All residents received similar housing. Following the plans of progressive European and Soviet architects, Brasilia's planners grouped the apartment buildings into superquadra to foster a collective life. Each superquadra (roughly 360 apartments housing 1,500-2,500 people) had its own nursery and elementary school. Each grouping of four, superquadra had a secondary school, a cinema, a social club, sports facilities, and a retail sector.

In Brasilia no streets function as public gathering places; there are only roads and highways to be used exclusively by motorized traffic. One could fairly say that the effect of the plan has been to design out all those unauthorized locations where casual encounters could occur and crowds could gather spontaneously. There is a square. The square was a vast, monumental Plaza of the Three Powers, flanked by the Esplanade of the Ministries, is of a scale that would dwarf even a military parade. In comparison, Tiananmen Square and Red Square are positively cozy.

The plaza, like many of Le Corbusier's plans, is best seen from the air. Arranging to meet a friend there would be rather like trying to rendezvous in the middle of the Gobi desert. And if individuals did meet, there would be nothing to do. This plaza is a

symbolic center for the state; the only activity that goes on around it is the work of the ministries.

People who move to Brasilia discover it as a city without crowds. They complain that it lacks the busy corners, the bustle of street life, and the small-scale facades that animate a sidewalk for pedestrians. It is almost as if the founders of Brasilia planned not to make a city but to prevent one (Scott 1999).

Life in Brasilia often feels standardized, bland, and anonymous -- an existence without pleasures. The population lacks small accessible spaces they can stamp with the character of their individual activities. The two most frequent complaints of superquadra residents are the monotony of the apartment blocks and the isolated residences. The facade of each block is strictly geometric. Nothing distinguishes the exterior of one apartment from another; there are not even balconies that would allow residents to add distinctive touches and create semipublic spaces. Just as the general design of the city conspires against an autonomous public life, so the design of the residential city militates against individuality.

Owing to its architectural repetition and uniformity, Brasilia has few landmarks. Each commercial quarter or superquadra cluster looks roughly like any other. The result is a macro-order but with a micro-confusion that makes locations hard to find. To the planners of a utopian city whose goal is more to change the world than to accommodate it, these failures—and the general disorientation occasioned by life in Brasilia—may be considered a part of their didactic purpose.

From the beginning, however, residents of Brasilia refused to behave precisely as the city's master planners intended. Some citizens showed a determination to make themselves heard. For instance, when the number of construction workers outran the temporary housing allotted to them in what was called the Free City, laborers began to squat on additional lands where they built makeshift homes. Where whole families migrated, the houses sometimes became quite substantial. These pioneers organized to defend their land, and by 1980 fully 75 percent of the population of Brasilia lived in settlements that had never been anticipated in the central plan. Meanwhile the planned city reached less than half of its projected population.

The unregulated Brasilia—one might call it the real Brasilia—is quite different from the original vision. Instead of a classless administrative city, it is a city marked by commerce, business, self-selection, and segregation. The unplanned neighborhoods of the rich and of the poor are not mere accidents; one could argue that they are unavoidable companions to the artificial order at the plan's center.

How much success has Brasilia achieved? Little, if we judge by the city's capacity to inspire love of its way of life. The real Brasilia, as opposed to the hypothetical Brasilia in the master planners' documents, is mostly a product of resistance and subversion. (Illustrations 15, 16) (Scott 1999)⁴

4.3 Chandigarh (Implemented)

Geometry is the means, created by ourselves, where-by we perceive the external world and express the world within us. Geometry is the foundation. It is also the material basis on which we build those symbols, which represent us to perfection and divine.⁵

....The age in which we live is therefore essentially a geometrical one; all its ideas are oriented in the direction of geometry.⁶

Chandigarh is one of the most significant urban planning experiments of the 20th century. It is the only one of the numerous urban planning schemes of Le Corbusier to have actually been executed. It is also the site of some of his greatest architectural creations. The city has had a far-reaching impact, ushering in a modern idiom of architecture and city planning all over India. It has become a symbol of planned urbanism. It is as famous for its landscaping as for its architectural ambience. Most of the buildings are in pure, cubical form, geometrically subdivided with emphasis on proportion, scale and detail (Illustration 1). Le Corbusier summed up his work on the city in an 'Edict', reproduced below in full.

4.3.1 Edict of Chandigarh set by Le Corbusier

The object of this edict was to enlighten the present and future citizens of Chandigarh about the basic concepts of planning of the city, so that they become its guardians and save it from individualistic ideas. This edict as set by Le Corbusier sets out the following basic ideas underlying the planning of the city:

The city of Chandigarh is planned to human scale. It puts us in touch with the infinite cosmos and nature. It provides us with places and buildings for all human activities by which the citizens can live a full and harmonious life. Here the radiance of nature and heart are within our reach. (Corbusier, 1950 as quoted from the official website of the Municipal Administration of Chandigarh)

The city was composed of sectors. Each sector was 800 meters by 1,200 meters, enclosed by roads allocated to fast-mechanized transport and sealed to direct access from the houses.

Each sector catered to the daily needs of its inhabitants, which varied from 5,000 to 25,000 and had a green strip oriented longitudinally in north direction stretching centrally along the sector in the direction of the mountains. The green strip was to stay uninterrupted and accommodate schools, sports fields, walks and recreational facilities for the sector. Vehicular traffic was completely forbidden in the green strips, where tranquility shall reign and the curse of noise shall not penetrate. The roads of the city were classified into seven categories, known as the system of 7 Vs.

V-1 Fast roads connecting Chandigarh to other towns;

V-2 Arterial roads;

V-3 Fast vehicular roads;

V-4 Free Flowing shopping streets;

V-5 Sector circulation roads;

V-6 Access roads to houses;

V-7 Footpaths and cycle tracks

Certain areas of Chandigarh were of special architectural interest, especially where harmonized and unified construction of buildings was aimed at. Absolute architectural and zoning control was to remain operative where skyline, heights, character and architecture of buildings as planned were not to be altered. No building was to be constructed north of the Capitol Complex. The central plaza in Sector 17 was designed by as 'Pedestrian's Paradise'. No vehicular traffic was to be

permitted in the plaza. In the industrial area only such industry as that powered by electricity would be permitted, so that the atmosphere could be saved from pollution. The Lake was considered a gift of the creators of Chandigarh to the citizens. Its tranquility was to be guaranteed by banning noises.

Le Corbusier stressed that the faithfulness to the mandated materials of constructions, concrete, bricks and stone and so on was to be maintained in all buildings constructed or to be constructed. The edict of Chandigarh was important reflection of the thought process of Le Corbusier.⁷

The biological analogy of Chandigarh speaks to this more in detail as will be seen later on in this thesis.

4.3.2 Genesis of the city

India attained Independence in 1947, but in the process the territory of British India was partitioned to form India and Pakistan. The large and prosperous Province of Punjab, was divided and Lahore, its capital, fell within the borders of Pakistan, leaving Indian Punjab without a capital. Those who had been compelled to migrate to India keenly felt the loss of Lahore, a city much loved by its inhabitants.

In March 1948, the Government of Punjab in consultation with the Government of India, approved a 114.59 sq. km tract of land at the foot of the Shivalik hills as the site of the new capital. An existing village gave its name (Chandi = Goddess of Power + garh = fortress) to the new city.

The decision to build a new city seemed like an extravagant decision to some at the time, but there were practical justifications. After partition, the population of all the existing towns in East Punjab had more than doubled on account of the migration of displaced persons from Pakistan. As a government publication pointed out: "Most of these towns, even before partition, lacked essential amenities such as adequate drainage and water supply and none of them had schools or hospitals which could meet the normal needs of the population according to modern standards for such services." (Kalia 1987)

The new city was needed not only to serve as a capital but also to resettle thousands of refugees who had been uprooted from West Punjab. India's first Prime Minister, Jawaharlal Nehru enthusiastically supported the project and took sustained interest in its execution. When he visited the project on April 2, 1952, he declared: "Let this be a new town symbolic of the freedom of India, unfettered by the traditions of the past, an expression of the nation's faith in the future....The new capital of Punjab will be christened as Chandigarh-a name symbolic of the valiant spirit of the Punjabis. Chandigarh is rightly associated with the name of Goddess Chandi = Shakti, or power." (Kalia 1987)

4.3.3 Earlier Design

Although the city is now forever linked with the name of Le Corbusier, he was not the Government of India's 'first choice'. In the late 1940's very few Indian architects were professionally trained in town planning so it was necessary to look abroad for a man

to carry out the Chandigarh scheme. The search led to the USA and Albert Mayer. Graduate of the Massachusetts Institute of Technology and founder of the large New York architectural firm of Mayer, Whittlesey and Glass, he was highly qualified for the job. Not only was he experienced, he was associated with American architects and thinkers Lewis Mumford and Clarence Stein.

Mayer wasn't new to India. As a lieutenant colonel in the US Army, he had served in India during World War II, building airfields in Bengal and the Burma-India theatre. He liked India -- in fact, just after independence he sent Nehru the outline of a program for model villages. In December, 1949, when the Punjab government approached him for the Chandigarh project, he was already associated with a rural development project at Etawah (Uttar Pradesh), and with the preparation of master-plans for Greater Bombay and Kanpur.

Mayer was thrilled with the prospect of planning a brand-new city, and he accepted the assignment although it offered him a modest fee of \$30,000 for the entire project. His brief was to prepare a master plan for a city of half a million people, showing the location of major roads and areas for residence, business, industry, recreation and allied uses. He was also to prepare detailed building plans for the Capitol Complex, City Center, and important government facilities and architectural controls for other areas.

Acutely aware of the myriad needs of a modern metropolis, Mayer included several American experts in the project: James Buckley, a specialist in the field of

economics and transport; Ralph Eberl, an expert on city services, roads and site engineering; H.E. Landsberg, a climatologist; and Clara Coffey, a specialist in landscaping. Later, on the advice of his friend Stein, Mayer inducted Matthew Nowicki. Nowicki was the head of the North Carolina State College School of Architecture. Soon, Mayer and Nowicki became the key American planners for Chandigarh.

Mayer drew his inspiration for Chandigarh from a number of American residential projects, such as Stein's Baldwin Hills, in Los Angeles, California, which were in turn influenced by the 19th century Garden City Movement of English architect Ebenezer Howard. Howard's idea was to counteract the disadvantages of the sprawling industrial towns by creating self-sufficient cities restricted in size and surrounded by green belts, which would have the advantages of both town and country.

Soon after his appointment in 1950, Mayer wrote to Nehru: "I feel in all solemnity that this will be a source of great stimulation to city building and replanning in India -- it will be the synthesis and integration in the world to date of all that has been learned and talked of in planning over the past 30 years. Yet, I feel we have been able to make it strongly Indian in feeling and function as well as modern." (Kalia 1987) According to Ravi Kalia, "The master plan Mayer produced was based on two principles, both of which were widely prevalent at the time in America. First, the basic unit was to be the neighborhood; the groupings and the variations of which were synthesized in the city. Second, the elements of site, topography, and location

in the region were to determine the overall character of the city, the road system, the location of the main architectural and functional foci, the park system and so forth." (Kalia 1987) As a third consideration, the plan was to give sufficient importance to direct observations of the region and its people. The plan had to provide for locally heavy bicycle traffic, schools of different sizes, the main business district, and other needs.

However, absence of any substantial scientific, statistical and demographic data was to remain an inherent drawback for the planners.⁸ The master plan as conceived by Mayer and Nowicki assumed a fan-shaped outline spreading gently to fill the site between two seasonal riverbeds. At the head of the plan was the Capitol, the seat of the state government, and the City Center was located in the heart of the city. Two linear parklands could also be noticed running continuously from the northeast head of the plain to its southwestern tip. A curving network of main roads surrounded the neighborhood units called Superblocks. The first phase of the city was to be developed on the northeastern side to accommodate 150,000 residents and the second phase on the southwestern side for another 350,000 people.

The plan, which reflected the American architects' desire to deliberately avoid the sterility of a geometric grid in favor of a loosely curving system, certainly had the overtones of the "romantic picturesque" tradition of a Garden City. In addition, Mayer and Nowicki produced conceptual schemes for the Capitol, super block and the City Center. The proposed Superblocks were to be graded income wise in three density

categories: 10, 30 and 40 persons per hectare. Mayer wanted a more democratic mix of housing types, and felt that the old practice of providing palatial bungalows for the elite needed rethinking as the services and open space provided to them would be at the expense of the have-nots living in the smaller houses. He also desired that most houses in the neighborhood units should be located on the periphery, so that the central areas were left for playgrounds, parks and recreational areas.

Mayer liked the variation of Indian streets, offsetting and breaking from narrow into wider and back, and thought that they were appropriate to a land of strong sunlight. At the narrow points, his house design involved an inner courtyard for ventilation with small openings on the street side to protect privacy. "We loved this little inner courtyard," Mayer wrote, "...for it seemed to us to bring the advantages of coolness and dignity into a quite small house." Another element in the planning was to place a group of houses around a not very large court, with the ends somewhat narrowing that could serve as a social unit where a group of relatives or friends or people from the same locality might live. It had the central area for play, gossip, and other recreational activities. The neighborhood units were to contain schools and local shopping centers. (Kalia, 1987).

The multi-mode transportation system was a major problem. Mayer tackled it by creating a "three-fold-system" that segregated land use in the master plan; there were neighborhoods and areas for business, industry and cultural activities. He also planned separate roads for incompatible types of traffic. Separate provisions were to

be made for slow animal-drawn carts, for bicycles and pedestrians. Also he proposed to have a configuration of fast-traffic arterial roads with at least 400 meters distance between the two. He also favored use of cul-de-sacs so that pedestrians and cyclists could move on paths through parks and green areas. Land was also to be reserved for future expansion of services like roads, parking areas etc.

The Capitol in the Mayer plan was located at the extreme northern edge of the city against the panoramic backdrop of the Shivalik hills. Both Mayer and Nowicki attached the greatest symbolic significance to the Capitol Complex in their architectural and visual impact of the built form of the city. The layout plan for the Capitol indicated an monumental piazza containing the Legislative Assembly and forming a visual landmark to which the Governor's Palace and the High Court were to be related on a visual axis. Broadly, it was a composition based on a loose cross-axis which unified otherwise isolated structures by related sight-lines. But a very interesting feature of the proposal was to dam the nearby seasonal rivulet of Sukhna choe and use its waters for large reflecting pools spread around the entire complex - - giving the buildings an ethereal reflective dimension.

Although Mayer's contract did not stipulate detailed architectural schemes, he felt that they could not isolate two-dimensional planning of the city from its architectural character. Consequently it was left mainly to Nowicki, his talented younger partner, to sketch out conceptual schemes for the image of the city. For the legislative assembly, he evolved a form that took the shape of a parabolic dome inspired by the

Indian stupa, symbolic motif of the sacred mountain. Nowicki was keen to end all his modern architectural creations with the Indian idiom of built form. He even endorsed the idea of the traditional home-cum-workplace of a small entrepreneur or artisan. His sketches indicate typical Indian features such as shops with platforms to sit on the floor, and overhanging balconies or awnings, with separate areas for hawkers. This house-cum-workplace had typical traditional features like brickwork jallis and screens to shield the windows from the hot summer winds.

Nowicki's conceptual sketches indicate curving streets, courtyards, and a delightful sequence of open and closed spaces - with ample use of water and greenery to soften the built forms. Quite appropriately the building materials of his choice was the good old brick, as it was the cheapest medium - a conclusion that holds true even now (Evenson, 1966)

Unfortunately on August 31, 1950, Nowicki died in a plane crash. Mayer felt that he could not handle the monumental project alone and withdrew, severing the American connection with Chandigarh.

Although Le Corbusier made many radical changes in the Americans' master plan, incorporating his own architectural and city planning ideas, it is a tribute to Mayer and Nowicki's vision that he incorporated several of their seminal ideas. For example, the basic framework of the master plan and its components - the Capitol , City Center, university, industrial area, and a linear parkland - as conceived by Mayer and Nowicki were retained by Le Corbusier. The restructured master plan

almost covered the same site and the neighborhood unit was retained as the main module of the plan. The Super block in Mayer's plan was now replaced by what was called the 'Sector' covering an area of 91 hectares, which was approximately that of the size of three-block neighborhood unit planned by Mayer. The City Center, the railway station and the industrial areas by and large retained their original locations. However, the Capitol, though still sited at the prime location of the northeastern tip of the plan, was shifted slightly to the northwest.

The neighborhood unit, so important to Mayer, retained its importance in Le Corbusier's plan. But the opposing viewpoints lay in the configuration of the neighborhood units. While the Mayer preferred a naturalistic, curving street pattern without the rigidity of a sterile geometric grid -- Le Corbusier was adverse to "solidification of the accidental". (Kalia, 1987) For Le Corbusier the straight line was the logical connecting path between two points, and any "forced naturalness" was superfluous. Moreover, Le Corbusier always looked at the city plan in terms of a single cohesive monumental composition -- with major axes linking the focal points of the city. The emphasis on visual cohesion between the various city components was an essential feature of his somewhat rigid grid iron plan. (Illustrations 2, 3, 4) (Kalia, 1987)

4.3.4 Le Corbusier's Plan

Le Corbusier's plan was based on the gridiron defined by a system of seven types of roads, which Le Corbusier called the 7 Vs (from the French word 'voie') and their

expected functions around and within the neighborhood. The neighborhood itself is surrounded by the fast-traffic road called V3 intersecting at the junctions of the neighborhood unit called the 'Sector' with a dimension of 800 meters by 1200 meters. The dimensions of the 'Sector' and its creation are best explained in Le Corbusier's own words: "Its dimensions are an outcome of studies made between 1929 and 1949 of the Spanish 'Cuadra' of 100 to 110 meters. A useful reclassification of the (Cuadras) led Le Corbusier to adopt a ratio of harmonious dimensions and productive combinations: seven to eight 'cuadras' on one side, ten to twelve 'cuadras' on the other, that is to say 800 meters by 1200 meters. This was the 'Sector' issued from an ancestral and valid geometry established in the past on the stride of a man, an ox or a horse, but now adopted to mechanical speeds... The entrance of cars into the sectors of 800 meters by 1200m, which were exclusively reserved to family life, could take place on four points only; namely in the middle of the 1200 m. in the middle of the 800 meters. All stoppage of circulation shall be prohibited at the four circuses, at the angles of the Sectors. The bus stops are provided each time at 200 meters from the circus so as to serve the four pedestrian entrances into a sector. Thus, the transit traffic took place outside the sectors: the sectors being surrounded by four wall-bound car roads without openings (the V3s). Consequently, no house (or building) door opens on the thoroughfare of rapid traffic. In place of bazaars crammed with individual merchants and crowds of people, Le Corbusier however substituted huge squares that today stand largely empty. Whereas road crossings in India had typically served as public gathering places, Le

Corbusier arranged the zoning and layout to prevent animated street scenes. One observer noted that the width between meeting streets was so great that one saw nothing but vast stretches of concrete with a few lone figures here and there. Le Corbusier and his sponsors tried to wipe away the old India and present residents of Chandigarh, largely government administrators, with an image of their future.

The drawback, however, was the growth of separate little squatter settlements at the periphery of Le Corbusier's austere, authoritarian, ordered center. In these spontaneous hamlets one finds the small-scale street traders, the meeting places, the hawkers, the social spots that the master architect forced out of his central districts. Human nature and variety, it turned out, could not be banned, merely dislocated. (Illustrations 5,6,7,8,9,10) (Scott 1999)⁹

4.3.5 The Biological Analogy

Le Corbusier liked to compare the city he planned to a biological entity: the head was the Capitol, the City Center was the heart and work areas, and the institutional areas and the university were regarded as hands and the industry as the limbs. Aside from the Leisure Valley traversing almost the entire city, parks extended lengthwise through each sector to enable every resident to lift their eyes to the changing panorama of hills and sky. Le Corbusier identified four basic functions of a city: living, working, circulation and care of the body and spirit. Each sector was provided with its own shopping and community facilities, schools and places of worship. 'Circulation' was of great importance to Le Corbusier and determined the

other three basic functions. By creating a hierarchy of roads, Le Corbusier sought to make every place in the city swiftly and easily accessible and at the same time tried to ensure the tranquility and safety of living spaces.

Of all 'bodily elements', it was the 'head' i.e. the Capitol, which mostly engaged the master architect's interest. It was here that Le Corbusier always looked for a chance to make dramatic statements in the context of Chandigarh, and particularly the Capitol. Incidentally, the priorities of the Indian government and Le Corbusier's natural inclination converged.

4.3.6 Le Corbusier's Definition of use of Chandigarh

The following is an extract from the Punjab Administration web site, which quotes Le Corbusier's definition of Chandigarh. This extract is included mainly to understand the way Le Corbusier perceived a city and the kind of relationship he established with a city treating it as a living being.

Corbusier defined Chandigarh thus:

Chandigarh is a city offering all amenities of life to the poorest of the poor of its citizens to lead a dignified life. Chandigarh is a Government city with a precise goal and consequently a precise quality of inhabitants.

On this presumption, the city has not to be a big city (metropolis?) -- it must not lose its definition. People say that life must come in the city from other source or activity especially industry. An industrial city is not the same as an administrative city. One must not mix the two. It seems that complement of the original definition should be the invitation of forces, which can supplement the forces of the city not opening a conflict or rivalry. We must take care that any temptations do not kill the goal, which was foreseen at the moment of the foundation of the city. Therefore, naturally, old doors must be opened to actually unknown initiatives. It appears that the future of Chandigarh will be opened to all the cultural factors in different kinds of manifestation: teaching (school), university, new science of imparting audio-visual training and so on.

It is a means to express and to disperse thought (editions: books, magazines and eventually printing of books, magazines, etc). Means to express and disperse arts (in time and space – history and geography). All kinds of reproduction of art-witnesses (editions: visual means – photographs, diagrams etc at different scales). Diverse manifestations of exhibitions, shows, theatre, festivals, creations of highest modernity etc. such manifestations reclaiming the organizations and use of travelling, possibilities of hostelry, etc. For the culture of the body there can be created an organism having as disposition any possibilities of meeting for competitions or tournaments. All this will afford the creation of a 'Chandigarh' label, which will be the guarantee of quality and worth emulation.¹⁰

4.3.7 The Functions for Chandigarh as defined by Le Corbusier

According to CIAM (Congres International de l' Architecture Moderne), Charter of Athens, Le Corbusier laid down functions for Chandigarh. The force of this Charter was in giving the first place to the dwellings: the environment of living for the family under the rule of '24 solar hours'. The second place was given to working, which is the daily act of human obligation. The third place was given to the culture of body on one hand and an intellectual leisure on the other. When all these goals were achieved, it was possible to give to each of them a respective rightful place and at this moment can interfere the problems of realizing the contacts: that is 'circulation'.

Referring to this line of conduct as stated above, the urbanism of Chandigarh emerged as a conclusion. The charter brought many appreciable factors. However the question placed before the city's development authorities was what will be the future?

Chandigarh being an administrative city, two centers emerged: One as the government with Capitol Complex buildings and parks and its precise situation in the landscape. The second one was the town hall, placed in the City Center.

The main constituent elements occupying the ground of the city were:

(a) The Sector:

The key of modern urbanism is 'the Sector', which was defined as a container of family life (24 solar hours: night and day). The population would be approximately from 5,000 to 20,000 inhabitants. Chandigarh had 30 sectors. Each sector had its maintenance organizations, the food provisions, schools (kindergarten and primary), necessary artisans (repairs, etc) the daily leisure (movies etc) all traversing in the middle of each sector. This was the V-4. The V-4 gave the horizontal connection between the contiguous sectors. The sectors were also specially devoted to all that concerned a family life (Man, Woman and Child), day and night. The sector was surrounded by high-speed roads with bus stops every 430 meters and given eight entrances in this social group. The fundamental principle of the sector was that no door was to open on the surrounding V-3s. Therefore the four surrounding V-3s were to be separated from the sector by a blind wall all along. In consequence, the sector would never receive transit buses or cars. If there were today any actual organizations, which were to break this rule, it should be set right. However, the V-4 could accept the through passage of cars and buses but only at low speed. Each sector would have a green properly oriented in the direction of the mountain, constituting a band vertically connecting a series of sectors. In these bands will be installed the diverse schools and the sports fields.

(b) The resulting geography:

(Concentration and dissemination in the city and out of the city) The 'Charter of Athens' of the CIAM charter proclaimed the functions of urbanism (as already given

above). Each function was to be contained in one container, which was one building. The first problem was to give the specific size of this building according to each function. The modern life had to lodge all its activities in containers of conformed size: 'unities to grandeur conform' (for living, industry and for leisure, school, museum, etc. sports) Each of these tools ('containers of conformed size') had to find their rightful place on the land. Their locations were to be fixed on the paper (plan) with their necessary surroundings. Some of these containers constituted a concentration while the other dissemination. At Chandigarh the place was given to the family containers (the sectors). For the work place was given the Capitol, University, City Center, and a limited industrial land.

(c) *Indispensable facts:*

These were the acceptable facts (their biology) by which the human factors were to be put on the summit. According to Le Corbusier, it was the relationship between the cosmos and man. Law of Sun was of the greatest importance. In Chandigarh, the sunlight was to be controlled so that the day hours could be employed for working. It was a technical intervention in the domain of construction of dwellings and public buildings.

The air, to be breathed, was a condition of human life. The problem of 'aeration' (breathing) was very important. The urbanistic conception of noise control was to be introduced in the construction of buildings. Enunciating the spirit of the city, Le Corbusier said: "The sun, space and verdure are the ancient influences, which have

fashioned our body and spirit. Isolated from their natural environment, all organisms perish some slowly, some quickly, and man is no exception to this general rule. Our towns have snatched men from essential conditions, starved them, embittered them, crushed them, and even sterilized them.... Unless the conditions of nature are re-established in man's life, he cannot be healthy in body and spirit... " ¹¹

4.3.8 The Buildings

(a) The Capitol

The Capitol is Le Corbusier's tour de force. He began to sketch the designs for the Capitol buildings during his first visit, in early 1951. Like the Acropolis, which Le Corbusier loved, the complex stands aloof and dominates the city even today. These geometrical concrete buildings were intended to embody the new spirit of democracy as manifested by the founding government of India. The size and solidity of the structures were meant to denote that authority. Le Corbusier devoted great attention to the placement of the various buildings and other elements to avoid a static balance of rigid geometry while at the same time preserved the alignment along a crossed axis that gave the whole complex a subtle visual cohesion. (Illustrations 11, 12, 13)

(b) The Secretariat

The first conspicuous building to come into view is the Secretariat. The largest of all the buildings in the complex sized at 254 meters by 42 meters. Positioned at a sharp right angle to the mountain range it was designed as a vast linear slab-like structure,

a workplace for 4000 people. An endless rhythm of balconies and louver on its linear facades punctuated in a subtle way by a deliberately asymmetrical composition of brise-soleil (a sun shading device), conceived by Le Corbusier in one of his earlier studies, the conceptual design of a skyscraper in Algiers in 1938. While a repetitive brise-soleil clad the five bays of the linear façade of the secretariat, the sixth bay, which contained the double-height rooms reserved for the ministers had an asymmetrical pattern. Its facade, besides the rhythmic brise-soleil, is also sculpturally punctuated by the protruding masses of angled ramps and stairways. The roofline had a playful composition of a restaurant block, a ramp and a terraced garden, that broke the endless linearity.

(c) The Assembly

Close to the huge sunken parking area in front of the Secretariat is located the Assembly, the most sculptural and eye-catching of all the geometrical forms of the Capitol. When Le Corbusier first arrived in Delhi, he saw the old astronomical observatory called Jantar Mantar, built by Maharaja Jai Singh. Reacting to its structures Le Corbusier recorded, " They point the way; bind men to the cosmos... the precise adaptation of forms and organisms to sun, rain air etc." The essence of these forms took the form of Le Corbusier's imagination and later when he began sketching for the Assembly; these conceptual forms found expression in Le Corbusier's drawings. All the initial sketches incorporated some form or the other of a tower atop a cuboid building. But it was only on his fifth trip to India in May/June 1953 that his vision of the Assembly got concretized. Flying over Ahmedabad, he

noticed the cooling towers of a power station. It was the shape he had been looking for. From this inspiration, a great hyperbolic drum, 39 meters in both diameter and height was incorporated in the plan along with a pyramidal skylight connected to the drum by a small bridge. Inside, the legislative chambers are dramatically illuminated with shafts of light. The building had two entrances: one at the basement level for everyday use and the other from the piazza level for ceremonial occasions through a massive entrance. This entrance was 7.60 meters high and 7.60 meters broad, whose enameled door (a gift to Punjab from France) translates a cubist mural painted by Le Corbusier himself. The door and many other elements of the Capitol demonstrate Le Corbusier's predilection for melding art and architecture. (Illustration 14)

(d) The High Court

The High Court was a linear block with the main facade toward the piazza. It had a rhythmic arcade created by a parasol-like roof, which shaded the entire building. Keeping in view the special dignity of the judges, Le Corbusier created a special entrance for them through a high portico resting on three giant pylons painted in bright colors. Very much in the tradition of the Buland Darwaza of Fatehpur-Sikri, this grand entrance with its awesome scale, was intended to manifest the Majesty of the Law to all who enter.

Juxtaposed between the main courtroom of the Chief Justice and eight smaller courts, was a great entrance hall. Its scale; especially the height could be

experienced intensely while walking up the ramp. The symbolism of providing an "umbrella of shelter" of law to the ordinary citizen was found vividly manifested here. The continuity of the concrete piazza running into this space created a unique site and established unity of the structure with the ground plane. The massive concrete pylons representing the "Majesty of Law" were painted in bright primary colors and visually punctuated the otherwise rhythmic facade of the High Court.

(e) Monuments

One day in 1952 when the first drawings were being made, Jane Drew, (wife of Maxwell Fry; a colleague of Le Corbusier for the project of Chandigarh) casually suggested to Le Corbusier: "Why don't you set between the edifices of the Capitol some of the signs that you sometimes evoke and which symbolize your strongest preoccupations?" (Evenson 1966) Le Corbusier accepted the suggestion and so it was that besides the three major buildings of the Capitol Complex, Le Corbusier planned a number of monuments along the main piazza to activate and embellish its linear perspective. (Evenson, 1966)

(f) The Open Hand

The most significant of the monuments is the Open Hand. Conspicuous by its scale, this giant hand in metal sheet raised 26meters from a sunken trench and rotated freely in the wind from a high concrete pedestal, conveying the symbolic message: 'Open to give, Open to receive' which became the official emblem of the city.

(g) Tower of Shadows

Le Corbusier's idea of the "24 Solar Hours" provided the impetus for this monument. This was an interesting study of the movement of the sun. Here he explored various shading devices and demonstrated that one could control the sun on the four cardinal points of an edifice and that one can play with it even in a torrid country and obtain lower temperatures.

(h) Martyrs' Memorial

A memorial to the martyrs of the Punjab partition, consisted of an enclosure: a place where symbolic sculptures were to be placed.

(i) Museum and Art Gallery

The Museum, located in Sector 10 in the cultural zone of the Leisure Valley closely resembled the two other museums built by Le Corbusier: the first in Ahmedabad (1958) and the second in Tokyo (1959). The museum in Chandigarh was completed in 1968, three years after the death of Le Corbusier. All these museums repeat the form of a spiral within a square box. The facade is clad in brick tiles.

Officially named the Government Museum and Art Gallery, it is a square 50 meters on each side planned on a grid system of beams and columns. The main building was divided vertically in three levels with heights of 3 meters and 2.40meters. The area was divided into double height and triple height spaces. The ground floor (entrance, reception, lecture hall, cafeteria, workshop and storage) occupied approximately 2790 square meters. A ramp leading up from the triple height

entrance hall takes visitors to the main display gallery on the second level, which covered an area of 2140 square meters. The building was designed to make optimum use of daylight.

4.3.9 Industry

Despite his bias against industry, Le Corbusier was persuaded to set aside 235 hectares for non-polluting, light industry on the extreme southeastern side near the railway line as far away from the Educational Sector and Capitol as possible. Of this, 136 hectares were to be developed during the first phase. In the event of the city expanding southward, Le Corbusier suggested the creation of an additional industrial area in the southern part of the city where a second railway station could be established. While the Industrial Sector was directly connected to the civic center by a V-3 road, a wide buffer of fruit trees was planted to screen off this area from the rest of the city.

4.3.10 The City Center

The Jan Marg (Public Avenue), culminating at the Capitol, is the main north-south axis of the city. The Madhya Marg (Central Avenue), culminating at the sector 14, is the main east-west axis.

The City Center was laid out immediately southeast of the intersection of these two axes. It is one complete sector of approximately 100 hectares and broadly divided into a two zones on the north and south. The Southern zone was developed as a center of district administration, containing the district courts and police

headquarters, the fire station and interstate bus terminus, while major commercial and civic functions are carried out in the northern section.

Originally Le Corbusier wanted to raise some high-rise buildings in the City Center and made sketches for them. A slab-like office building and a hotel in the form of a round tower were tentatively indicated. But influenced by the limitations of building materials and methods, a uniform four-storey height was, however, finally established for all buildings of the City Center. (Evenson 1966)

Lack of elevators, and the fact that Chandigarh lies in a zone of moderate seismic activity, dictated the four-storey height limit. The size of the buildings was determined by stipulating what the owners could afford. The building form emerged from architectural control defined by the municipal administration based on the guidelines given by Le Corbusier.

4.3.11 Housing

The residential buildings were governed by a mechanism known as 'frame control' created by the municipal administration to control their facades. This fixed the building line and height and the use of building materials. Certain standard sizes of doors and windows are specified and all the gates and boundary walls must conform to standard design. This particularly applied to houses built on small plots of 250 square meter's or less. All these houses were built on a terrace pattern and while they were allowed a certain individual character. The idea was to ensure that the view from the street, which belonged to the community, was of same visual order

and discipline to maintain uniformity. Individuals were given the freedom to create the interiors to suit their requirements for dwelling, working, relaxing. All buildings along the major axes of the city were brought under architectural control. It was made mandatory that a person building a house in Chandigarh would have to employ a qualified architect and the design was to be submitted to the Chief Architect for approval. These rules were essentially set by the administration in an attempt to keep the definition of Chandigarh intact as made by Le Corbusier.

4.3.12 Commercial Buildings

All buildings located in the City Center and commercial or institutional buildings located along V-2 roads were subjected to controls. The system of the City Center was based on a grid of columns, fixed 5.26 meters shuttering pattern on concrete and a system of glazing or screen walls behind the line of columns. The interior planning was left to the owners, and in the exterior, certain variations are permitted to give variety to the architectural composition. ¹²

4.3.13 Summary of the Chapter

Mainly targeted towards learning the planning ideas, methods and principles of Le Corbusier this chapter discovers different aspects of Le Corbusier as an Architect, Town Planner, and a Human Being. From the vast grandeur of the City of Three Million to the minute details of windows in the buildings in Chandigarh, this chapter reveals the simplicity, rigidity and several other factors of Le Corbusier's way of thinking which are later discussed in chapter seven. From the dictatorial way of

laying and defining the functions for making a city work to addressing the subtle details of human needs are handled by Le Corbusier in a meticulous way.

As the thesis now reaches its crucial stage and moves into part two, it shifts the focus from the paradigms of real world environment to the virtual world environment; a change from past to the present and consequently, into the future.

CHAPTER 5**Virtual Worlds: Concepts and Contexts****5.1 Introduction to Virtual World**

Computing, networking and virtual reality technologies are gradually approaching the level of maturity where large-scale multi-user virtual environments will be possible. This will lead possibly to the development of large-scale spaces for the on-line community to meet, socialise and carry out business. One might consider these environments to be virtual towns or, eventually, virtual cities which contain many of the features, and problems of their real world counterparts. This part of the thesis draws on literature from the disciplines of city planning and architecture to consider some of the issues that may be important in the design, development and administration of these environments in order to make them pleasant, usable and manageable.

There is currently a building 'boom' on the Internet. New 'towns' and 'cities' are springing up in cyberspace, constructed with digital bricks and mortar. These new electronic cities are popularly known as virtual cities, digital cities or cyber-cities. Many thousands of people are using these virtual city environments to carry out everyday activities like shopping, relaxing and meeting friends.

The possible end result of technological advances is a large number of people using powerful computers, which are connected to world-wide networks. One aspect of this networking is that it provides the possibility of communication with

large numbers of people with similar interests. This has already been seen in the use of USENET News and similar systems, which were first utilised by the academic community, where the networking facilities were widely available some years ago. These facilities are now more widely available due to the expansion Internet access.

The most recent developments have established multi-user three dimensional environments, or Collaborative Virtual Environments (CVEs) which allow a number of people to interact with others in a simulated 3D space. Looking to the future, it can be anticipated that computing and networking power will continue to increase. Eventually this will allow CVEs to mature until it is possible to have large numbers of users inhabiting distributed virtual environments; interacting with each other, using voice communication and other means such as gesture and possibly even facial and bodily expressions. One issue, then, is the development of the virtual environments systems to facilitate this, and so areas such as computer graphics, interface technologies, user embodiment and networking must be considered. However, alongside this there is the matter of the design of the environment where the interaction takes place. Given that environment envisions a large number of users, the creators of this environment will have to cater for their needs by first providing enough space and secondly by considering what the users will need from that space. This will depend on whether they are using the environment for business or leisure. Under these circumstances the virtual space can be considered to be a virtual town or city.

This would be a city in which it has a number of inhabitants who may want their own real estate as the base for their use of the space, and also those who want to engage in social or business activities in more appropriate, often shared, areas. In order to look at the design of such spaces one can look at the way cities are designed in the real world through the literature of city planning. This chapter continues to look at the parallels and differences between virtual and real city environments such as city planning on the large scale and at smaller scale. ¹

5.2 A City Planning Perspective

The Anatomy of City: Real and Virtual

Designers of virtual cities have an opportunity that rarely arises in city planning: to build their space from scratch. This provides an opportunity to extract the best principles from a variety of 'city planning' theories and principles and apply it to the design of virtual cities. To do this well it is important to recognize the similarities and differences between the real and virtual branches of city design.

The main concern of city planners in both real and the virtual city environments is to produce and manage a large and complex environment so that it works for its large number of inhabitants. That is it provides the facilities that those users require for the activities in which they choose to participate, whether alone or as a group. The inhabitants should be able to access these facilities easily and doing so should be a pleasant experience. This means that users should be able to have a private space which, they can make their own, which implies that some customization of the

environment should be possible. This will need to be managed so as not to encroach on the needs of other inhabitants. The city should also support multi-user areas for work and leisure. Examples of these might be parks, office buildings, theatres, sports stadiums and conference facilities. To allow access to these facilities the city should provide an efficient transportation infrastructure.

In reality designing a real city environment is a complex task of balancing many requirements and possibly competing needs of elements, such as industry, retail, business, residence, transport and leisure. The virtual city does not have to adhere to the physical constraints of the real world and so it may be able to overcome some of the complexities of city design. Also, many of the physical artifacts which exist in a real city will either not be required or will not be an issue in the virtual world. For example, the issue of pollution from any industry, which exists in a real world environment, will not exist in a virtual world environment so it will not be a requirement of design. It will also not necessary to worry about issues such as parking, as cars will either not exist or they might be available on demand. However there could be different issues such as band-widths, number users at a given point of time (Internet Traffic) etc. which might be needed to be taken into consideration. However, one concern must be how far the planners can stretch away from the metaphor of the city in designing the virtual environment and still have a usable space. For example, it will not be necessary in a virtual environment to actually build a city with buildings, as is essentially the case in reality. Yet before this environment is constructed in a two or three dimensional space, the users must be asked if they

would be able to, effectively navigate and maintain orientation in such a space. This problem has already been identified and highlighted with respect to information visualization (Chalmers, 1993) and could equally be an issue for virtual cities. The best idea is therefore to keep its planning and design as simple as possible in terms of its concept and ultimately the end product. ²

5.3 What Are Virtual Cities?

5.3.1 Definition

The term 'Virtual City' is widely used on the Internet to describe a diverse range of different information interfaces and content. However, important distinctions need to be made in the type of virtual cities that one can find on the Internet. They can be categorized into:

- (a) **Web Listing Virtual Cities** are Web sites, which describe themselves as virtual cities, but in reality are merely on-line guides, menus and listings. They are often created solely for advertising purposes, particularly for tourism promotion and make no attempt to represent the built form of cities.
 - (b) **Flat Virtual Cities** using 'flat' maps of cities. This stylized town map of familiar landmarks and buildings is a graphical interface to detailed online information.
 - (c) **3D Virtual Cities** use virtual reality technologies to model the built form of cities, to varying degrees of accuracy and realism.
 - (d) **True Virtual Cities**, which are an effective digital equivalent of real cities, providing people with an experience of walking around an urban place. To fulfil this criterion a true virtual city must have a sufficiently realistic built form of
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interface, a rich diversity of services, functions and information content, and most importantly, the ability to support interaction. The possibilities of constructing true virtual cities on the Internet are discussed later.

5.3.2 Three-D (3D) Virtual Cities

A variety of virtual reality (VR) technologies are being used to create three-dimensional models of virtual cities on the Web that people can go into and walk around. The most popular approach is using VRML (Virtual Reality Modeling Language), a Web modeling language able to construct objects in three dimensions. These objects can be any scale, from models of molecules to buildings and cities. VRML provides a flexible and powerful, platform independent, tool to model the urban form of virtual cities.

The three-dimensional models are downloaded from the Internet into any computer memory storage and one is then able to freely explore the streets and view details from any angle. These types of Web-based VR technologies provide an important step towards the creation of virtual cities by providing the means to create realistic 3D built form. The examples discussed later in the case studies are a close enough but yet not true virtual cities. This is because though they contain some interesting information behind the interface and support any social interaction they are not planned using any principles. They are merely three-dimensional models.

To give virtual cities a real sense of life they must support social interaction through face-to-face meetings, discussion or just chatting. This can be achieved by enabling the 3D built form of the virtual city in multi-user environments whereby any number of users can be present in the same model.

In a true virtual city its built form needs to be geographically referenced, with all its elements appropriately. For the planners the virtual cities could be future three-dimensional interfaces that help is properly referencing these elements. The virtual city environment in essence becomes an information system in which multiple users could enter, walk through the environment and interact. ³

5.4 Virtual cities as Metaphors: a way of Interpretation

Designing the virtual environment is a challenging problem because in its newness and abstraction, it presents a nearly blank canvas to the designer. There is neither an inherent form nor much history and shared culture on which to base a design. Its features are unprecedented. Its technological infrastructure is in constant flux. The metaphor of the city is a very useful tool for thinking about the virtual world. The virtual world is abstract and unknown; the metaphor of a city is physical and, though very complex, better known. This thesis will look at some of the key parallels between real cities and virtual spaces and between the planners of these environments.

A metaphor is a cognitive tool, a way of structuring thought. In particular, metaphor is useful (and arguably essential) for thinking about abstractions. The cultural and

symbolic meaning of 'city' helps shape the conception of what the virtual city environment could be like. Using the metaphor transfers the meaning of 'city' to the abstract virtual environment. And, while the Internet is 'fundamentally and profoundly anti-spatial' (Mitchell 1995), a physical metaphor makes the abstract comprehensible, our constant experience of the spatial world makes such metaphors both powerful and pervasive (Lakoff and Johnson 1980).

There are parallels both between real world cities and virtual city environments, as well as between the real-world architect and virtual system designers. Both real-world and virtual cities are (or should be) vibrant gathering places of people, centers of commerce and entertainment. The designers of both urban spaces and of virtual systems are creating environments that influence the interactions that occur within them and the culture that grows around them. But there are also important differences. In the real world, the architects and planners create a solid infrastructure of buildings, streets and so on around which people and objects move. In the virtual world, the same creators are working with very different materials and with a much more encompassing task. The whole communication structure and the means by which human beings are represented must be designed. That is this environment cannot be developed in bits and pieces and the creator has to take care of the minutest details. For example angle of the view while walking through the virtual environment or small details on walkway such as signs and posts.

5.5 Comparisons: Similarities and Dissimilarities in the Real and the Virtual Cites

Many points of comparison can be drawn between the physical and the virtual city. In City of Bits (Mitchell 1995), William Mitchell surveys a wide range of these comparisons. He examines the city metaphor in roles ranging from the aesthetic and physical to the economic and political. His analysis highlights the key points of comparison in a series of analogies like "Muscles / Actuators", "Facade / Interface", "Territory / Topology", "Enclosure / Encryption" and so on.

One of the strongest parallels between the city and the virtual world is their immense population. Modern cities are filled with strangers, huge crowds of people one passes on the street but does not know. This is very different from life in a village. It is different even from life in the classical cities - the polis whose agora and civil life are so often cited in the discussions of electronic community. Many urban theorists have cited this continuous exposure to unknown persons of diverse and often unfamiliar backgrounds and habits, as one of the most salient characteristics of city life. (Milgram 1977; Wirth 1938).

The virtual world is similarly populated by millions of people, most of whom are strangers to each other. Examining how this population pattern has shaped real world city culture can help us understand the forces that are shaping the development of on-line cultures. Furthermore research can point to designs that may help the virtual city avoid some of the real city's problems; it can also suggest

directions that may be especially fruitful to explore. To cite an example, the more number of people starting to use the virtual environments as a medium of daily business, the more they will reduce the actual traffic on roads as many activities could be done by just sitting at one point. This will eventually help in reducing pollution.

The characteristics of the city - its density, size, heterogeneity - have elicited cultural responses that are distinctly urban. These responses show the adaptations people have made in order to 'best benefit' from urban conditions. The inhabitants of today's virtual environments are similarly faced with competing desires: to be known and yet not to be exposed. One can see today's Web home page as the cultural equivalent of clothing; a personal display created for public viewing.

5.6 Perceiving the Virtual City

The design of the city affects not only how well its inhabitants can find their way around, but how well they can make sense of its social and symbolic complexities (Lynch 1960; Milgram 1977). Kevin Lynch, writing about the importance of a 'legible' environment, said:

Obviously a clear image enables one to move about easily and quickly: to find a friend's house or a policeman or a button store. But an ordered environment can do more than this; it may serve as a broad frame of reference, an organiser of activity or belief or knowledge... Like any good framework, such a structure gives the individual a possibility of choice and a starting-point for the acquisition of further information. A clear image of the surroundings is thus a useful basis for individual growth.
(Lynch 1960)

The inhabitants of the virtual city have similar needs. They need to be able to get from one place to another, to know what is available and who their fellow inhabitants

are. The abstract nature of the on-line world makes a legible environment especially important: a poorly conceived interface is far more impenetrable than the most twisted alleyways.

Both Lynch and Milgram asked inhabitants to draw maps of their city; their goal was to understand how the structure of the city was perceived. Comparisons of these maps showed much individual variation in the features portrayed, based on personal interests and experiences. The maps also showed group patterns, attributable to differences in class and other affiliations. The maps also showed architectural and spatial elements that were common to all. An important conclusion from their studies is that legibility in an environment is not same at all times as legibility in, say, a chart, which should have simplicity and clean, grid-like structures. Instead, it is based on memorable structures and symbolic spaces and on the existence of areas with distinctive visual styles. The planned space, on the other hand with its clearly laid paths, is legible easily because it does not contain the complexity of detail as in an organic environment. It is therefore more direct and easy to understand. This is an important aspect to be noticed in the design of virtual spaces

5.7 Essential roles of Architect and Planners as the Creators of the Virtual Environment

The city metaphor extends also to the parallels between their respective builders: the urban architect and the designer of virtual spaces. Design is not a quantifiable science. Though the usability of certain features can be measured (much as

ergonomists measure stair-treads for safety and human factors specialists measure menu designs for speed), much design assessment is subjective. One studies things that have been built, to see how they were used and how people changed and adapted them; from this, one develops an approach to the design of new spaces.

In his book Technology and Cities, Lewis Mumford says:

The architect must understand the technology of buildings, the properties of materials and the forces that make buildings stay up (or fall down); the architect must also understand how the buildings and street plans and lighting designs will affect the people who inhabit them.

On one hand there is the engineering side of building: a matter of calculating loads and stresses, of making joints watertight and roofs rainproof, of setting down foundations so solidly that the building that stands on them will not crack or sink. On the other side there is the whole sphere of expression, the attempt to use the constructional forms in such a way as to convey the meaning of the building to the spectator and user, and to enable one, to participate more fully in its functions.

The architect desires that the users should feel more courtly when they enter a palace and more like business and efficient atmosphere when they enter an office. The users could be more like citizens, more co-operative and responsible, more proudly conscious of the community they serve when they goes about the city and participate in its many-sided life. Architecture, in the sense that is presented here, is the permanent setting of a culture upon which its social drama can be played out with the fullest help to the actors. (Mumford 1952)

Like the architects and the planners of real cities, the creators of the virtual city environments must also understand the technology, knowing what is feasible to build today, and the kind of problems, yet to be solved. And, like architects and the planners of real cities, the creators of virtual environments have a primary role to create a social environment. Architecture may not determine human behavior, however bad design can numb the human spirit and good design can have powerful, positive influences on human well being. Of the many values designers seek to build into their designs perhaps none is more important than fostering community and human interaction (Donath 1997).

There are, however, important differences between the role of creators of real world and the creators of the virtual environments. In the real world, the built environment is only a small part of the environment as a whole. In the virtual world, the built environment is everything: it is a wholly mediated and synthetic world. The participants in a virtual world are wholly dependent upon the tools supplied by the creators of the space in order to communicate within that space. The choices made by the creator of a virtual environment thus greatly influence as well as constrain the means of communication and the ways in which a cultural vocabulary in the environment develops. (Refer Cybertown case study p. 81)

The creators of a virtual space shape the community in a more profound way than their real-world counterparts. In real world environment, people eat, sleep, and work in buildings. The environments of these buildings affect how interactively they do these things. However the buildings do not completely control their perception of the world.

In the electronic domain, the design of the virtual environment is everything. Whether or not the users know other people are privy to a conversation, or they can connect to an on-line identity to a real-world person, or whether they have only a faint notion of the personalities of those around themselves -- everything is determined by the design of the virtual environment. This is where the role of the creators of this environment, essentially the planner, becomes important. The creators can guide the users by way of their design and make them accustomed to

the environment. This nears to the conclusion that a geometrically planned and designed environment will be much easier to understand, navigate and work in. ⁴

5.8 Designing the new Environment

The city metaphor has resonance and depth, for there are many parallels between the city and the virtual world, and the city metaphor provides many striking images with which one can think about building on-line environments. It is thus not surprising that there are many metaphors in common usage such as Digital Cities, Electropolises, Downtown Cyberspaces and so on. Yet, too often, the city metaphor is taken literally and the resulting interfaces do not provide the functions of a city; they merely replicate the facade.

Hollan and Stornetta in their research paper 'Beyond being There' at the 1992

CHI conference state:

The electronic city is endlessly mutable. Its structure can grow and change at rates inconceivable in a world of brick and stone. Its appearance may be highly subjective and individually tailored to the taste of every visitor. The city metaphor works when it is applied functionally, i.e. when we think about the role of public spaces in social life and the use of landmarks in building collective memories.

As technology advances, it becomes increasingly possible to recreate the experience of 'being there' while separated by thousands of miles. While it may be possible soon to have full video/audio in a synthetic space - or to recreate Rome or London or New York in a 3D walk-through - the emphasis is with exploring what can be done that is new, that goes beyond the literal re-creation of the physical world. (Hollan and Stornetta, 1992)

This is exactly the realm where this thesis is trying to superimpose the ideas and principles of Le Corbusier as new methods in virtual city planning could be explored, developed and tested.

5.9 Overview of the Design of Virtual Cities on two levels:

1. Macro Level Design which deals with the overall layout of the space, the positioning and proportions of different areas of the city.
2. Micro Level Design of the city is concerned more directly with the smaller scale design issues that deal with the look and feel, the architecture and the provision of facilities in various zones of the city for the inhabitants.

5.9.1 Macro Level Design

The first concern in designing the virtual city on a large scale is the kind of structure, which is to be given to the environment. It is necessary to consider the variety of different functional areas which will be demanded by the inhabitants, and the range of activities in which those inhabitants will wish to engage. Some of the most obvious are meeting other people for social discussion or business meetings, which may each, require a different functionality for the facilities. Recreational uses of the space such, as viewing performances and sports is another important consideration. Even simply walking through interactive environments as one would in a park could be the possible activities. Recreational uses could provide great potential for creative design within the virtual world on a scale, which would be otherwise impossible in the real world. This is because with the Internet, it will be possible to produce displays of products using images and graphics and even provide on-line ordering facilities. This may also include providing services for the users with space designed for personal or business areas. City planning over many years has developed a

variety of approaches to the problem of producing effective layouts for cities. The same approach could be tried in planning and developing a virtual city.

5.9.2 Micro Level Design

Design of the city on the small scale is concerned more directly with the minute details in the production of the environment. The most obvious part of creating this environment is the visual appeal of the space. Design is the key tool in this endeavor. Variety may also be a key concern in designing a city, which is stimulating as well as attractive. However, making parts of the city pleasant to inhabit may go beyond the production of good-looking buildings and into more functional domains.

Some evidence to support this comes from an experimental study carried out by an American sociologist William Whyte (1988.) The purpose of this experiment was to look at the reasons why some of the parks and plazas in New York were more widely used than other parks and plazas. The plazas had been developed as a result of incentive bonuses which the city of New York had paid to developers to encourage them to build open spaces at the same time as they built each new office building. Whyte formulated a number of hypotheses as to why some plazas were more popular than others and tested them by filming the patterns of use of a number of areas. Some of these hypotheses were shown to be correct but some of the most obvious seemed to show no correlation to the number of people using the locations in the plaza and even some of those locations which would seem to be the best locations were under used. Whyte looked at factors such as the size and shape of

the plaza, the aesthetics and the amount of sunlight without finding a significant correlation. Finally he found that a strong factor in the use of a plaza was the amount of space available for the users to sit down. What with hindsight seems like an obvious factor was far from being the first to be considered. Obviously, there is not likely to be a direct application of this to virtual worlds, where sitting may not be an option for some time, yet there is a lesson to be learned that the design of a good space may not depend entirely on what immediately springs to mind. It has to be planned meticulously. As mentioned earlier, this is again where geometrically and systematically environments will be able to make sense than organic environments.

In her book 'The Death and Life of Great American Cities' (Jacobs, 1961) the writer and neighborhood activist Jane Jacobs looked at the way in which small streets can make their inhabitants feel safe. Again, it is difficult to apply this directly to virtual city streets. Here physical safety will not be an issue, but a feeling of safety could be an important contributing factor to a feeling of contentment which should be attainable in virtual spaces by borrowing some of the cues from real streets. Jacobs argues that fear comes from deserted streets and from strangers. She also claims that the main enforcement of security on a street comes not from the police or other authorities but from the actions, or mere presence, of concerned inhabitants of that street. She lists three qualities that must exist for people to feel safe on a street: a clear boundary between public and private spaces, knowledge that the inhabitants of the street are observing the environment and the presence of other people making legitimate use of the street. Jacob concludes that for a space to be seen as safe,

and therefore as a large part of that space been seen to be pleasant, there should be evidence that the environment is being used and that there will always be other people around to observe. This feeling of safety can be reinforced if there is a familiarity with the activities on the street and the people there that come from these routine activities.⁵

The reflections from the study of this section combine together the elements of city planning to suggest a model for a creating a pleasant virtual city environment. The next chapter focuses on clarifying the conceptual ideas of a virtual environment as discussed in this chapter by looking at two cased studies of virtual environments currently existent on the Internet.

CHAPTER 6**Case Studies of Virtual Cities currently existent on the Internet****6.1 Cybertown**

Cybertown is a free, clean, safe community environment currently existent on the Internet. It is a place for people to communicate, explore and share in the magic of online 3D. Cybertown is claimed as the "Civilization for the Virtual Age" - a futuristic, immersive society accessible via the Internet. Cybertown citizens use personalized 3D avatars to represent themselves in the environment. These citizens with their own avatars can own free personal 3D homes with virtual pets, hold jobs, form clubs, shop in the virtual mall, dance in the nightclub, get free Cybertown e-mail addresses, attend live celebrity and author chat events and participate in many other activities. Citizens are actively involved in the social structure of the community and with each other, making Cybertown a true virtual community.

A 3D house can be bought and upgraded by using Cybertown's own currency called as 'Cyber-Cash'. There is a whole social and economic structure in Cybertown and people can participate in it with other people from all over the world. They can do this across multiple Cybertown Colonies, which have their own special and unique identities.

Cybertown creators claim to feature technological advances in their environment where the inhabitant's actions with objects would be seen simultaneously by people in the same environment from anywhere in the world. The identity established by

one's avatar, which can be completely customized, is also maintained from community to community.

Citizens can create their own customized objects either for their own use or for trade. Citizens can create custom avatars with the help of downloadable software. They will be able to create, sell and trade custom made houses or other living abodes as well as custom avatars. The purpose of Cybertown has been stated as a place for harmonious interchange of ideas and information.

The Cybertown has its own constitution, which defines the law for its inhabitants to keep the environment on the web healthy and to avoid any crimes and vandalism. Certain guidelines of behavior therefore need to be followed.

The creators of Cybertown claim that it is the largest 3D sci-fi community on the Internet. This futuristic off world city is home to multi-national citizens who inhabit and socialize in richly detailed 3D worlds using 3D avatars to represent themselves. Cybertown is more of a way of life than a web site. Members, called as Citizens interact with Cybertown staff (essentially the creators of this environment) to create their own social structure that contains a government as well as an economy. Cybertown also provides special programming for its members through entertainment and educational formats including contests, celebrity visits, parties, live multimedia events, videos, concerts, classes and town meetings. Members can immerse themselves in these virtual, multi-user environments in a wide variety of ways. (Illustrations 22, 23)

6.2 Norstar Mall

NorstarMall.ca Inc. is a division of SKG Interactive Inc., which is a publicly traded company and is focused on creating Canada's premiere e-commerce destination. NorstarMall.ca, was launched on July 1st 1999. The goal of this enterprise is to become the "Ultimate Canadian Online Shopping Destination" and the most user-friendly e-commerce hub site available to e-shoppers in Canada.

The 3-D version of NorstarMall.ca offers consumers a realistic mall environment to shop in and focus attention on the products available there. Complete with information desks and window-shopping capabilities, the 3-D version of NorstarMall.ca claims to redefine the way Canadians shop online.

NorstarMall.ca is an e-commerce portal that through the medium of state-of-art technology, provides customers with one primary point of entry to over 800 e-retailers. NorstarMall.ca is also a wireless shopping portal, developed through a strategic partnership. The creators of NorstarMall.ca claim that it is the Canada's first 3-D shopping environment.

Initially NorstarMall.ca was introduced as a two-dimensional environment, designed with accessibility and ease of use in mind. This two-dimensional environment has been continuously upgraded since its initial launch in order to increase both, its ease of use and speed. It then added a new aspect to the site by three-dimensional online shopping environment ("NSM3D"). It was designed for the broadband Internet user

and provides a media-rich, interactive shopping experience. NSM3D offers consumers a realistic mall environment to shop in, complete with information desks and window-shopping capabilities. Upon entering a store through the NSM3D environment, customers are linked directly to the shipping section of the web sites of different products available there. As NSM3D evolves, the company claims that it plans to add new and innovative promotions that will increase consumer traffic to the web site, and ultimately to the online stores who rent a cyber real estate on this website.

The above two case studies are interesting examples of different approaches considered for developing a virtual environment. It is however important to notice that both the environments are in the evolving stage towards the realization of a virtual city environment. However it can also be observed that they do not use any specific methods or planning principles to implement their development. It is at this point that this thesis will intervene into incorporating the city planning ideas and principles so as to create more interesting experiences in terms of inhabiting the interactive environment.

Chapter seven that follows discusses and summarizes the two paradigms discussed so far in this thesis. It tries to make an attempt to bring out the salient features of Le Corbusier's planning and tries to relate them to the planning of virtual environments.

(Illustration 24)

CHAPTER 7**Findings, Comparison and Summary of the Case Studies**

A definite line of conduct is essential. We need basic principles for modern town planning. We must create a firm theoretical theme and so arrive at the basic principles of modern town planning. (Corbusier 1929) ¹

7.1 Findings from the Case Studies:**7.1.1 Le Corbusier's Planning Principles**

The salient features of principles of planning defined by Le Corbusier as studied in the earlier chapters are summarized as below:

- (a) He advocated universality in city planning. His planned cities could be located anywhere, free of context, history, and traditions of the place. The environment patterns created over the time didn't matter to him, as his philosophy was to treat a City Plan as a plain piece of canvas upon which a single integrated composition could be imposed.
 - (b) He wished that any new city designed should be organized, serene, forceful, airy and ordered.
 - (c) He was a strong supporter of geometry (grid) in planning and insisted on right-angled junctions.
 - (d) He called for standardization of building elements such as doors, frames, roof tiles and even screws. He strongly believed that the construction standards should be similar every where in support of his idea of context free cities.
 - (e) He was for strict separation of societal functions (Zoning) and asserted definitively that the plan is the dictator of any city.
-

By reading and studying Le Corbusier, one can learn the evolution of his thinking on City Planning. The monotony of similarities and parallels in the design can be seen in the examples of these discussed in the case studies before. The City for Three Million, even though hypothetical and unimplemented, shows the same strong expressions as that of his other planned cities and basically his principles of planning. Brasilia on the other hand, is a good example of Corbusier's influence on the world of city planning with Oscar Neimeyer taking a lot of inspiration from him while acting as the designer. Similar examples of Le Corbusier's uncompromising ideas can be observed in his plans for Paris and Moscow (Illustrations 19, 20, 21). Chandigarh was the only city, a dream come true for Le Corbusier where his plans were finally recognized and implemented in full as if to console his efforts to revolutionize the way the cities built. Here he implemented his principles without any hesitation as he was given a free hand in this by the Government of India.

In his book, 'Chandigarh: In the Search of Identity', author Ravi Kalia wrote:

While the American Planners preferred a naturalistic, curving street pattern without the rigidity of a sterile geometric grid; Le Corbusier was adverse to 'solidification of the accidental'. For Le Corbusier the straight line was the logical connecting path between two points, and any 'forced naturalness' was superfluous. Moreover, Le Corbusier always looked at the city plan in terms of a single cohesive monumental composition -- with major axes linking the focal points of the city. The emphasis on visual cohesion between the various city components was an essential feature of his somewhat rigid grid iron plan. (Kalia, 1987)

For the purpose of analysis in this chapter, only Chandigarh and its planning would be used to determine whether the planning principles of Le Corbusier could prove to be a revolutionary idea in the development of Virtual City metaphor.

The master plan as conceived by Mayer and Nowicki assumed a fan-shaped outline spreading gently to fill the site between two seasonal riverbeds. At the head of the plan was the Capitol, the seat of the state government, and the City Center was located in the heart of the city. The plan reflected the American architects' desire to deliberately avoid the sterility of a geometric grid in favor of a loosely curving system. It certainly had the overtones of the 'romantic picturesque' tradition of a Garden City. It was a composition based on a loose cross-axis which unified the otherwise isolated building structures that were related only by sight lines

Le Corbusier made many radical changes to the Americans' Master Plan, incorporating his own architectural and city planning ideas, however it is a tribute to Mayer and Nowicki's vision that he incorporated several of their seminal ideas. The super-block in their plan was now replaced by a sector. His plan was based on a grid iron pattern defined by a system of roads called as 7Vs. A neighborhood unit called as a 'Sector' was inducted. He arranged the zoning and layout to prevent animated street scenes.

Le Corbusier liked to compare the city he planned to a biological entity. In this he identified four basic functions; living, working, circulation and the body and spirit. This is how he set the definition of the use of the city. This also reflects his strong dictum: "The plan is the Dictator of the City"

The Master Plan is of poetic significance. It is almost biological in its form. Its commanding head; the Capitol Group; its heart the city commercial center; its hand

as the industrial area; its brain the intellectual center in the park land where are the museums, university, library and other such cultural and educational activities are located. It has its stomach in its city center in the central market, its veins are embedded in the roads, the water, electricity. The whole city is surrounded by open country, but it has its internal lungs too, its green breathing space. This long simile of a town, known as an organism, can be even further extended to the fact that allowance has been made for growth (Evenson 1966).² Le Corbusier has focussed mainly on designing the Capitol Complex, which was necessarily the 'Head' of his city. In short, this analogy was used to define the zoning pattern of Chandigarh to create an order in use of the city.

7.1.2 Positive and Negative aspects of Chandigarh

This section interprets Le Corbusier's planning principles in the context of real and virtual city planning.

- (a) Le Corbusier's city was originally planned with the idea of considering the Human scale for proportion. However the final product was totally out of scale.
 - (b) He replaced the free flowing plan of Mayer and Nowicki by a strong rigid grid.
 - (c) He specifically arranged zoning such as Capitol, Industry, Housing, Commercial, etc. which unfortunately was completely opposite of a typical Indian characteristic settlement. In other words, his planning was free of any context related to Indian culture and traditions.
 - (d) His idea of wide streets made interaction difficult.
-

- (e) His restrictions on planning design and development on the people resulted in the development of sprawl squatter settlements around the periphery of the city.
- (f) His Biological Analogy and the definition of use of Chandigarh however show his conscious futuristic vision to merge the city with the 21st century.
- (g) The resulting geography was very distinct from his analogy.

However if Le Corbusier's plans or his ideas of planning are superimposed on a virtual city, give a completely different picture. The reasons why Le Corbusier's plans would work, possibly more efficiently as Virtual cities could be related to:

- (a) His idea of straight, effective and simple to follow planning, which directed and dictated the user at every step.
- (b) The context free nature of his plans, which could be applied anywhere and the Internet being a living example of amorphous city without boundaries provides a perfect setting to create an environment incorporating his ideas into contemporary Internet technology.
- (c) His rigid grid iron plans bring clarity to navigation, strength in representation, solidity to the interface and distinctiveness to the character of a virtual city.

These findings of positive and negative aspects help in building the argument of this thesis that Le Corbusier's principles, even though failed to achieve any credibility in real world city planning are almost directly applicable in the development of virtual city environments.

7.2 Summary of the findings

The creation of virtual city environments needs a definitive plan and certain principles that could help in systematic development of this environment. Le Corbusier's principles are a bridge to the development of such kind of environments. The research in this area could be focused on the application of these principles to improve the planning, design and management of real cities.

The virtual city information system could be used by a wide range of groups, from developers looking for sites for new buildings, local authorities and utilities planners in the management of the urban infrastructure, to provide tourists with detailed guides, and for residents as a community resource. The particular style of interface and the level of detail of information presented could be tailored to suit the needs of the user group concerned.

Virtual cities are computer based, digital equivalents of cities that have similar qualities of real cities for the user to get a real sense of being in an urban place. As yet there are no virtual cities on the web that satisfy this demanding definition. Of course there are serious technical constraints on the performance of the web, which affect this demand. However, the progress in the design and construction of virtual cities is rapidly occurring, most noticeably in terms of representation of built form on the web.

The prospect of creating true virtual cities, with a real sense of urban life, that people can visit from anywhere in the world and at any time is tremendously exciting.

Perhaps the virtual city will be the city for the 21st century as dreamt by Le Corbusier!

The thesis now moves on from here to propose a concept of a Metaphorical Virtual City using the findings from earlier research and taking references from certain conceptual models already in consideration in the eighth and the concluding chapter.

CHAPTER 8

Conceptual Interpretation and Proposal based on the Research

Ordering of the city: I believe it to be natural that an inner law should animate a work created by a human being. Let me refer to the dictionary: Rule: to guide; principle, law; discipline, order. (Evenson 1966) ¹

The Materials of City Planning are sky, space, trees, steel and cement in this order and in this hierarchy. (Evenson 1966) ²

8.1 Interpreting Virtual City in a Real Context

Cities are very complex spatial environments and ordinarily the inhabitants of these environments know how to get information, how to reach certain locations in a city, and how to make use of the available infrastructure in the city. Cities provide a rich set of navigational infrastructure that lends itself to creating sub-metaphors for navigational tools. A city metaphor makes this existing knowledge about a structured environment available to the user of a computerized information system.

In this chapter, in order to make the structure of modern information systems easier to understand and therefore easier to use; a conceptual user interface metaphor is proposed based on the structure of a city.

The initial focus is on several properties of user interface metaphors that will distinguish them from current systems, like the richness of information or the use of visualizations to show the structure of information spaces. The strengths and problems of spatial user interface metaphors are also described ahead. The advantages and drawbacks of information city metaphors are discussed further. A few scenarios of how a virtual city might work follow. Finally it is determined how the

implementation of this metaphor will take place using either a textual or graphical virtual environment or a combination of both.

Cities as well are spaces where people navigate collaboratively. They guide each other, they point out landmarks, they give (sometimes, incomplete) route descriptions and they interact directly with each other and with objects in space. These properties of the dynamic city environment and its navigational infrastructure are the qualities supported in the Information City metaphor being created here. The Information City envisioned is a tool to either communicate structure of an information space to the user or to explicitly use it as a tool for navigation.

In order to understand the structure of these suggestions in a better way, they have been divided into several parts. The initial part describes the problem of navigation in complex information spaces. The challenge of communicating the structure of an information space to a user is then focussed on. Navigation is defined as a mapping from such a structure to navigation activities. It is argued that navigation can be easy only if the structure of the space is understandable.

Next, the spatial user interface metaphors are described and how they can help in navigation by making structures explicit. The advantages and disadvantages of spatialization are described, and it is anticipated that future spatial metaphors will differ from earlier systems both in their use of history information and rich visualizations.

Later architectural and city-planning concepts are outlined that would be used in the design of the Information City. City-planners have a good understanding of how to structure large architectural spaces to make them easy to use and to navigate. The elements of the city are based on the studies of principles of city planning in the earlier chapters. Related metaphors in literature are also reviewed.

The Information City is then defined by describing its elements, their main properties and how they interact. The Information City is a system of metaphors that allows creating complex information spaces using a structural framework based on the city. The city elements are split into structural elements, navigation tools, information providers, etc.

Finally, certain issues that might counter a virtual city are discussed. Also issues such as management of such cities are discussed.

8.2 Navigation in Complex Virtual Spaces

User interface metaphors facilitate understanding the structure of an information space, which in turn helps the users to find the information they are looking for. This structure stems from an information domain and is communicated via the user interface. The user interface metaphor itself imposes additional structure on the information space.

The term virtual space hints at a spatial conceptualization of the metaphor. This thesis proposes that spatial user interface metaphors have advantages for

navigational and organizational tasks. There is a strong relationship between spatial metaphors and information visualization: the visualization communicates the structure of the information space so the user can easily navigate it. The examples of these metaphors are discussed in detail further.

The basic principle of hypertext is non-linearity. Where most types of information have a typical order in which they should be apprehended, they are not necessarily true for hypertexts. Hypertext reading has been called associative reading, as the user determines the reading order dynamically in an associative way. One possibility for communicating the structure of an information space is to visualize it using a graphical representation (Information Visualization). Structural visualizations of this kind are one of the main working areas in the field of information visualization.

8.3 Spatial User Interface Metaphors

An advantage of spatial organization schemes is their initial familiarity for users. Most people easily understand the arrangement of objects in a visual representation as showing implicit relationships. A good example for how complex spatial relationships can be is the perceived structure of a city as overlapping neighborhoods or districts. City areas do not form a strict hierarchy but rather a structure of partial containment (Alexander 1982).

Similarly information objects can be arranged in the form of a visual expression such as graphics. Spatial arrangements based on a spatial metaphor thus are a useful

tool to visually express complex relationships between different entities in the virtual environment.

Spatial metaphors further provide source domains for metaphors representing access paths, enclosure, forbidden access etc. which can be the basis for navigation tools in information spaces.

The major problem of spatial metaphors is that they cannot represent large spaces very well. 'Scaling' therefore causes problems both for the visualization of the metaphor as well as for the navigation (how to access a location that is remote in that space).

8.4 The Virtual City: Motivation and Basic Development Concepts

The Information City is a conceptual spatial user interface metaphor for large information spaces. It is based on structures found in real cities, on knowledge of city planning and on how people learn such environments. The city is a rich environment with which humans have extensive experience. It is an excellent source for a metaphor because it is extensible and can be navigated using commonly available infrastructure.

8.5 Why use a City Structure?

The main argument for the city metaphor is that starting with the complexity of a city the metaphor provides dynamic structures that scale up comparatively well and also provides useful navigation tools to cope with the space's complexity. Another

argument for the city metaphor is that people tend to know only small parts of cities well and easily learn how to navigate between these parts.

Many of the city elements can serve as container metaphors (Lakoff and Johnson 1986). Examples are the district, the neighborhood, the block, the building and so forth. Several of these elements have strong boundaries (for example the building or the room). They are ideal sources for metaphors that describe strong encapsulation and access control.

People are used to navigating city structures. They are familiar with the road network and infrastructure and can navigate easily once they know the city. People also have learnt social protocols for various city elements, which control the interaction with other users in these areas. The city therefore is a social space as well.

8.6 Elements of the City Environment

Even though cities may be planned, their evolution over a period of time is in an organic way. Their structures develop out of the needs of their users and from the interaction of many people. In his book 'The Image of the City' (Lynch 1982), Kevin Lynch describes five major elements in the city image. They are the Node, the Path, the Edge, the District and the Landmark. However experiences say that these are not the only city elements conceivable. City elements are not always clear-cut. Their fuzziness stems from the fact that the city environment is not strictly hierarchical. Kevin Lynch is referred here in order to define the elements of city precisely.

Later on, the importance and influence of Le Corbusier's planning ideas and principles is referred to explain the metaphorical city. It is very interesting to notice that the elements of the city listed by Lynch are close to the ideas of Le Corbusier. In his book 'The City of Tomorrow' (Le Corbusier 1929); Le Corbusier describes the contemporary city in parallel with the five elements of Lynch mentioned above.

- (a) A node corresponds to an intersection in Corbusier's principles and is an element like a point in the perceived image of the city environment. In the structure of the city a node can be the crossing of two major streets or other linear elements. For navigation purposes people often refer to such nodes when describing their location.
 - (b) A path corresponding to a road by Le Corbusier is one of the two linear elements in the city environment. A path is a mental concept describing how to get from a location A to a location B. This is also where Le Corbusier's explanation of grid pattern and right angled intersections comes into focus (Evenson 1966).
 - (c) Edges represent borders or visual separations in the environment. Consider a highway leading through a city. It is a strong separating element between two areas (edge) but can be perceived also as a path depending on the point of view and the actual context. The V's defined by Le Corbusier for Chandigarh are a representation of this concept
 - (d) Districts or Neighborhoods are areas containing objects with a common element or character. They show clean boundaries when they are bordered by an edge.
-

This is the case in cities with historic centers where city walls provide a highly visible edge.

(e) Landmarks are elements showing unmistakable form. Landmarks must be discernible from all other instances of similar objects in the environment. They are like nodes conceptually small elements. Landmarks are of special importance when giving directions since they are easily recognizable. The 'Sector' defined by Le Corbusier and several monuments in the context of Chandigarh represent Le Corbusier's of characterization.

A well-designed real city provides a well-balanced mix of the five city elements, (Lynch 1982). This allows users to easily learn paths, to describe and remember routes and locations. It also may give locations in the city a feeling of place that provides context for objects nearby and a framework for social interaction (Erickson 1993).

The city elements described in the earlier part provide the essential structural elements for a city metaphor to be usable. The city metaphor can adopt additional city elements and characteristics to enrich the bare city with additional information.

A city that consists only of similar blocks with little or no differentiation is difficult to use even when plenty of structural elements (like paths and landmarks) are available. Finding a particular building in a district would still involve looking at each of them in sequence. If buildings look differently, possibly giving an indication of their contents, etc. then finding a certain building in this environment will be much easier.

As the user's needs change the visualization of additional information may also change according to the task at hand. This change provides several different views of the same environment, each of which can be optimized for certain navigational tasks (Dieberger & Bolter 1995).

8.7 Existing City Metaphors

Many existing city metaphors stick to the concept of strict hierarchies. It is often more a nuisance than a useful tool. In most of these environments buildings and rooms are simply containers and arranged in whatever fashion.

The two cases of virtual city environments studied in chapter six are a good example. However it is important to notice that however crude they are as of today, they mark the beginning of this concept of a virtual city and its existence on the Internet.

8.8 Description of the Information City Metaphor

8.8.1 Structure

The topology of the Information City is based on generalizations of three major elements: Buildings or containers, landmark and path. The Information City consists basically of a collection of containing elements that are associated with at least one landmark. The largest containing element is the city itself, but there is no restriction to only one city. The next smaller element is the district. Inside districts there may be

sub-districts that consist of buildings. Buildings contain floors and rooms: according to the structure of the information organized within the container.

Each container can be considered a complete subspace that does not have to adhere to the general city framework but may be organized using a different metaphor, should that be adequate.

8.8.2 Elements

When closing in on the city, major navigational paths that separate large districts come into view first. Getting closer brings lower order paths and smaller containers into view. Buildings and small-scale areas can be recognized. Finally, single buildings, small-area landmarks, architectural properties of single buildings, and specialized buildings, like subway stops, can be discerned. Similarly the virtual city could also begin with a simple interface and then unfold into a multi level environment.

8.8.3 Containers

A building is a container for information or infrastructure in the Information City.

Buildings have a unique address and show their accessibility using doors.

Landmarks are special non-access or public access buildings. In a graphical realization of the Information City landmarks can be seen from far away.

Rooms are containers inside buildings. Their walls may contain doors or windows to access other rooms or the outside. Rooms show their accessibility through doors. In

a virtual environment, containers will be places where the information is stored and at times displayed on demand.

8.8.4 Links

Paths connect two locations in the city. As in the real city, a path is a continuous element of the Information City. Paths outside buildings are visualized as streets or roads.

Intersections of paths are squares. Large squares are major elements in the city. Squares correspond to the nodes.

Lines connect the city environment either by location or by vision. Paths and lines should be visualized differently.

Links in case of virtual environment would be hypertext links or graphical leading to another set of information. They will be governed by the factors of connectivity, which would provide features of access control in certain cases.

8.8.5 Navigation and its Tools

Transportation and navigation are interpreted as different tools. Although both of these are navigation in the traditional sense, transportation is considered to be a more passive form of navigation where the user is moved, whereas navigation is an active process. Walking is navigation for short distances. It uses paths, squares and all open access structures. Walking can be half-automatic when an address (a link) close by is selected or the user decides to follow a 'red carpet' or direct link. Driving is a metaphor for fast walking and for covering medium distances. Driving in a Taxi

could be considered equivalent to a Guided Tour. Flying is used for long distance navigation.

8.8.6 Information Distribution

Information providers are the information-carrying entities of the city. The facade of a building is not only a wall, but it provides information about the contents of a building. Information walls present information. This idea could be well suited for the concept of ad banners, which are very common in the virtual environment. They can be considered to the real world equivalents of Billboard advertising.

8.9 Using elements of Chandigarh to superimpose on the Virtual City

The 'Grid' as the main navigation frame for the city can be expected to bring clarity in navigation of the interface and acts as the information provider of the city.

The 'Capitol' a representation of supreme administrative power, would act as the main section of the interface where the administrator has his full controls.

The 'Secretariat', 'The Assembly', 'The High Court' buildings would act as the containers of different types of information about the city as defined earlier. The motifs and drawings of Le Corbusier on the Capitol Buildings could act as the information walls providing information about the building or the concepts in general.

The City Center will mainly act as the hub or the place where people will spend most of their recreational time. This place will act as a provider for online interactions, business, shopping and all those activities, which take place at one to one basis in a city center.

The Industry will be an invisible force, which will drive the whole online world - the back end management of the dynamics of the city. The Monuments will act as landmarks defined earlier.

Besides the above specific buildings, there could be few other metaphors such as walking or driving around the city as defined before. Those would be generally designated by VRML or QTVR movies. Guided tours around the city as a metaphor for taking a guided tour on a bus, ad banners as the information providers of the city, just as the billboards. Bridges would act as connections and finally the 'Vs' acting as site maps or direct links or in today's definition, 'Information Super-Highways' to the needed information.

8.10 Implementing an Information City

The Information City is a conceptual metaphor. It is unlikely a complete implementation of all ideas and structures described so far will be ever seen together. However there are several possibilities regarding how to implement the Information City in parts and to use the ideas of the city for information systems.

8.11 Using a Graphical Virtual Environment

Not too long ago a realization of the Information City even on a high-end computer would have been material for a science fiction movie. With the ongoing boom of the Internet, the acceptance of VRML (Virtual Reality Modeling Language) and the availability of very powerful desktop machines, a purely graphical realization of an Information City is within reach. Interface designers will have to cooperate with

specialists outside the traditional user interface fields, a strategy that proved to be helpful already in the past. (Chang, Clanton 1994)

Information contained in an Information City often will be in the form of text and graphics combined together. A graphical realization therefore has to make sure this text is presented in a readable form to the user. Text on an information wall has the disadvantage that users will see it at an oblique angle, which will bring back the problems of early spatial metaphors trying to extend the flat desktop. (Card, Robertson, York 1996)

8.12 Building a City

An important unresolved issue for a complex structure such as the Information City is how to actually create the city structure. As mentioned in 8.6, even though the city may be planned much in advance; It is unlikely that a complete Information City can be created in one step. Instead, like in a real city, it will have to develop over time out of the interaction of its users (inhabitants) with the environment.

Initially the city might be only a small collection of basic infrastructure residing in empty space (the void). Large districts do not have a fixed location but are arranged as small individual entities. This prevents them from ever growing into one monolithic city. Districts therefore can grow without being restricted by adjacent districts. The connection between these islands is provided through links. An important consideration is minimal infrastructure that ideally should be available in

every environment, at least in a simplified form. It should consist of at least one object that can serve as landmark.

8.13 Conclusions

In an attempt to establish a co-relation between Le Corbusier's theories of Town planning and their applications in the virtual environments, the research into this thesis initially began with a small introduction to the history and origins of Utopian town planning. It proceeded to explore the ideas and planning principles of some eminent architects and planners.

As the thesis progressed, it became more focussed on learning and exploring Le Corbusier as a revolutionary Architect-Town Planner and his planning ideologies and principles. In order to understand Le Corbusier's theories in a better way, a case study of three different cities in different contexts was made and findings were drawn.

The thesis then changed its paradigms in the second part and shifted its focus to researching and understanding the concept of Virtual Worlds. This research took place by exploring some of the current trends and discussions taking place in the field of designing virtual environments. The concept of a Virtual City was defined here. In order to understand this concept in a better way, a case study was done to analyze the existing Virtual City environments on the Internet.

The latter part of this thesis was mainly concentrated on making a co-relation between the theories of Le Corbusier and their interpretations and applications in a metaphorical way for creating and designing an ideal virtual city. The findings and

eventually a conceptual idea for development of such an environment are summed up in the last two chapters of the thesis.

It truly is interesting to find that even though the theories and principles developed by Le Corbusier for real life cities failed to justify their importance and utility, the same when interpreted metaphorically give a completely different meaning and sense to the virtual city environment. The drawbacks of these theories of being idealistic, dictatorial and rigid for real life cities became virtues when interpreted in terms of virtual environments.

Consequently at the end of this thesis it can be concluded that the superimposition of Le Corbusier's theories on the world of virtual planning open a completely new avenue for research and development. Architects and Planners can now more actively get involved in designing and creating of virtual environments along with the real life environments. They can establish a common language of creativity, design and define a system towards creating an interactive virtual environment. The beginning of such involvement is demonstrated in this thesis by developing a small conceptual model for the interface of Virtual Chandigarh.

The last Chapter of this thesis discusses constructing a conceptual spatial metaphor in the form of an interface, called the Information City. This metaphor is based on knowledge transferred from the fields of architecture and city planning and designed to support navigation in the resulting virtual city environment. Contrary to other city metaphors in the literature we define a detailed ontology of city elements, describing

how each element pertains to a navigational structure. Navigation tools provide the infrastructure to move in the Information City.

In this thesis two major questions are raised in search for finding a co-relation in between the real city and the virtual city. What the virtual city will look like and what effects the presence of the virtual city will have on the physical city? As discussed in the elements of city in 8.8.2, the virtual city will mainly be a graphical representation of the real city enhanced by the use of real city metaphors. Necessarily this thesis states that the virtual city will be a metaphorical interpretation of the real city. Although it is difficult to bring this analogy to a literal meaning, the way the information is presented in the virtual city interface will strongly affect these interpretations. Thus, it can be concluded that the physical appearance of the virtual city would mainly be the elements of a browser interface supported by element metaphors. This will include navigation in the form of 2D, 3D, hypertext and graphics. The virtual city will be therefore a virtual version of a physical place. This virtual city is expected to have quite a few impressions and effects on the real city. This is because many activities performed physically could now be done electronically through the medium of the virtual environment. Online shopping, trading, business, banking etc. could be a few activities to name. Incidentally, that is the reason why in the description of 6.2, the Norstar Mall claims to advance change in the way people shop. Hence, the presence of the virtual city and the activities taking place within them are expected to have a positive effect on the real cities. However, there could also be some negativity to this in terms of physical limitations

of the activities and ultimately the experience. This thesis is thus an attempt to bring the two environments closer to each other by way of metaphorical interpretation. (Illustrations 25, 26, 27)

8.14 Reflections on the future of Virtual Cities

Even though this thesis formally ends the discussion with the preceding conclusion in 8.13, it would be worth to mention concerns that could follow these virtual city environments in the future. A few issues are addressed as reflections from this thesis.

The issue of governing is an important one, if any lessons, which have been learnt from city planning are to be applied in an effective and consistent manner. In the case of virtual cities it is also possible to consider management on two levels:

- (a) The city itself, its buildings, zones and architecture, and
- (b) The underlying computer systems which drive the virtual world and which may themselves be complicated in nature.

The relationship between these levels, if any, must also be taken into account.

The authorities of real cities have to carry out a very complex task. They will be responsible for managing growth of the city so that new developments can take place. All these tasks must be carried out in the face of pressures from interested parties such as businesses, resident groups and minorities groups.

So how would these problems map to the virtual city is a very interesting question to be addressed. The problem of managing the development and growth of the space

will remain. The administration will want to encourage new people to join the community as can be seen from Internet growth which will lead to companies wanting to be represented within the environment too.

It can be summarized that individuals will initially be drawn by the social aspects of the space, to meet and interact with other people with similar interest. Businesses (and other institutions, such as universities) will be drawn by advertising opportunities and, if the right facilities are provided the chance to carry out activities such as meetings and attendance at trade shows (which in reality may require a large travel budget) without leaving their offices. Both of these types of users will have some desire to have their own individualized presence in the space, an equivalent of the Internet home page. The nature of this presence should be representative of the type of user to avoid misleading other inhabitants. Also, the location will be important. This indicates that some executive control and policy should be applied to applications for new space allocations. In effect this means planning and zoning laws.

Many of the services required in real cities will not be required in the virtual space. There will be no garbage to collect and lighting will either be a global phenomenon or very easily managed on a more local scale. Services such as the maintenance of law and order will be required but in a very different way to what is seen in real cities. It will probably be concerned mainly with dealing with abuse of the system, unsolicited and unwanted contact and possibly some control of content where data access is allowed. Finally, there will be a separate set of services based on the

infrastructure of the world such as maintaining the accessibility of the system, audio communication, other interaction methods such as billboards and asynchronous communication etc. This again raises the issue of the different levels of management in the environment. (Ingram 1996)

It is obvious that the virtual city environment requires a highly complex computer system. To manage such a thing on any sort of useful scale demands a sophisticated network of inter-linked and distributed. Each system will therefore have its own local administration for its hardware and software. There are a number of questions that arise from this. Should these administrators be governing higher level aspects of life in the virtual city? Should there be different administrative domains in the space, and should these map onto servers, or groups of servers in the real world? Should there be a higher-level administration governing policy for the whole city? These are major issues that need to be dealt with in the future.

Illustration 1

City Map of Chandigarh existent today defined by the Municipal Boundaries as referenced from <http://chandigarh.nic.in/frcity.htm>

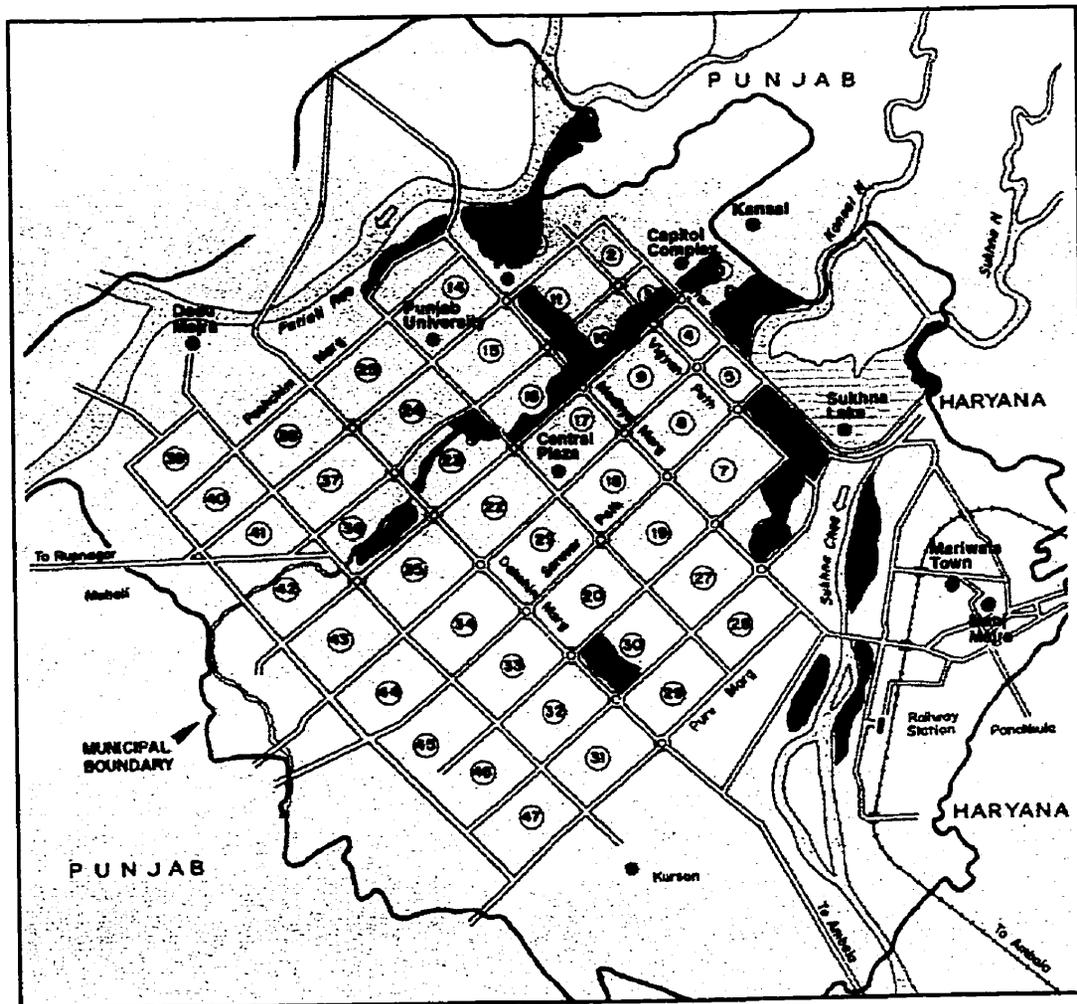
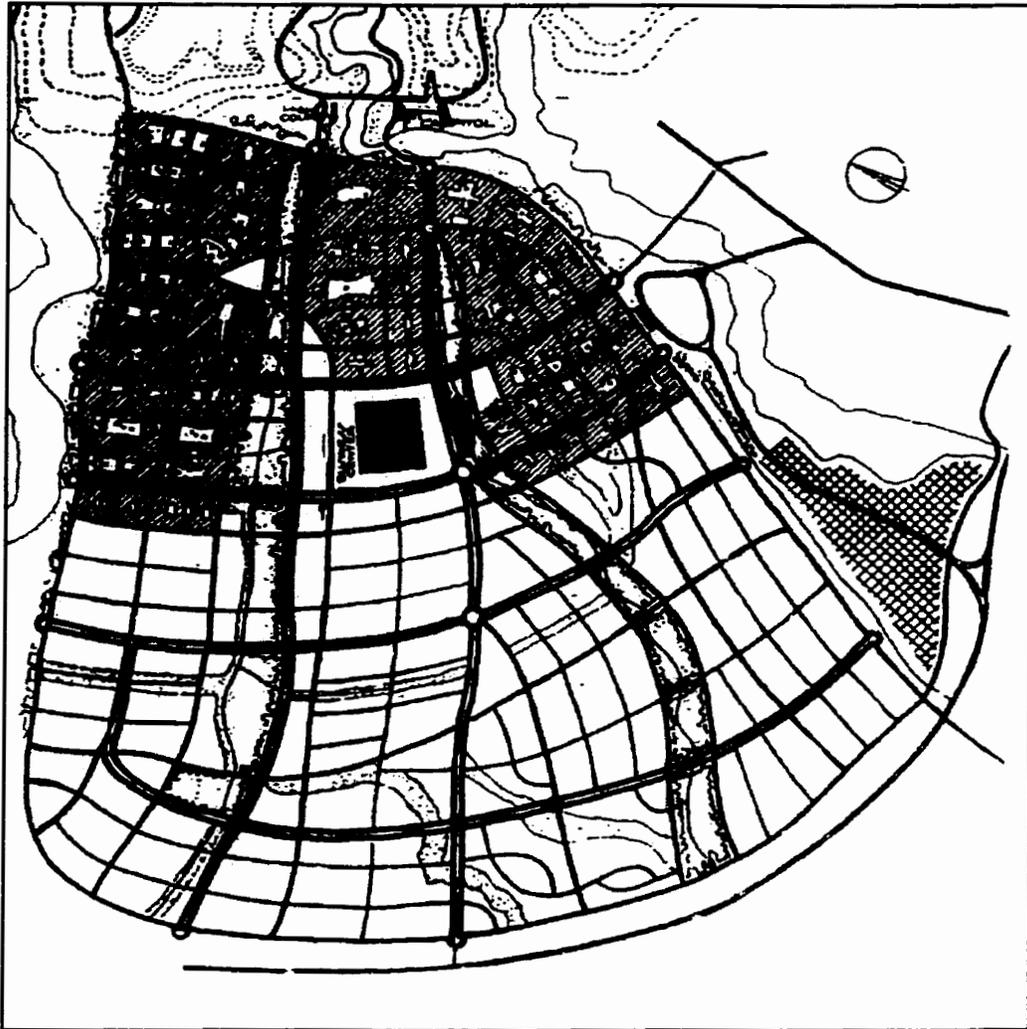


Illustration 2

Master Plan for Chandigarh by Albert Mayer RAIC Journal, 1955 (Evenson Norma, Chandigarh, 1966)



The shaded portion indicates the area of initial development while the lower portion outlines the projected area of eventual expansion.

Illustration 3

The 'leaf plan' of Chandigarh by Mathew Nowicki Scheme 1, Evenson Norma, Chandigarh, 1966.

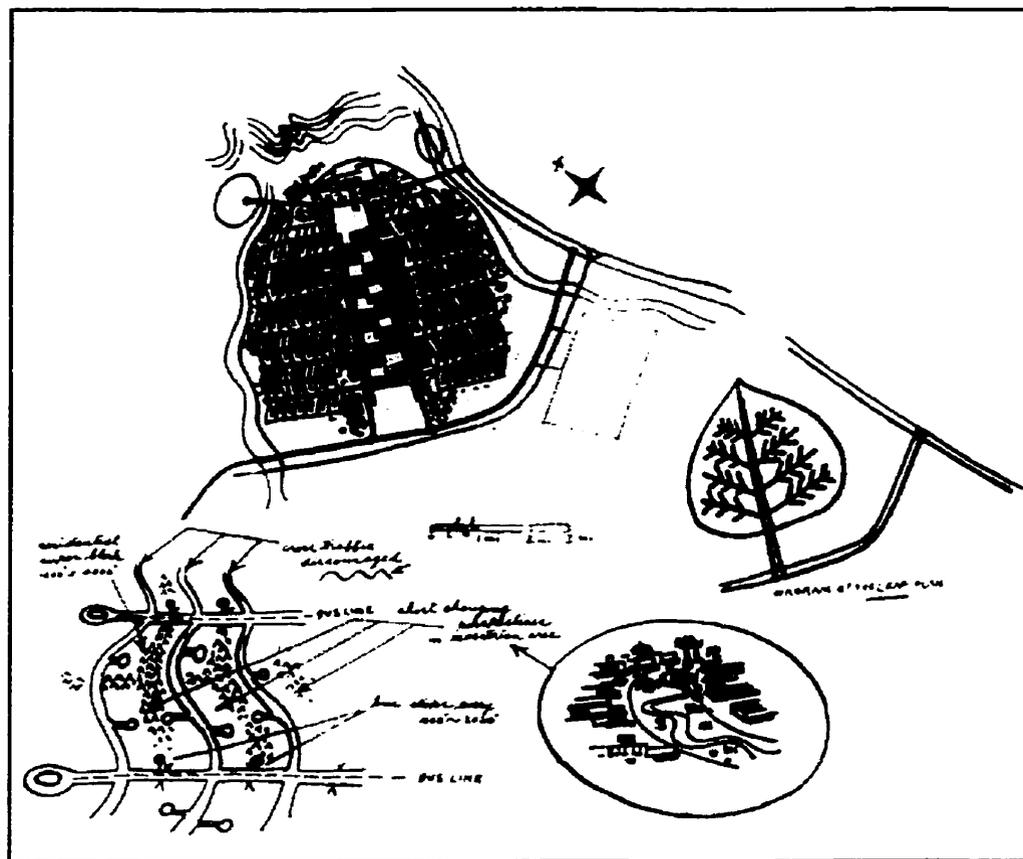


Illustration 4

The 'leaf plan' of Chandigarh by Mathew Nowicki Scheme 2, Evenson Norma, Chandigarh, 1966.

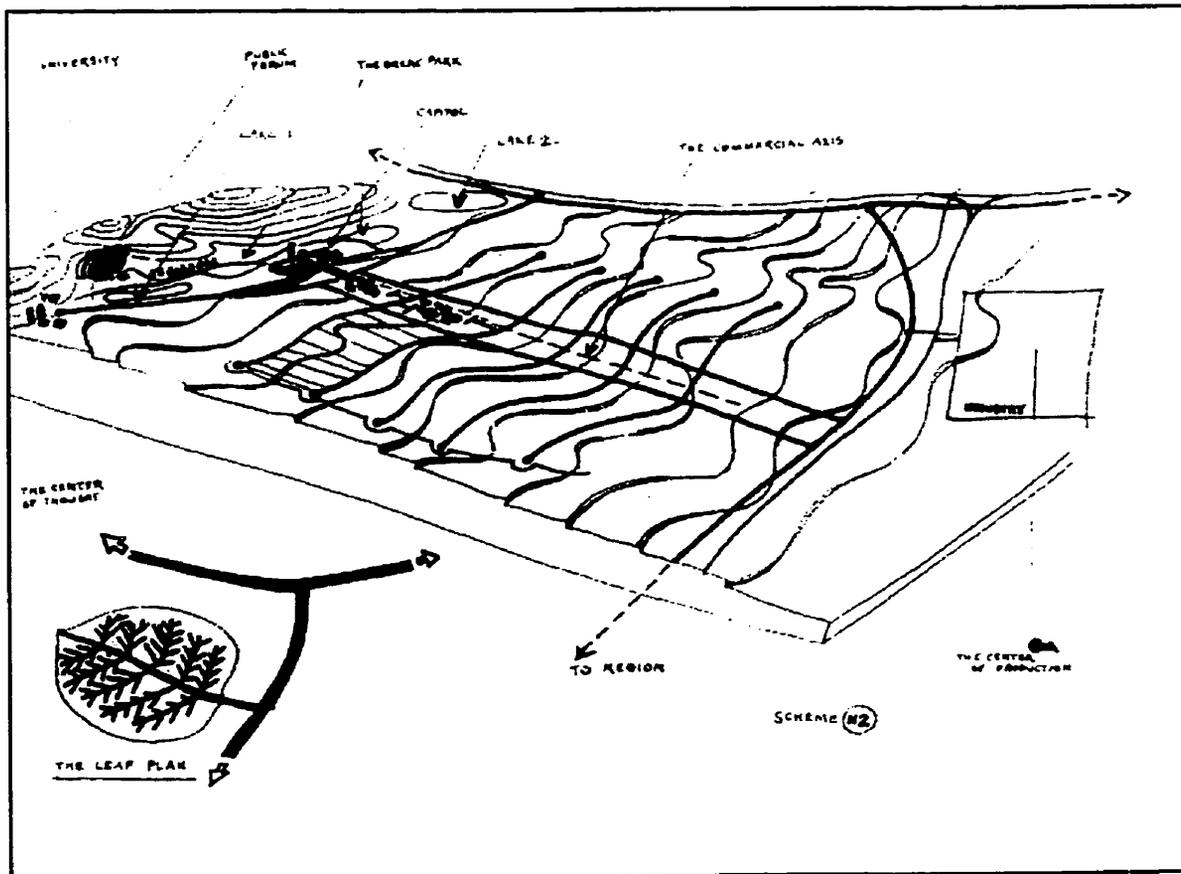
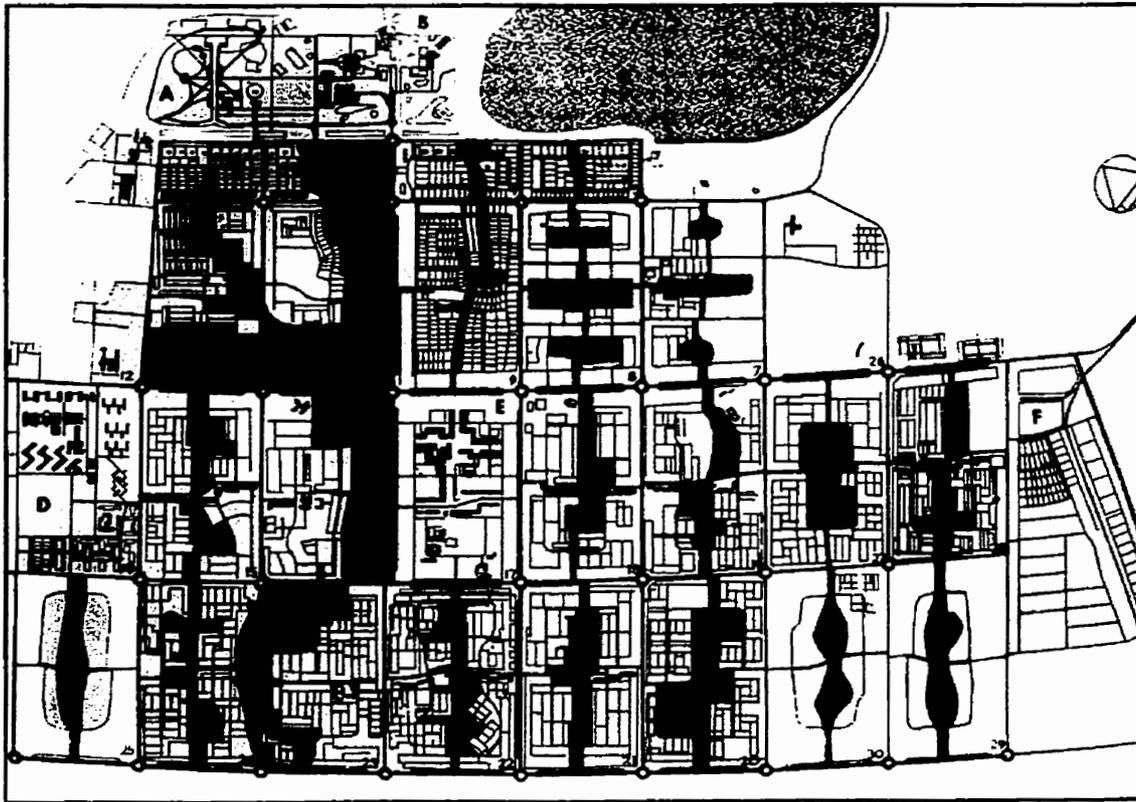


Illustration 5

Part plan of Chandigarh from Capitol Project Office Drawing, Evenson Norma, Chandigarh, 1966.



A. Rajendra Park, B. Capitol Complex, C. Lake, D. University (Sector 14), E. Central Business District and Civic Center (Sector 17) F. Industrial Area

Illustration 6

Le Corbusier's study sketches for Chandigarh, Modular II. Evenson Norma, Chandigarh, 1966.



Illustration 7

Le Corbusier's study sketches for Chandigarh, Modular II. Evenson Norma, Chandigarh, 1966.



Illustration 8

Le Corbusier's study sketches for Chandigarh, Modular II. Evenson Norma, Chandigarh, 1966.

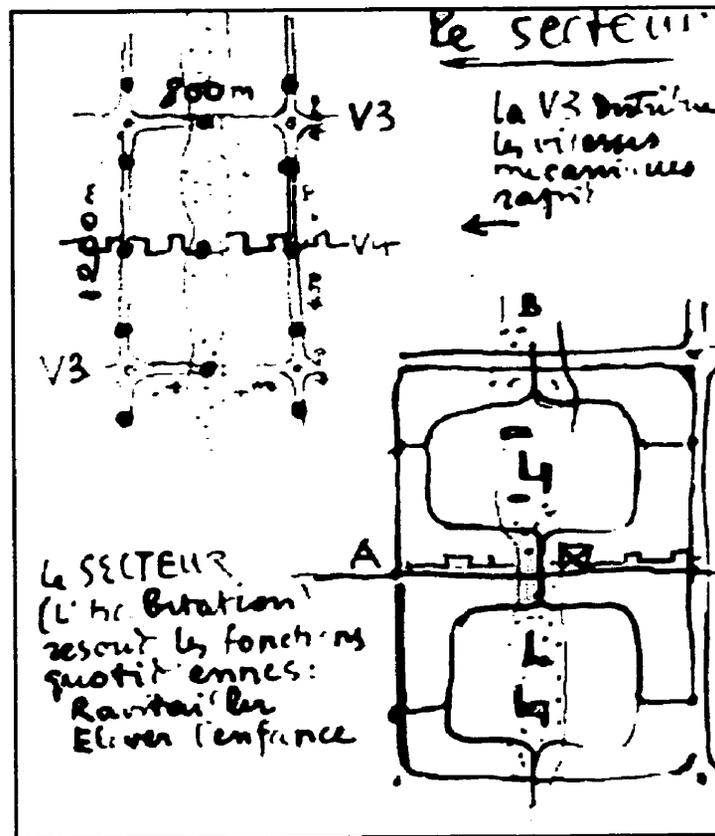


Illustration 9

Le Corbusier's study sketches for Chandigarh, Modular II. Evenson Norma, Chandigarh, 1966.

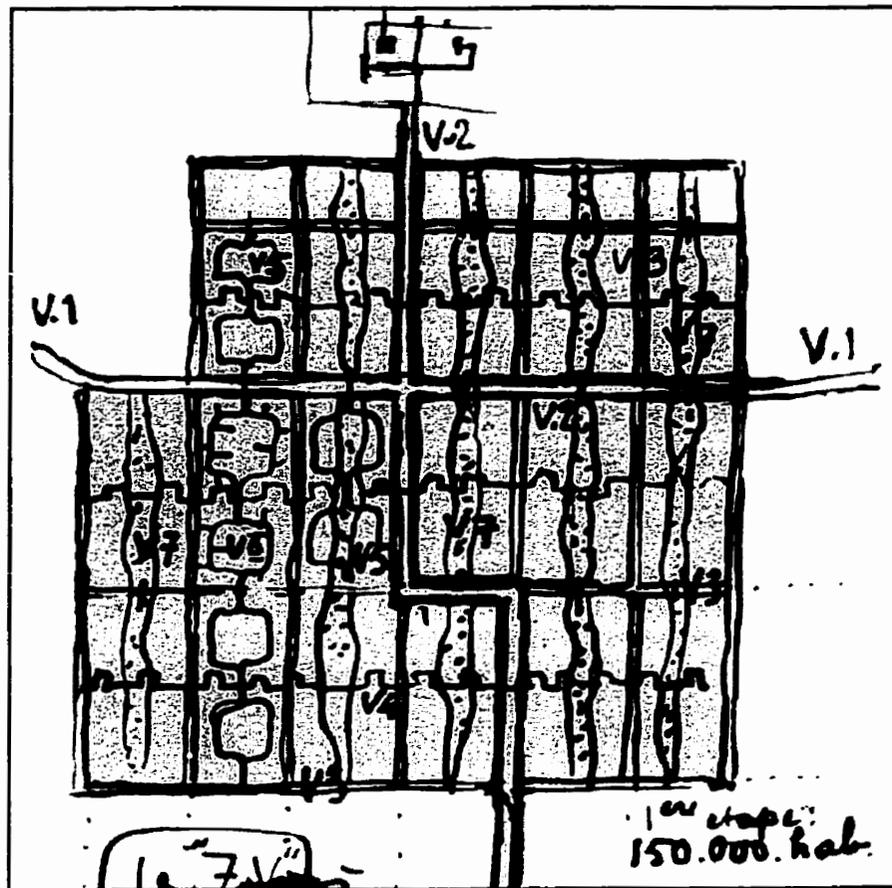
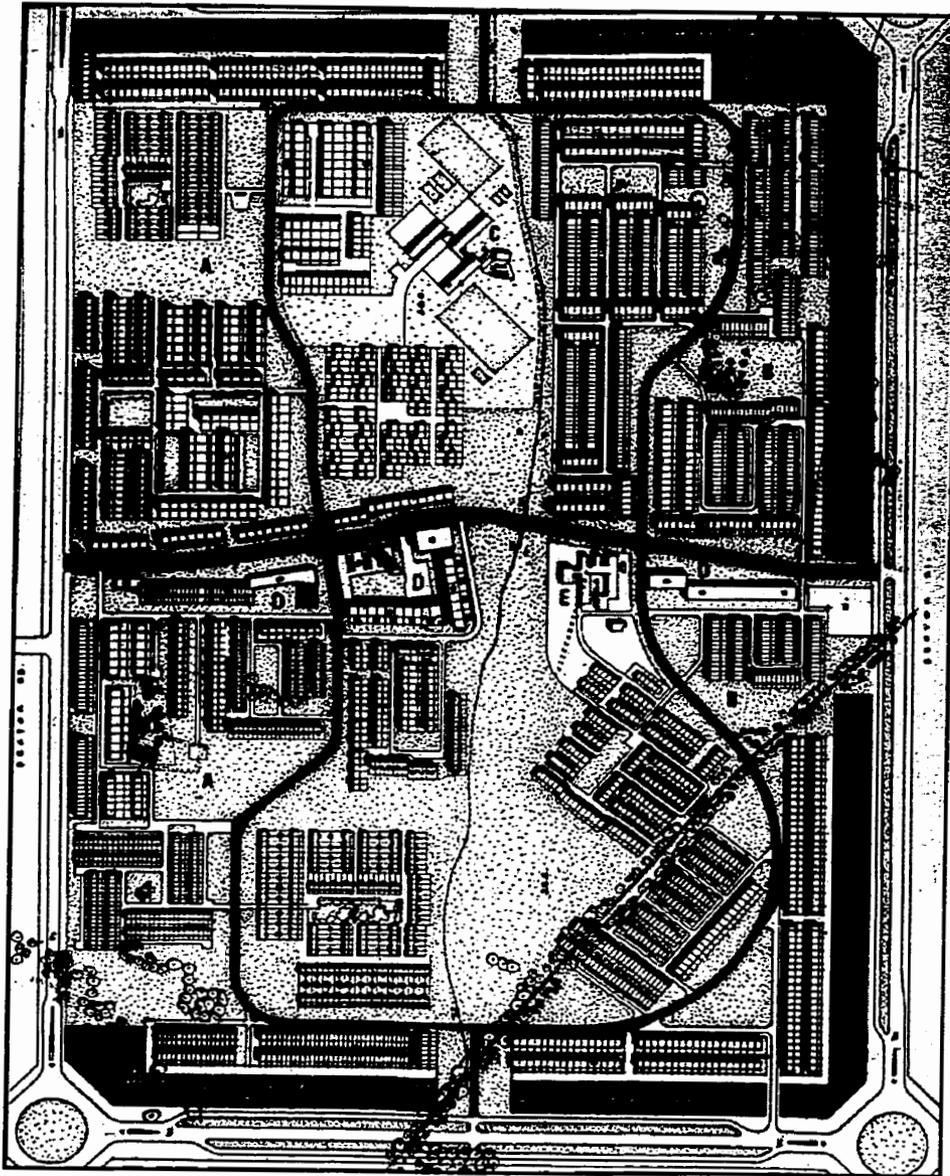


Illustration 10

Sector, Evenson Norma, Chandigarh, 1966



Sector 22, the first residential sector developed in Chandigarh. The sector is surrounded by V3 avenues intended for rapid traffic and bisected by the V4 bazaar street. The V5 loop road serves as primary traffic distributor while short V6 roads serve housing groups. A. Government housing, B. Private housing, C. Junior secondary school, D. Bazaar, E. Health center.

Illustration 11

Plan of capitol area with Rajendra park at left and capitol complex at right, Evenson Norma, Chandigarh, 1966

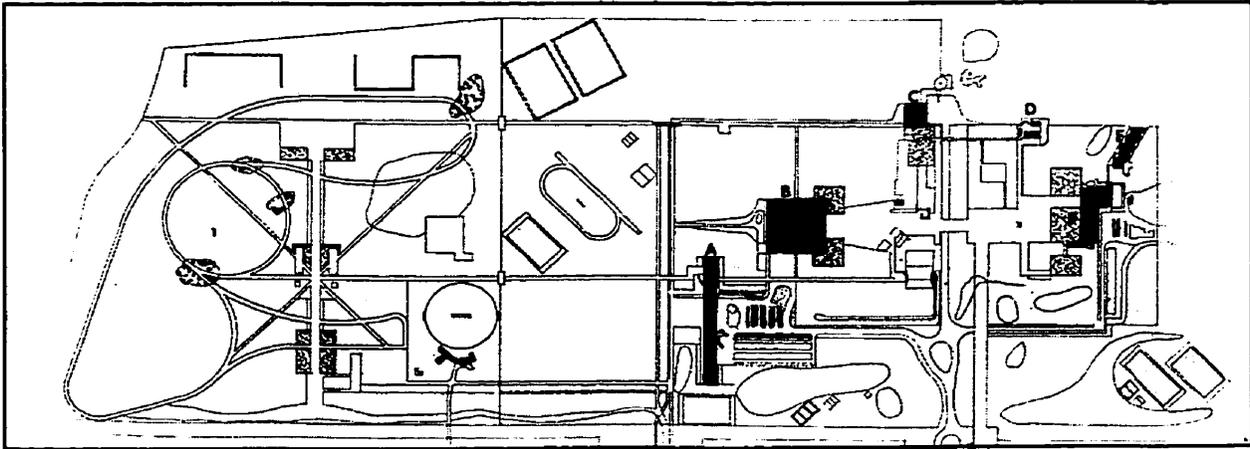
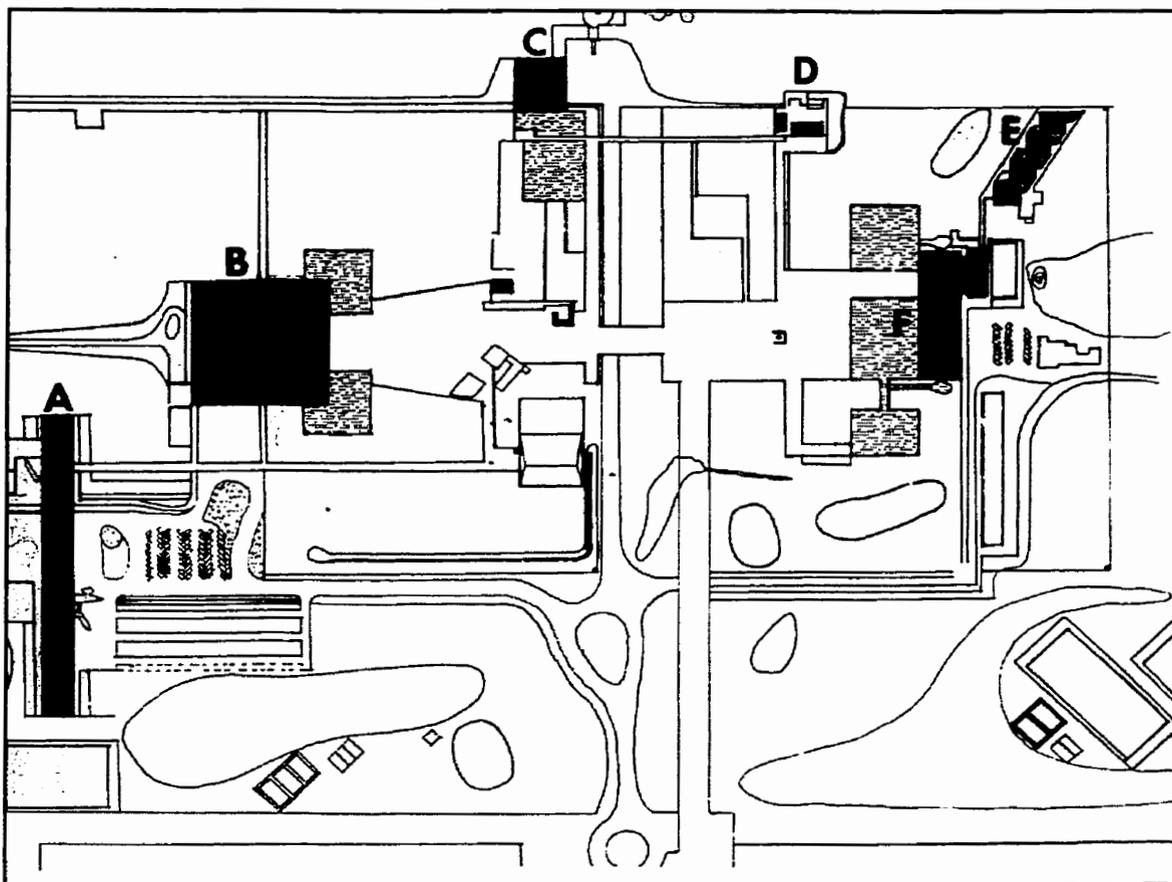


Illustration 12

Final plan of capitol complex showing revisions made as of December 1956.

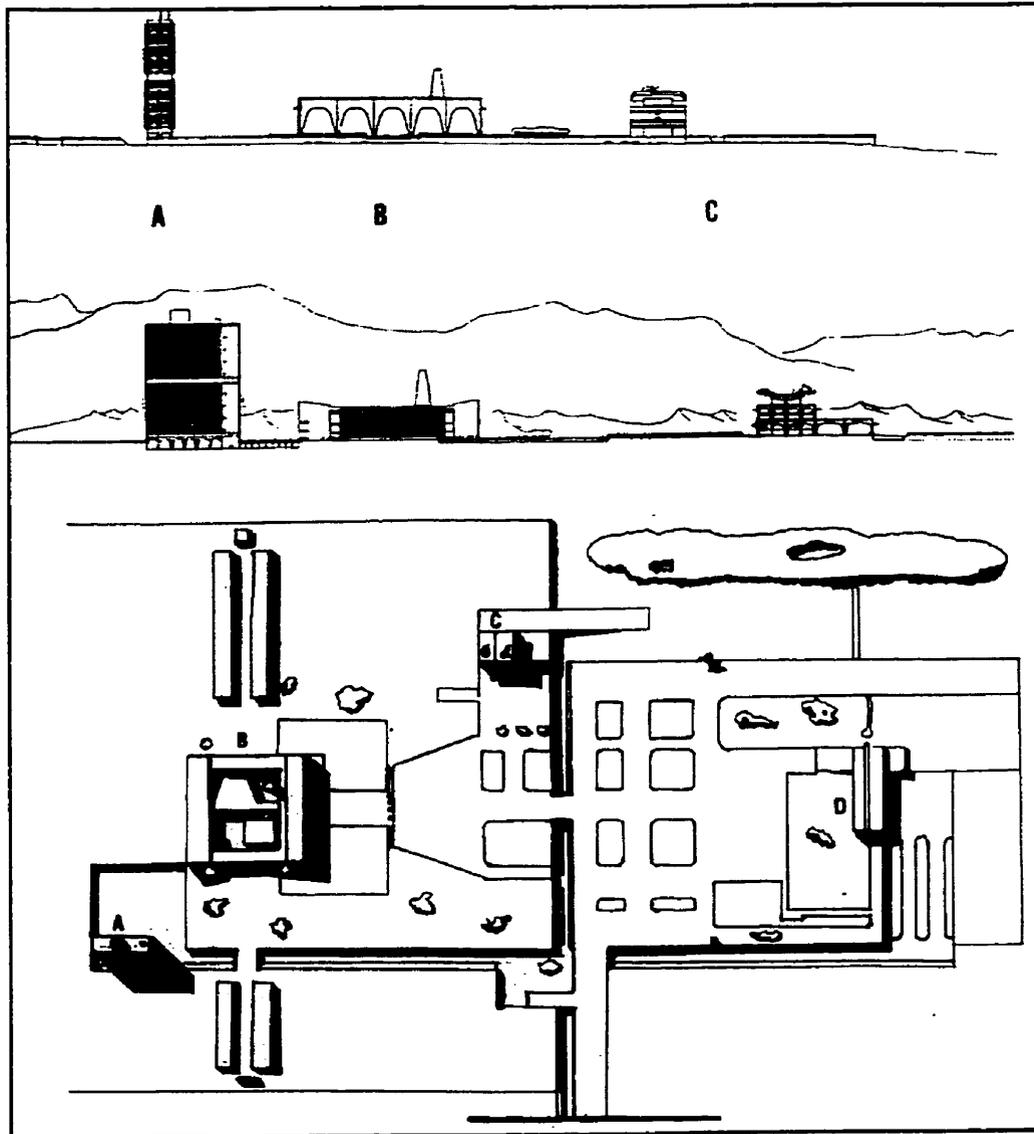
Evenson Norma, Chandigarh, 1966



A. Secretariat B. Assembly, C. Museum of Knowledge, D. Open hand monument E. High court annex, F. High court.

Illustration 13

Capitol complex, preliminary scheme by Le Corbusier, employing high rise secretariat. Evenson Norma, Chandigarh, 1966



A. Secretariat, B. Assembly, C. Governors Palace, D. High court.

Illustration 14

The Assembly, long section. Evenson Norma, Chandigarh, 1966

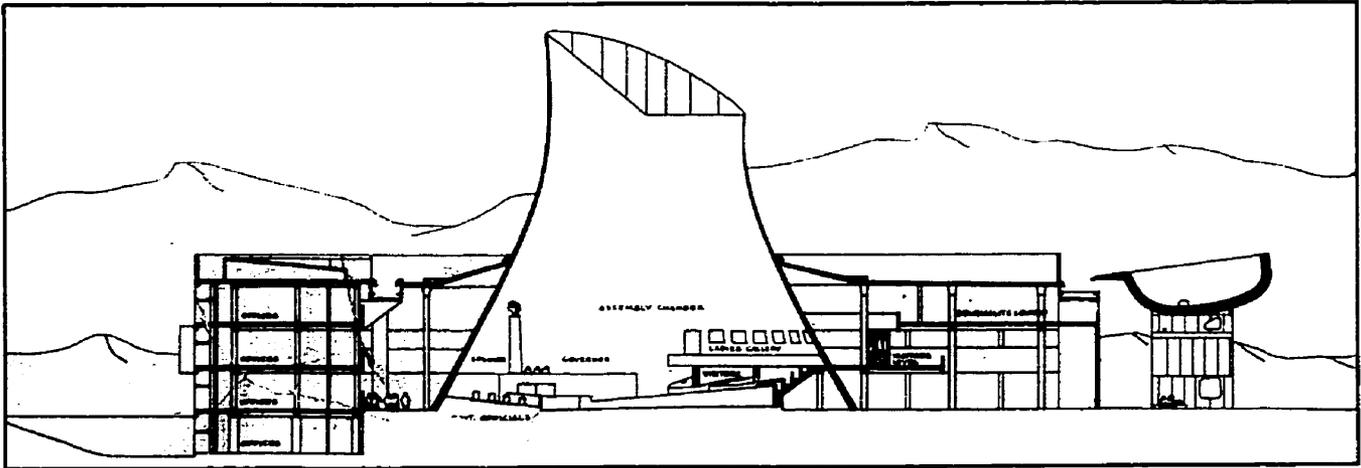
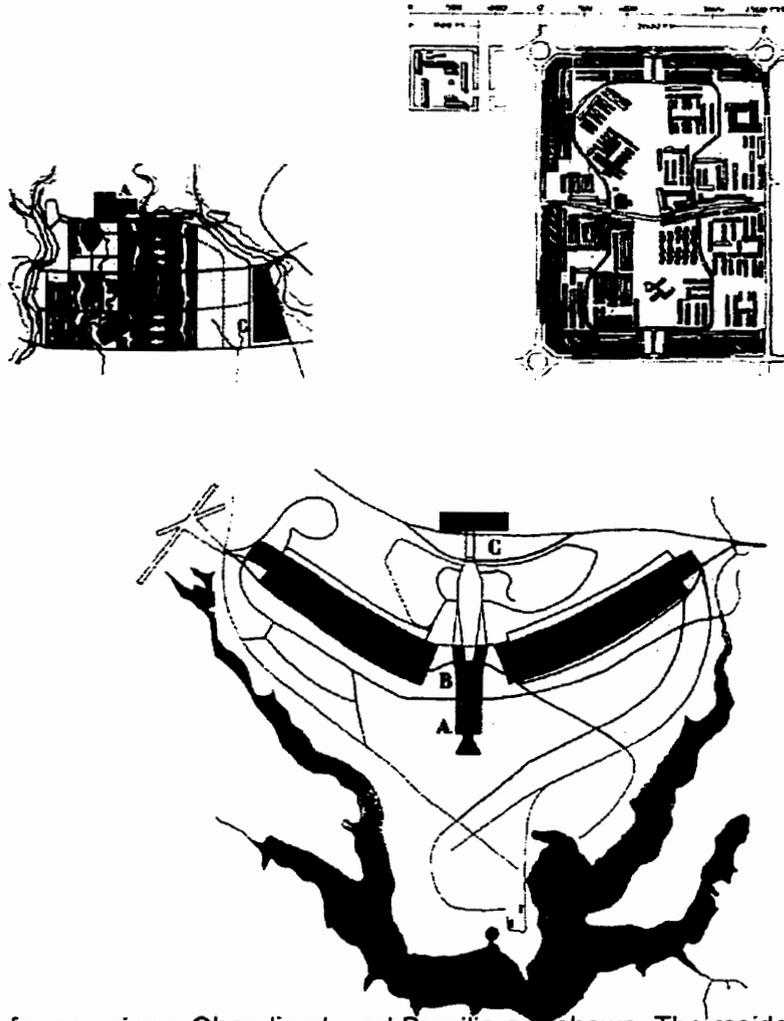


Illustration 15

Plans of Chandigarh and Brasilia Compared, Superblock Comparisons from Architectural Forum November 1960. Masterplan Comparisons from Architecture in Australia, December 1959, (Evenson Norma, Chandigarh, 1966)



For the purpose of comparison, Chandigarh and Brasilia are shown. The residential superblock of Brasilia is compared with the sector of Chandigarh. Four 800 ft. superblocks of Brasilia form one sector.

Both Chandigarh and Brasilia had flat sites which incorporate man made lakes. Both plans embody monumental government complexes and employ residential superblock unit. As both were administrative capitals with no established economic base, industries were minimal. Chandigarh was relatively compact with its principal avenues forming the main axes. In Brasilia, the city itself took a linear cross axial configuration. A. Government complex, B. Central business district, C. Railroad station and industrial area, D. Residential superblock areas.

Illustration 16

Brasilia, Zoning layout plan taken from <http://www.civila.com/brasilia/index.html>

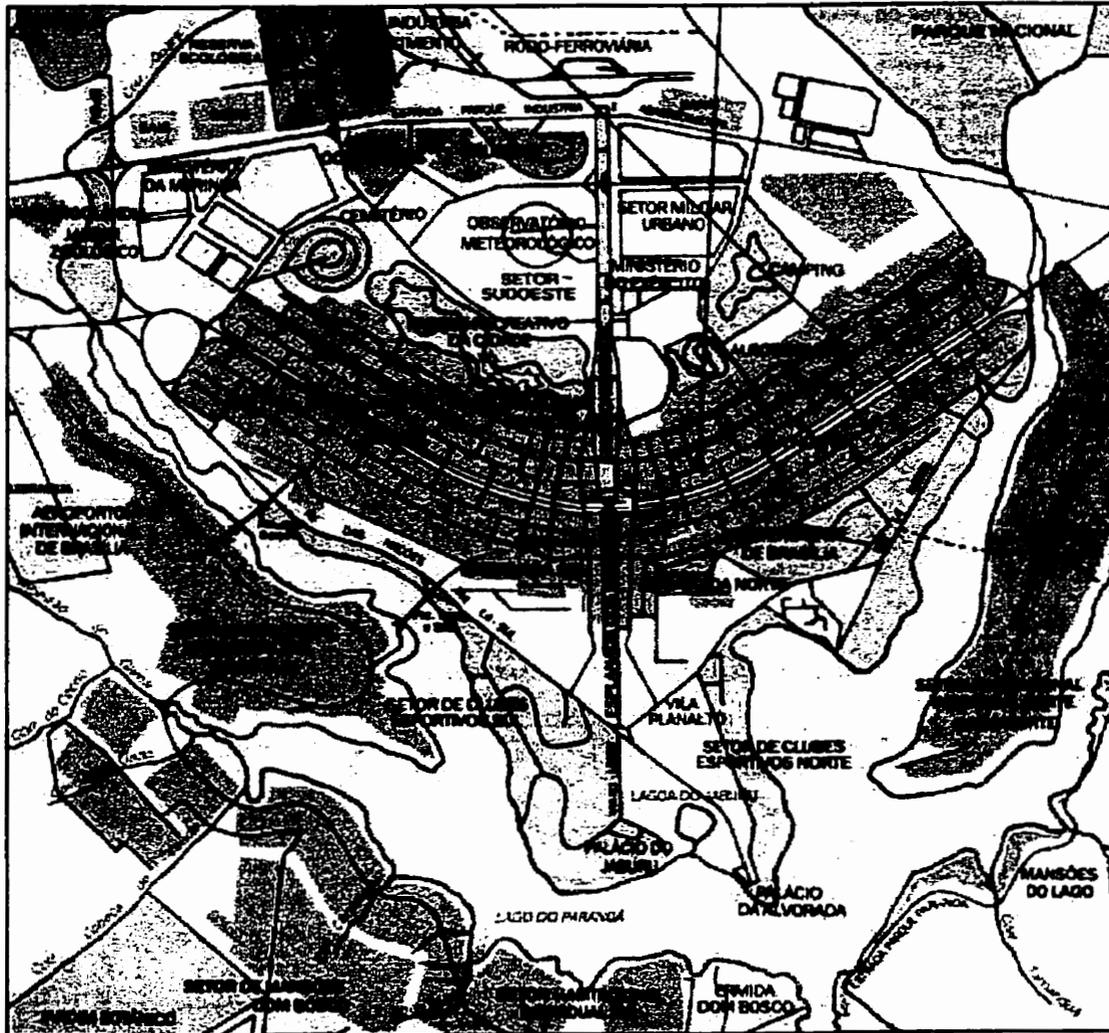


Illustration 17

Contemporary City for Three Million, A hypothetical City proposed by Le Corbusier,
The City of Tomorrow, 1929. p.172

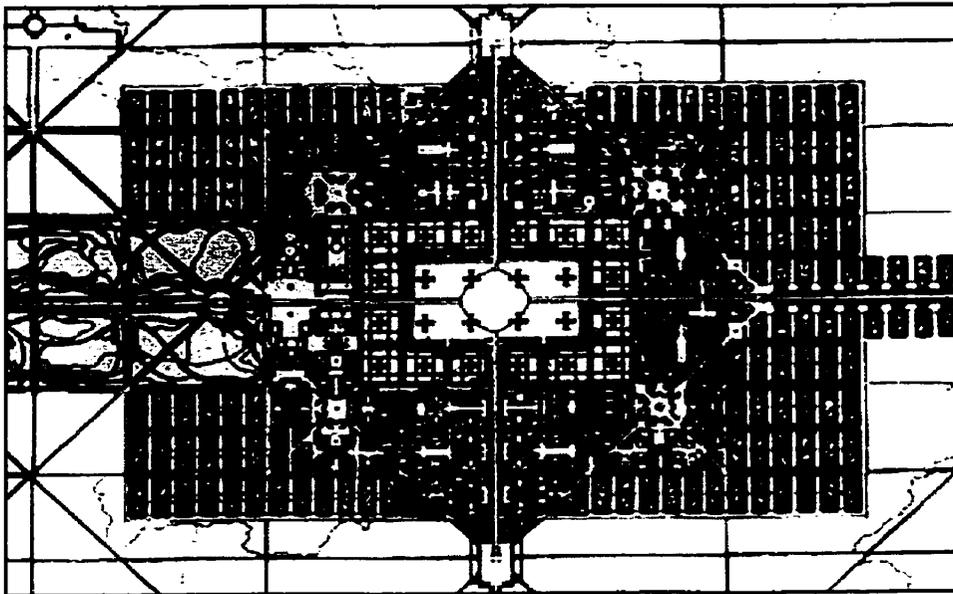


Illustration 18

Isometric view, Contemporary City for Three Million, proposed by Le Corbusier, *The City of Tomorrow*, 1929. P.171



Illustration 19

The 'Voisin' Plan of Paris by Le Corbusier, *The City of Tomorrow*, 1929. P.279

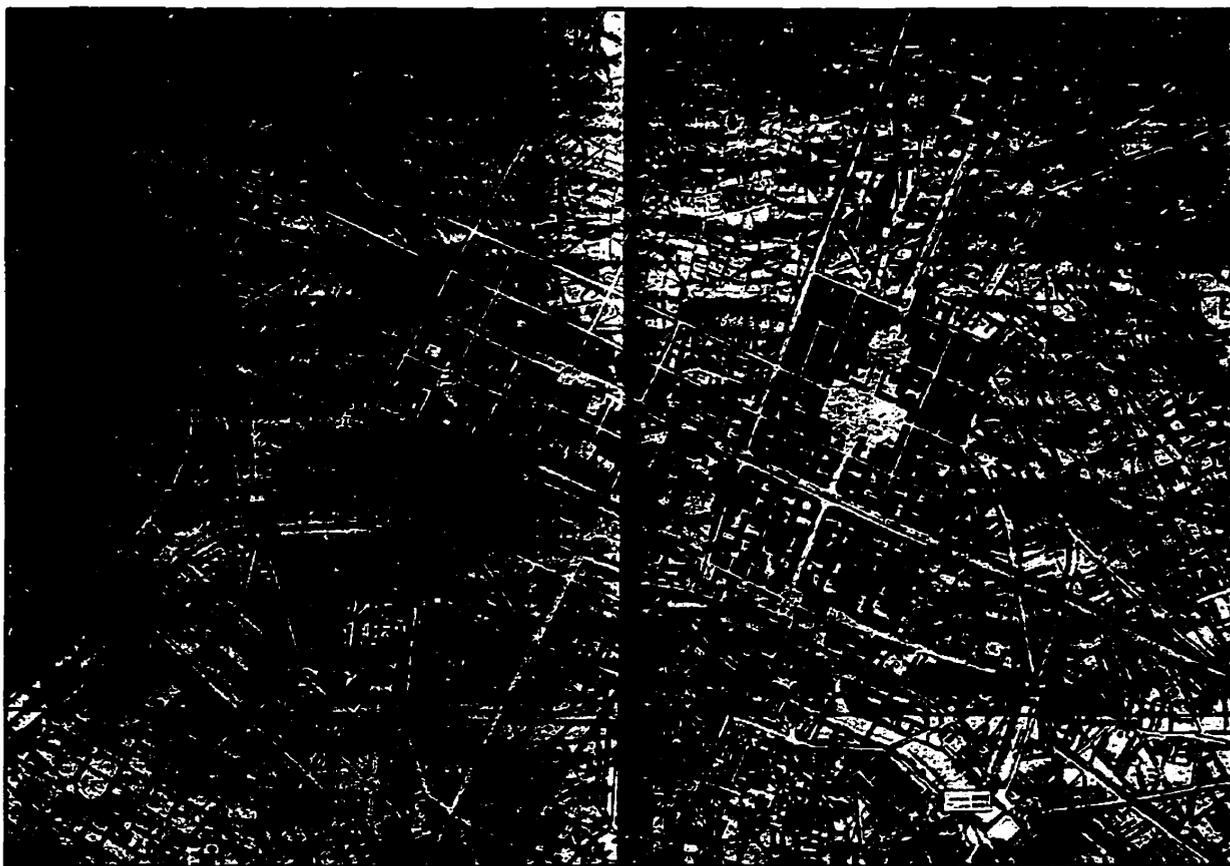


Illustration 20

Le Corbusier 'Response to Moscow'; the proposed city on the site of Moscow in relationship to the 'Green City' 1930, Foundation Le Corbusier, 20471, Jean-Louis Cohen; Le Corbusier and the Mystique of USSR, p. 140 -141

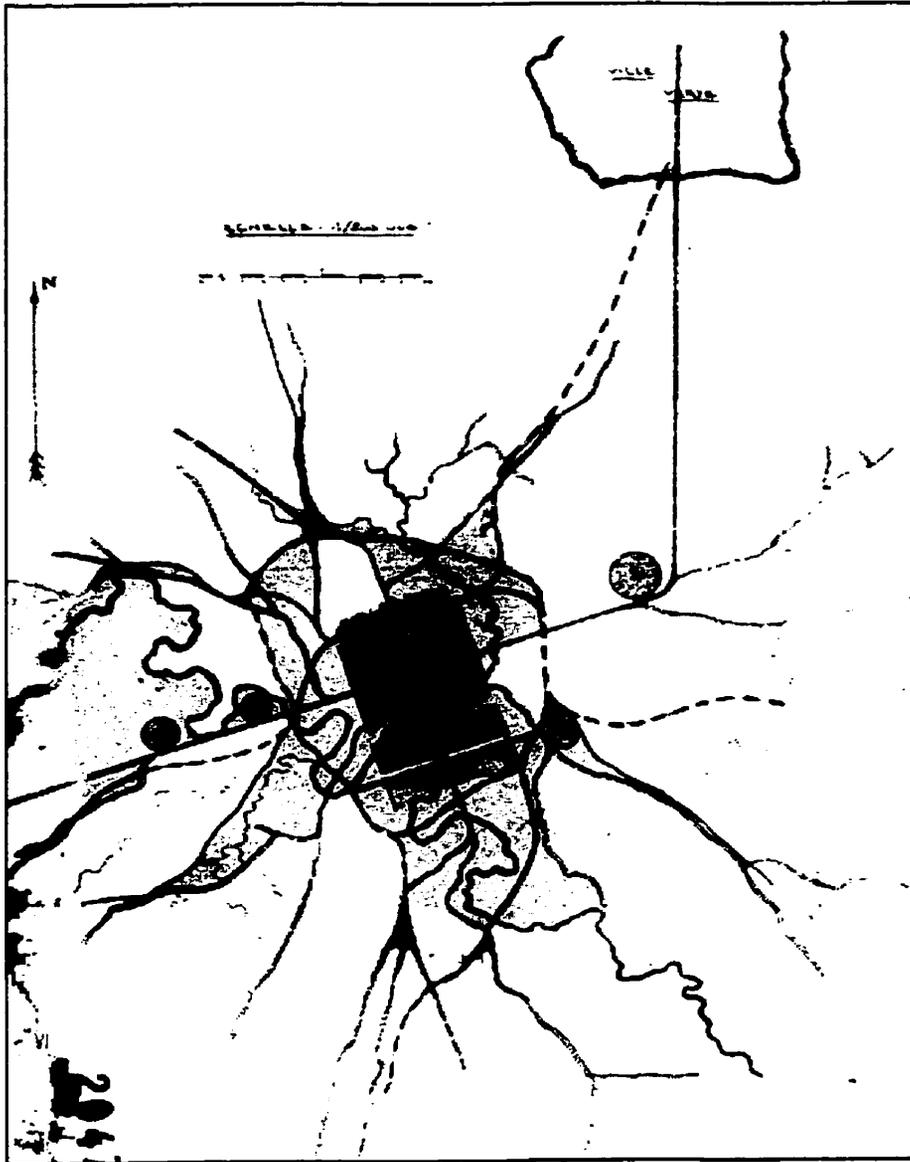


Illustration 21

Le Corbusier 'Response to Moscow'; the proposed city on the site of Moscow in relationship to the 'Green City' 1930, Application of the principles of Ville Radieuse, Foundation Le Corbusier, 20471, Jean-Louis Cohen; Le Corbusier and the Mystique of USSR, p. 142

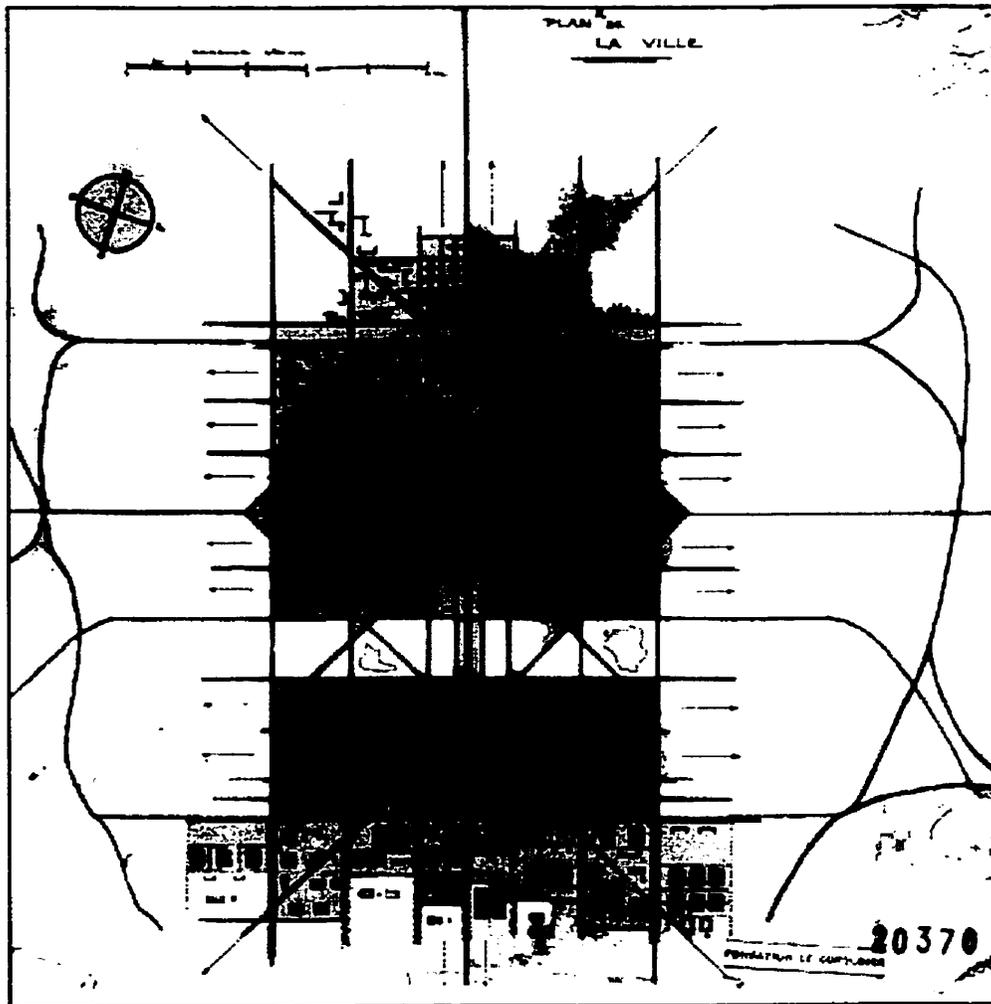


Illustration 22

View of Cybertown interface, an interpretation of a virtual city environment developed by Blaxxun Interactive. <http://www.cybertown.com>

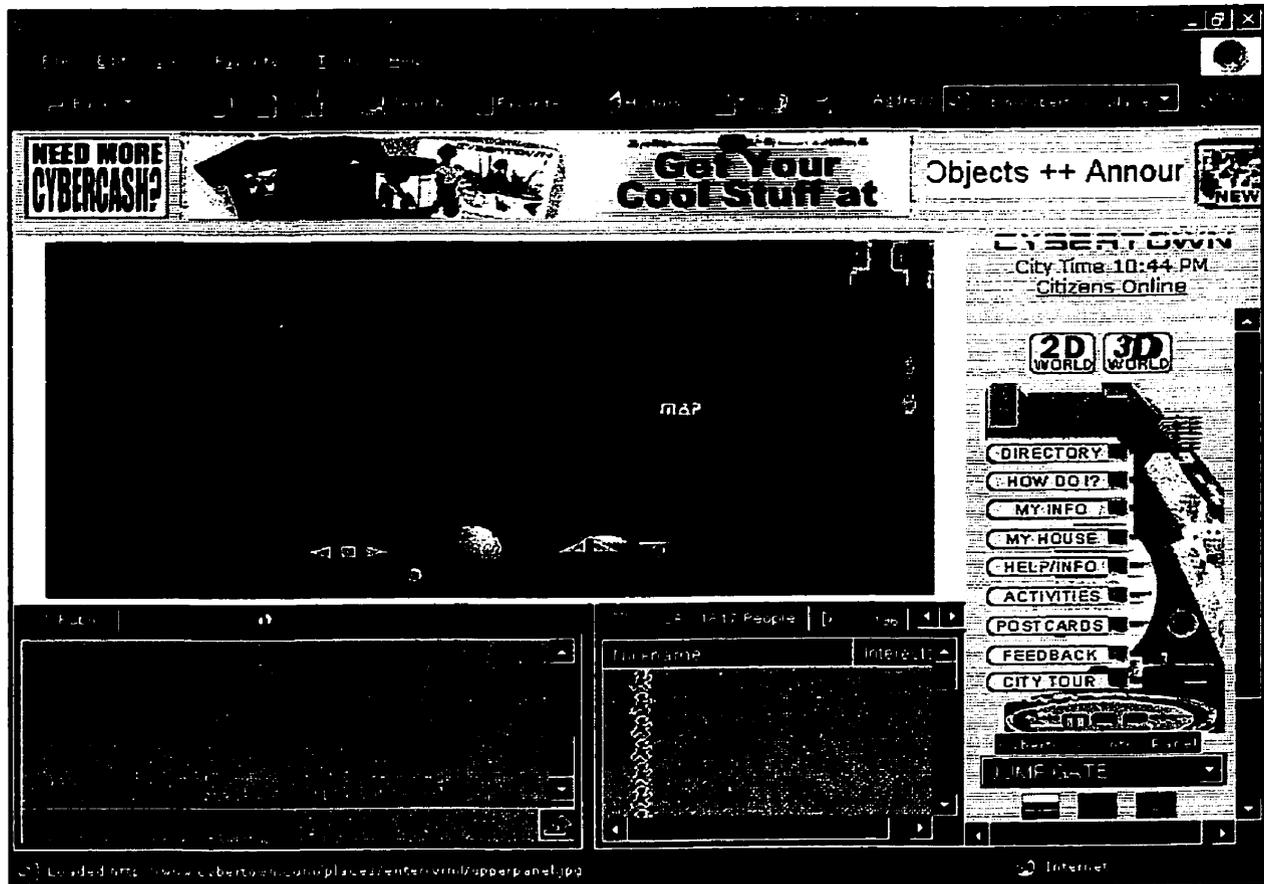


Illustration 23

Plan view of Cybertown Interface, an interpretation of a virtual city environment developed by Blaxxun Interactive. <http://www.cybertown.com>

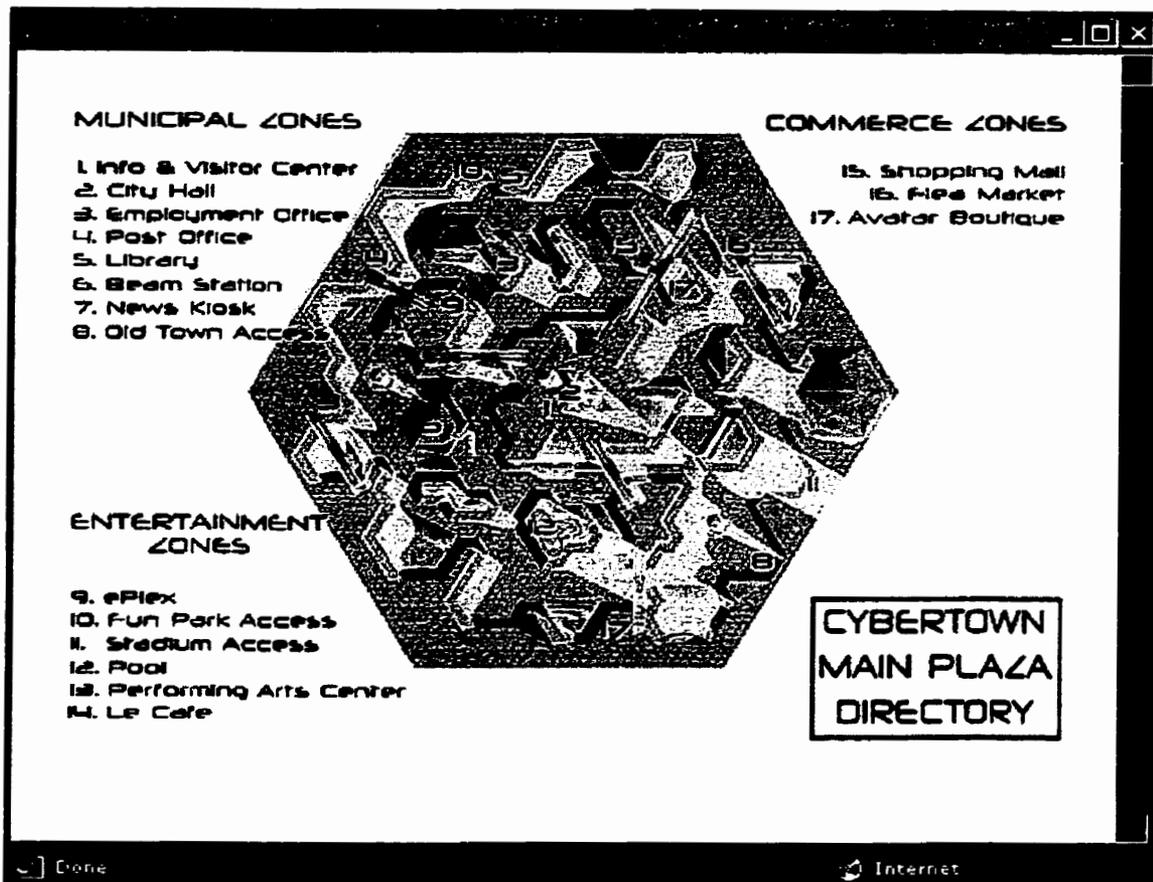


Illustration 24

Norstar Mall, a virtual city interface mainly devoted to online shopping experience enhanced by use of 3D navigation; an SKG Enterprise project

<http://www.norstarmall.ca>

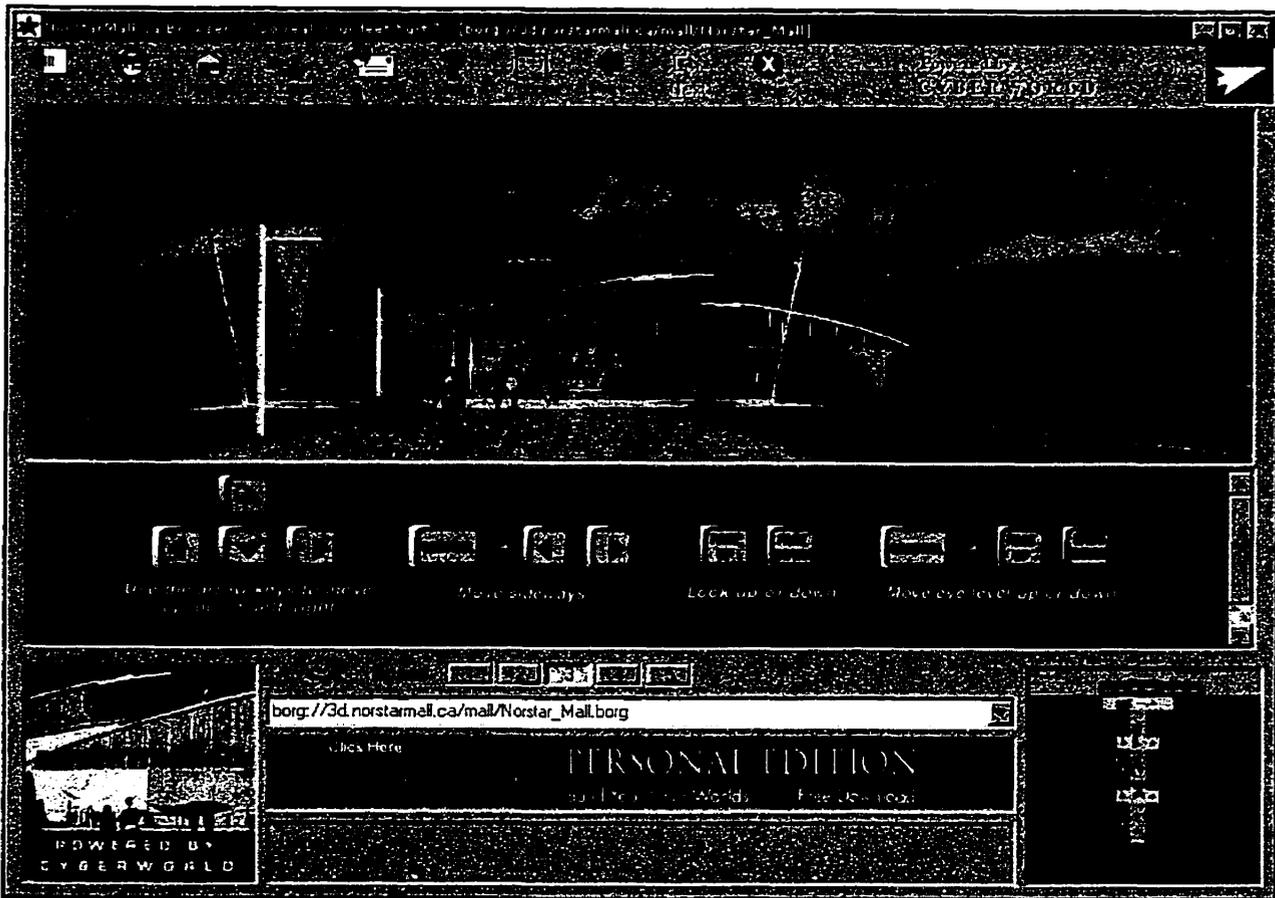
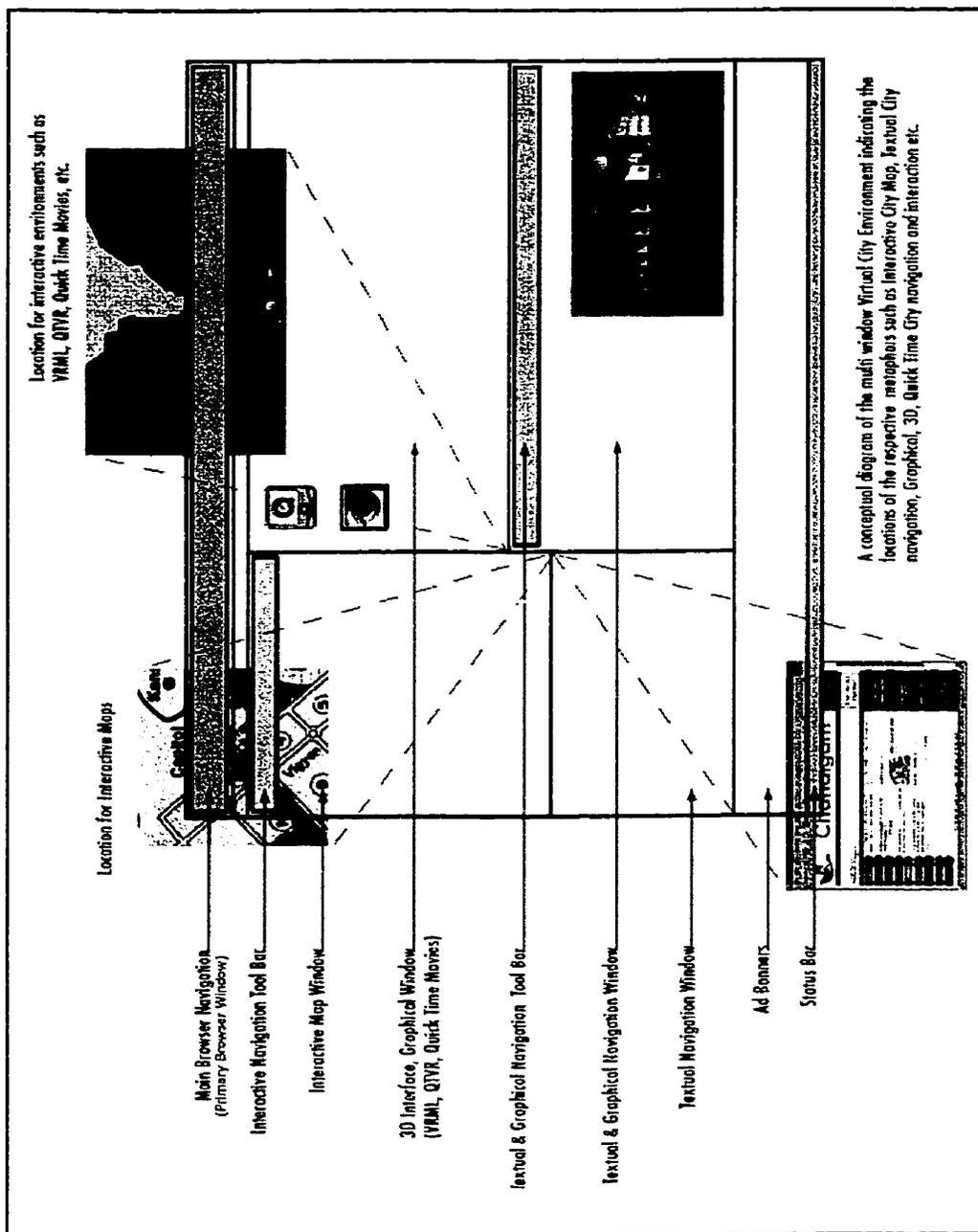


Illustration 25

Conceptual Navigation as explained for the initial concept of virtual city.



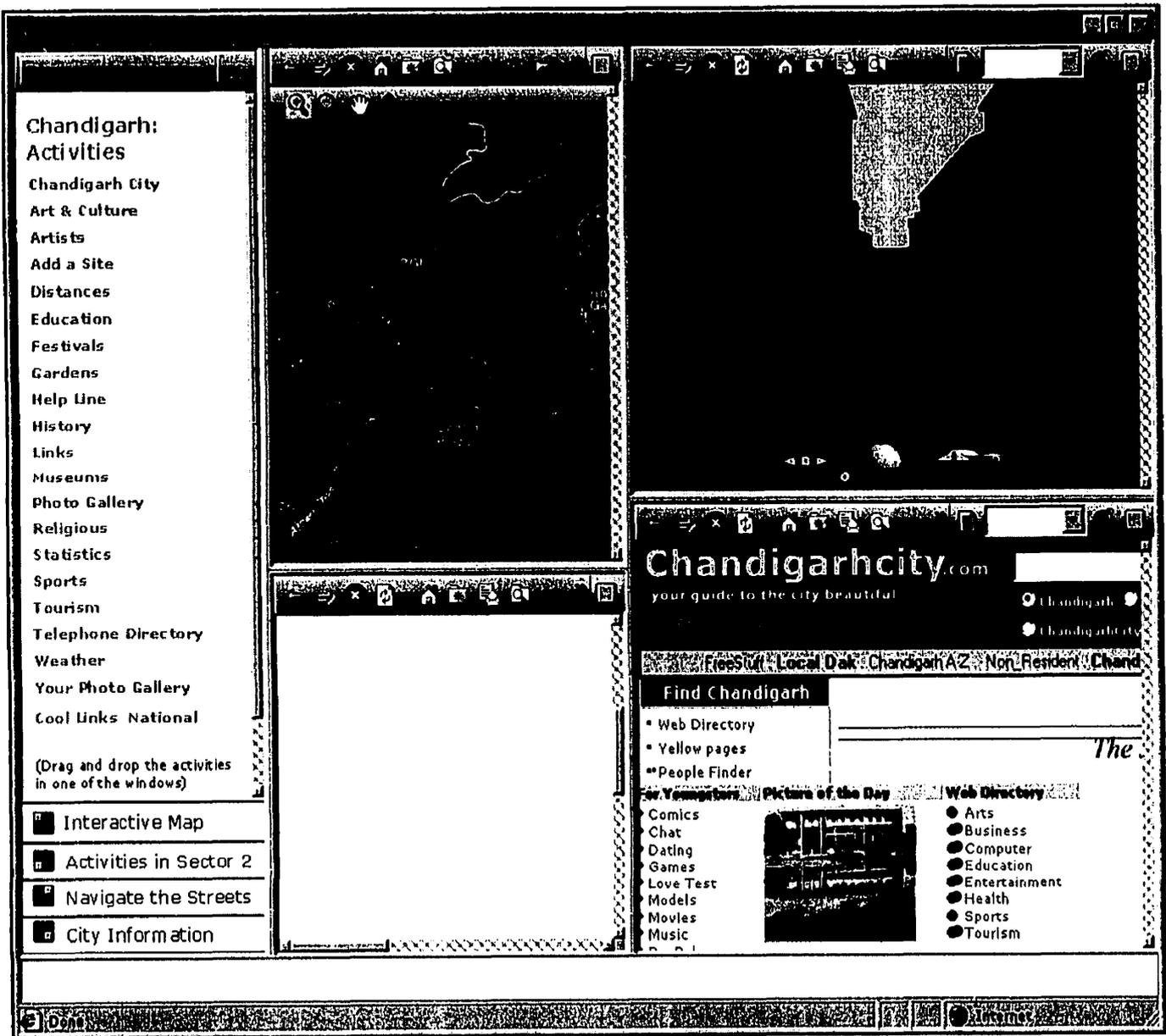


Illustration 27
 Conceptual prototype for the virtual city.

Notes**Chapter 1**

¹ Foreword of Le Corbusier's Book "The City of Tomorrow and its Planning", published in 1929

² Foreword of Le Corbusier's Book "The City of Tomorrow and its Planning", published in 1929

Chapter 2

None

Chapter 3

¹ From Le Corbusier "The Modular" p.223 re-quoted in Norma Evenson "Chandigarh" p.73

² As quoted by Le Corbusier in his famous book, "The City of Tomorrow", in 1929.

³ As taken from an extract in the paper presented by Ariel Newman which was re-quoted from The 4 Complete Architectural Works, ed. by Willy Boesiger, O. Stonorov, and Max Bill, 7 vol. 1935-65. The paper could be referred at <http://tx.technion.ac.il/~arariel/text.html>

⁵ As taken from a paper written by professor Scott James, Yale University, which is an extract from his book "Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed". Exact origins not referred to.

⁶ Quoted from Le Corbusier's Famous books The City of Tomorrow and it Planning and The Radiant City. Re-quoted in Professor James Scott's paper 'Tyranny in Bricks and Mortar', mainly based on his book, "Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed"

⁷ Ibid.

⁸ Ibid.

⁹ Ibid.

¹⁰ Ibid.

¹¹ *ibid.*

¹² As stated By Le Corbusier in his famous book, *The City of Tomorrow* in 1929 where he defines the new contemporary, ideal city

¹³ The origin of this statement was not traced. However the re-quote comes in Professor James Scott's paper *Tyranny in Bricks and Mortar*, mainly based on his book, "*Seeing Like a State : How Certain Schemes to Improve the Human Condition Have Failed*"

¹⁴ Quoted by Le Corbusier in his famous Book, *The radiant City*; re-published in 1964
Ibid.

¹⁵ Most of the collection comes from the re-quote in Professor James Scott's paper '*Tyranny in Bricks and Mortar*', mainly based on his book, "*Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*"

¹⁶ As stated By Le Corbusier in his famous book, *The City of Tomorrow* in 1929 where he defines the new contemporary, ideal city.

¹⁷ *ibid.*

Chapter 4

¹ As stated By Le Corbusier in his famous book, *The City of Tomorrow* in 1929 where he defines the new contemporary, ideal city.

² As stated By Le Corbusier in his famous book, *The City of Tomorrow* in 1929 where he defines the new contemporary, ideal city.

³ As stated By Le Corbusier in his famous book, *The City of Tomorrow* in 1929 where he defines the new contemporary, ideal city. Most of the part of the above description has been based from the article; *The City that never was- Unrealized Dreams* from the online planning magazine;
<http://www.feedmag.com/streetlevel/zurfeat.html>

⁴ This part of the research comes from Professor James Scott's paper *Tyranny in Bricks and Mortar*, mainly based on his book, "*Seeing Like a State : How Certain Schemes to Improve the Human*

Condition Have Failed".

⁵ A forward to "The City Of Tomorrow" published in 1929. The time, in which this was written was a period concerned, as had been renaissance, with a perfection of form, in this instance with the establishment of a formal expression considered suitable for a new machine age. Taken from 'The Modular' p. 61.

⁶ Ibid.

⁷ The Edict of Chandigarh is the explanation of the ideas of Le Corbusier about Chandigarh. The extract of this edict has been taken from an online journal about Chandigarh available at <http://chandigarh.nic.in/frarch.htm>. The web site is an online journal discussing mainly about the Development of Chandigarh as a Planned City.

⁸ As quoted by Ravi Kalia in his book "Chandigarh; in search of an identity" in 1987

⁹ As taken from the re-quote in Professor James Scott's paper 'Tyranny in Bricks and Mortar', mainly based on his book, "Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed".

¹⁰ As written by Le Corbusier in 1959 and Produced by Government of Punjab Administration on their official web site, 1999

¹¹ Quoted by Le Corbusier in re-quoted by Norma Evenson in Chandigarh 1966.

¹² The compilation of Chandigarh is a collection from the excerpts of the books Chandigarh by Norma Evenson and "Chandigarh; in search of an identity by Ravi Kalia. Some of the excerpts are also as a result of on online documentation about the development of Chandigarh available at <http://chandigarh.nic.in/frarch.htm>).

Chapter 5

¹ The section is based on a paper, Virtual Cities on the World Wide Web- Towards a new informational system, written by Andy Smith, Martin Dodge, & Simon Doyle of Centre for Advanced Spatial Analysis, University College, London.

² The section is based on a Thesis paper called 'Inhibiting Virtual Cities' by Judith Donath from MIT Media Lab.

³ The section is based on a Paper, Virtual Cities on the World Wide Web- Towards a new informational system, written by Andy Smith, Martin Dodge, & Simon Doyle of Centre for Advanced Spatial Analysis, University College, London.

⁴ The extract of this part was extracted from a Thesis paper called 'Inhibiting Virtual Cities' by Judith Donath from MIT Media Lab.

⁵ The section is based on a paper called Building Virtual Worlds- A City Planning Perspective' by Rob Ingram from Department of Computer Science, University of Nottingham.

Chapter 6

None

Chapter 7

¹ As quoted in by Le Corbusier in his famous Book "The City of Tomorrow" p.158.

² As cited by Jane Drew in "Chandigarh; Capital City Project' Architects' year Book 5 p.56 re-quoted by Norma Evenson in Chandigarh, 1966, p. 31.

Chapter 8

¹ Quoted by Le Corbusier in The Modular, p.223 re-quoted by Norma Evenson in Chandigarh 1966, p. 35

² What Corbu has been upto, "The Architectural Forum", 99:142-149 Sept 1953, re-quoted by Norma Evenson in Chandigarh 1966, p. 29

Primary Literature Review

This literature review is meant to highlight the reasons of motivation of this thesis. An enormous amount of work has been carried out in trying to create different views and models of virtual city environments. However this thesis takes a similar research to another level when it tries to establish a common language in between architecture and technology by trying to co-relate the principles of Le Corbusier, an Architect-Town Planner to creating an ideal virtual environment.

A few scholars have done a research in this area of interest earlier in the forms of theses, research papers, articles, etc. Their work has had a direct impact and has been a great help in the development of this thesis. Short summaries of the works of these people are mentioned below.

1. Donath Judith (Ph.D. MIT Media Lab) Thesis: 'Inhibiting Virtual Cities'

The goal of this research was to develop an approach to the design of on-line social environments. In order to foster the development of vibrant and viable online communities, the environment - i.e. the technical infrastructure and user interface, one must provide the means to communicate social cues and information. The participants must be able to perceive the social patterns of activity and affiliation and the community must be able to evolve a fluid and subtle cultural vocabulary.

2. Ingram Rob (CASA London) Research paper: Building Virtual Worlds: A City Planning Perspective.

A Research that studies from the disciplines city planning and architecture to raise some of the issues which may be important in the design, development and administration of these environments in order to make them pleasant, usable and manageable.

3. Dieberger Andreas, Emory University. Research Paper: A City Metaphor for supporting Navigation in Complex Information Spaces

Tries to emphasize and prove that The use of appropriate navigation metaphors can help to make the structure of modern information systems easier to understand and therefore easier to use.

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 3. **Batty M.**, *"New Technologies for Urban Designers- "The Venue Project"*
University College of London, Paper,
 4. **Benedikt, M.** *"Cyberspace; First Steps"* MIT Press, Massachusetts Institute of Technology, 1992
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 12. **Cohen, J.L.** *"Le Corbusier and the Mystique of USSR"* Princeton University Press, 1992
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39. **Smith A., Dodge M., Doyle S.**, "*Visual Communication in Urban Planning and Design*", Center for Advanced Spatial Analysis, University College London, Article 1999.
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Toward the Construction of Cyber Cities with the Application of Unique Characteristics of Cyberspace. Narushige Shiode
<http://www.casa.ucl.ac.uk/planning/articles2/urban.htm>
- [w]2. A CITY METAPHOR TO SUPPORT NAVIGATION IN COMPLEX INFORMATION SPACES:
The use of appropriate navigation metaphors can help to make the structure of modern information systems easier to understand and therefore easier to use.
Andreas Dieberger
http://www.mindspring.com/%7Ejuggle5/Writings/Publications/JVisLang_City.html
- [w]3. BLAXXUN INTERACTIVE
Blaxxun Interactive is the global technology leader for Virtual Worlds basis software, enabling more natural communication and interaction among people on the Internet in the areas of entertainment, e-commerce, and business. Virtual Worlds transform websites into feature-rich, interactive environments- from simple chat, to communities, to even applications with lively social infrastructures.
<http://www.blaxxun.com>
- [w]4. BRASILIA
Excerpts from the Environmental Communications Archives on Oscar Niemeyer and his plans for Brasilia; The Capital of Brazil
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<http://www.arcspace.com/architects/Niemeyer/>

[w]5. BUILDING VIRTUAL WORLDS:

a city planning perspective.

Rob Ingram

<http://www.casa.ucl.ac.uk/planning/articles3/vcity.htm>

[w]6. CASA

The Center for Advanced Spatial Analysis (CASA) is an initiative within University College London to develop emerging computer technologies in several disciplines which deal with geography, space, location and the built environment.

<http://www.casa.ucl.ac.uk/>

[w]7. CHANDIGARH PERSPECTIVES

Is a non-profit organization set up as a collaborative effort between the Chandigarh Administration and concerned architects and planners. The idea of setting up this organization was initiated by the need to celebrate the 50th Anniversary of the conception of the idea of planning Chandigarh.

The organization aims to facilitate research, organize exhibitions, seminars, and lectures and document and publish issues related to the architecture and urban planning concepts of Chandigarh.

<http://www.cperspectives.org/>

[w]8. CITY OF BITS:

Space, Place and the Infobahn.

William J. Mitchell

http://mitpress.mit.edu/e-books/City_of_Bits/

- [w]9. CITYSPACE, CYBERSPACE, AND THE SPATIOLOGY OF INFORMATION:
"The concept of space has been critical to architectural theory for over seventy years now... It remains however, an elusive idea, on the one hand meaning and referring to everything, on the other hand meaning and referring to nothing..."
Michael Benedikt
http://mather.ar.utexas.edu/center/benedikt_articles/cityspace.html

- [w]10. CITIES OF THE FUTURE - 2000 V2.0:
Urban space today is a site of unparalleled change, alteration and dynamism. The impact of globalised systems of economic power, mediated by electronics, have lent the contemporary city a mutable aspect. Cities seem to seeth with the potential for self growth, grown organically from the material that is the media age. No-one it would seem has a strong handle on where contemporary cities are going. Gone are the heady days of certainty which thrust skyscrapers out of a landscape of mining and manufacturing. These are the fluid and liquid city days.
David Cox
<http://www.othercinema.com/otherzine/cities.html>

- [w]11. COLLABORATIVE URBAN DESIGN THROUGH COMPUTER SIMULATIONS.
A senior honours essay prepared for the School of Urban and Regional Planning, University of Waterloo, Ontario, Canada April 1996
David Goodfellow
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- [w]12. DESIGN IN VIRTUAL ENVIRONMENTS USING ARCHITECTURAL METAPHOR
A HIT Lab Gallery, Master of Architecture Thesis, University of Washington
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1996

Dace Campbell

<http://www.hitl.washington.edu/people/dace/portfolio/thesis/document/>

[w]13. FEED

Excerpts of the Plan for the City of Three Million by Le Corbusier, An online planning magazine.

<http://www.feedmag.com/streetlevel/zurfeat.html>

[w]14. GOVERNMENT OF CHANDIGARH

Official Web Site of Chandigarh Administration

Developed by National Informatics Centre contains information about Chandigarh provided by Chandigarh Administration.

<http://chandigarh.nic.in/>

[w]15. LE CORBUSIER PLANNING PRINCIPLES

A product of the Ten Planning Principles for the Next Ten Million is the LeCorbusier-40. The title of this development concept is in recognition of Le Corbusier, one of the founding fathers of the Modernist movement and the author of The City of Tomorrow and Its Planning (1929).

http://weplancities.com/lecorb_40.htm

[w]16. MAPPING A VIRTUAL CITY

What would a virtual city in cyberspace look like? Well, a sequence of 'satellite' maps of AlphaWorld provide us with a pretty good idea. These fascinating maps show the growth of buildings, streets, parks and gardens designed and constructed by the citizens of the virtual world of AlphaWorld over the past five years. The virtual cartographer responsible is Roland Vilett, the lead programmer on the virtual world system at Activeworlds.com, which encompasses AlphaWorld and several hundred other worlds on the Internet.

http://mappa.mundi.net/maps/maps_013/

[w]17. NORSTAR MALL

An online shopping mall using VRML and self developed browsers offers consumers a realistic mall environment to shop in and focus attention on the tenant's key product offerings. Complete with information desks and window-shopping capabilities, the 3-D version of NorstarMall.ca is sure to redefine the way Canadians shop online.

<http://www.norstarmall.ca>

[w]18. PLANET 9 STUDIOS

Planet 9 Studios is a 3D content company focused on providing real business solutions for the Internet. We have produced over 200 virtual worlds for a variety of applications such as marketing, advertising, product visualization, training, architectural simulation, military visualization and entertainment. Our animation is used for TV, commercials and real estate. We are constantly incubating new software products for companies and helping them to reach market.

<http://www.planet9.com>

[w]19. QTVR

A web site for references on quick time virtual reality movies.

<http://www.tapit.ab.ca/qtvr.htm>

[w]20. RESEARCH PAPER - VIRTUAL ARCHITECTURE

Virtual Space (the) Transformation of Reality

Helmut Tichy, M.A. Computer Imaging in Architecture

<http://www.archlab.tuwien.ac.at/~htichy/researchpaper1.html>

[w]21. SQUARE ONE PRODUCTIONS

is a Photomontage animation and simulation company that provides persuasive, credible and cost-effective communication tools, such as 3D visual simulations and video.

<http://www.squareoneproductions.com/>

[w]22. THE INFORMATION CITY PROJECT:

A virtual reality user interface for navigation in information spaces.

Andreas Dieberger & Jolanda G. Tromp

<http://www.mindspring.com/%7Ejuggle5/Writings/Publications/VRV.html>

[w]23. THE COMPUTABLE CITY:

"By the year 2050, everything around us will be some form of computer..."

Michael Batty

<http://www.geog.ucl.ac.uk/casa/melbourne.html>

[w]24. TOWARDS THE VIRTUAL CITY:

VR & Internet GIS for Urban Planning.

Martin Dodge, Simon Doyle, Andy Smith, & Stephen Fleetwood

<http://www.casa.ucl.ac.uk/publications/birkbeck/vrcity.html>

[w]25. THE VIRTUAL VILLAGE

The Virtual Village is a unique initiative which, by taking advantage of the latest advances in telecommunications technology, addresses the need for the provision of local services, information and opportunities to rural communities. To deliver these services the Virtual Village is creating a network of computer and video conferencing facilities which links community centres in the rural villages with each other and the rest of the world

<http://www.virtual-village.co.uk/site/home.htm>

[w]26. TOWARDS THE VIRTUAL CITY

Paper on: Virtual Reality & Internet GIS for Urban Planning

Martin Dodge, Simon Doyle, Andy Smith & Stephen Fleetwood

<http://www.casa.ucl.ac.uk/publications/birkbeck/vrcity.html>

[w]27. TYRANNY IN BRIKS AND MORTAR

A paper by Yale professor

James Scott

<http://www.theamericanenterprise.org/taejf00h.htm>

[w]28. VIRTUALIZATION AND MULTI-CULTURAL GLOBAL CITIES:

This article briefly examines the implications of both the technical capacity for instantaneous transmission and the capacity to link people at indeterminate locations, for civic culture and public space...

Carlos Hernan Betancourth

<http://www.arch-mag.com/1/coll/coll2t.html>

[w]29. VIRTUAL CITIES: THE RE-MODELLING OF URBAN CONTEXTS

1997, final year dissertation for the B.A.(Hons) History of Art degree at Leeds University

Kieron Johnson

<http://www.leeds.ac.uk/opted/students/kieron.htm>

[w]30. YATRAINDIA (TOUR INDIA)

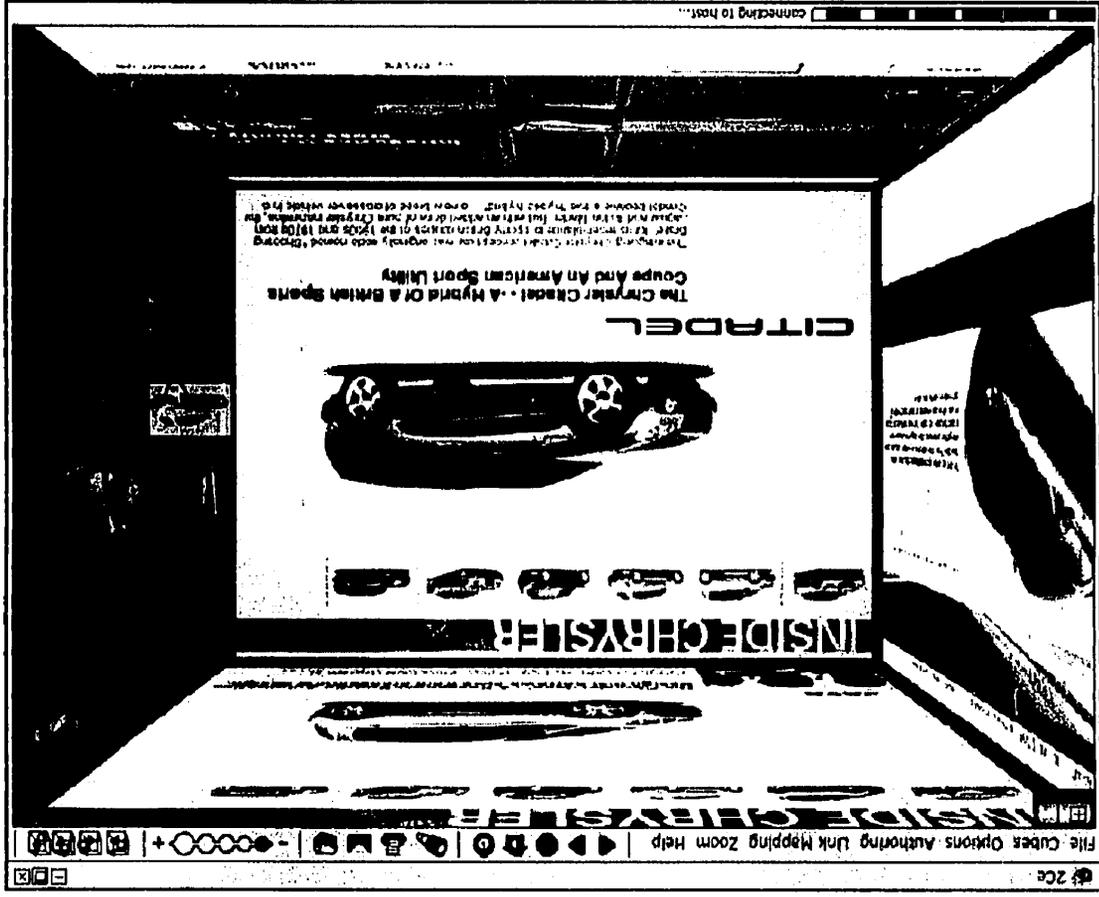
An informational web site about Chandigarh.

<http://www.yatraindia.com/Chandigarh/>

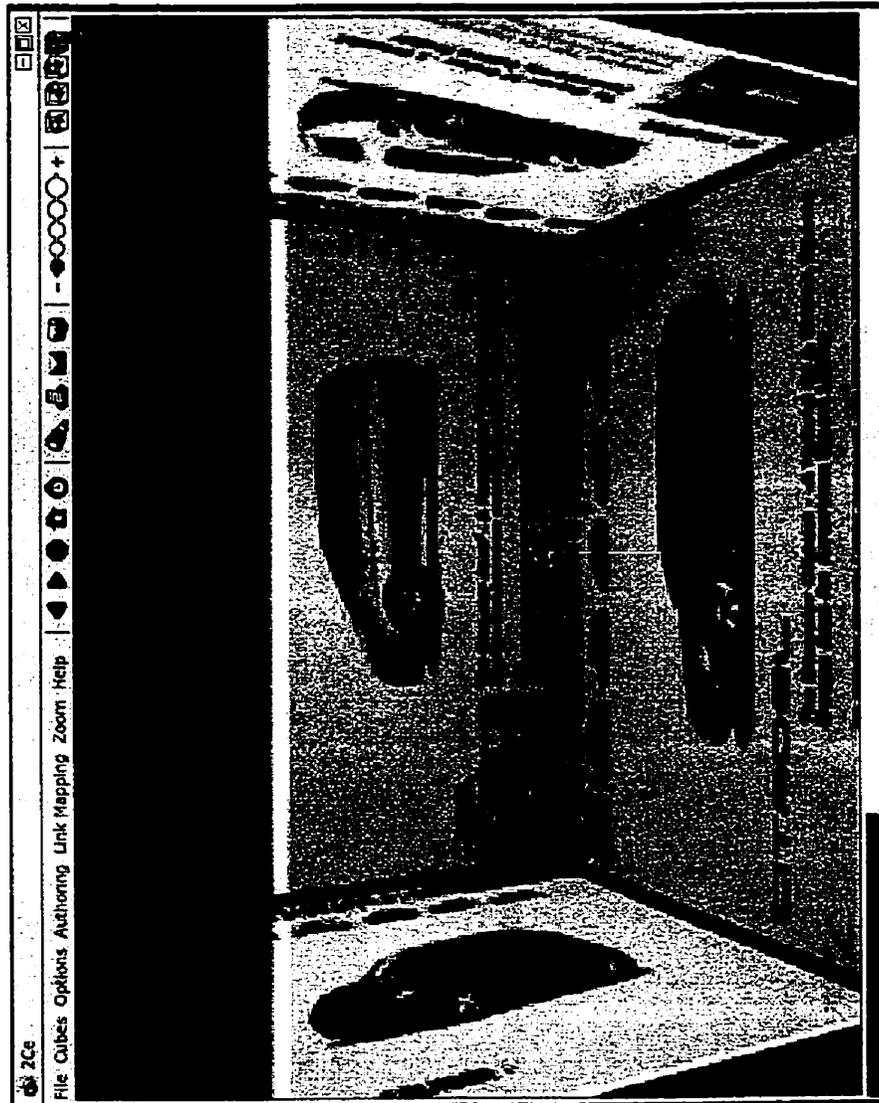
Appendix I**Illustrations of different types of Browser Interfaces**

1. Cubic Eye: A browser interface that utilises the concept of browsing in three dimensions. (<http://www.2ce.com>)
 2. Opera: A browser interface designed for multiple choice browsing. (<http://www.opera.com>)
 3. Virtual London: A browser interface designed to display the concept of Virtual London. (CASA, UK)
-

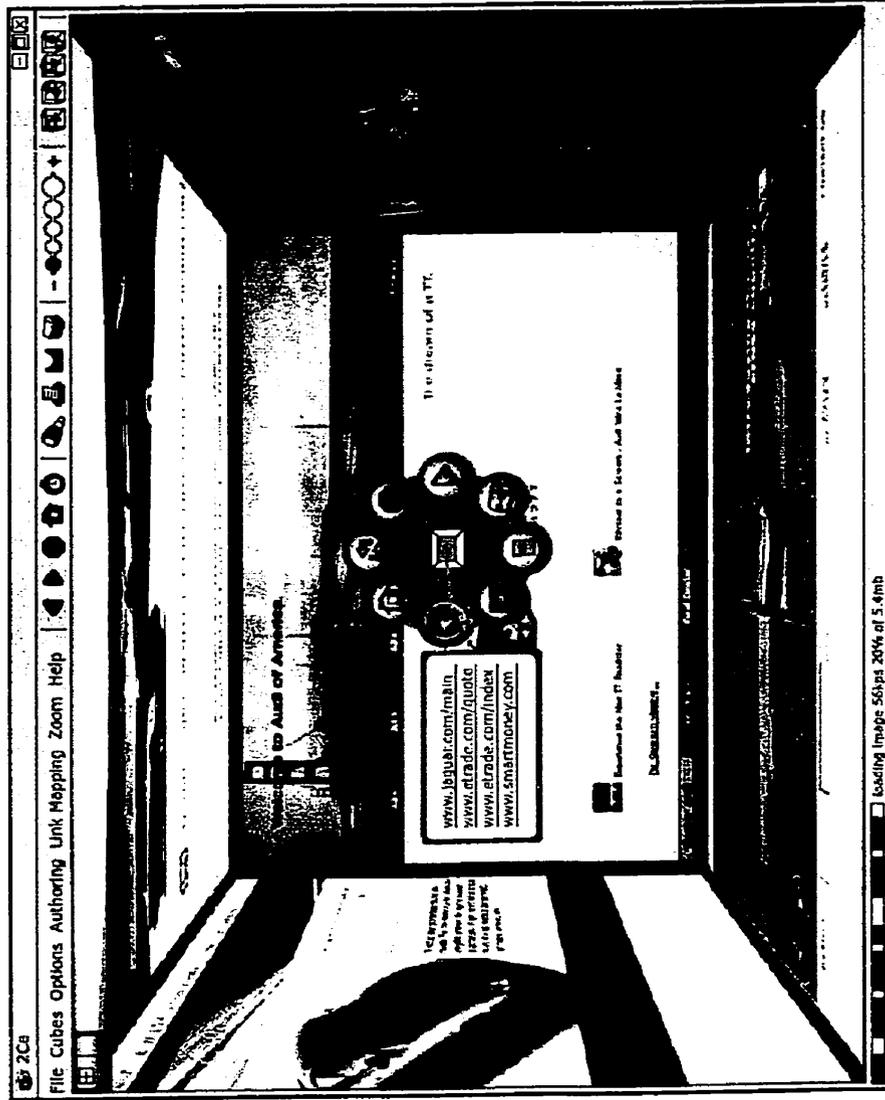
Cubic Eye Browser Example 1



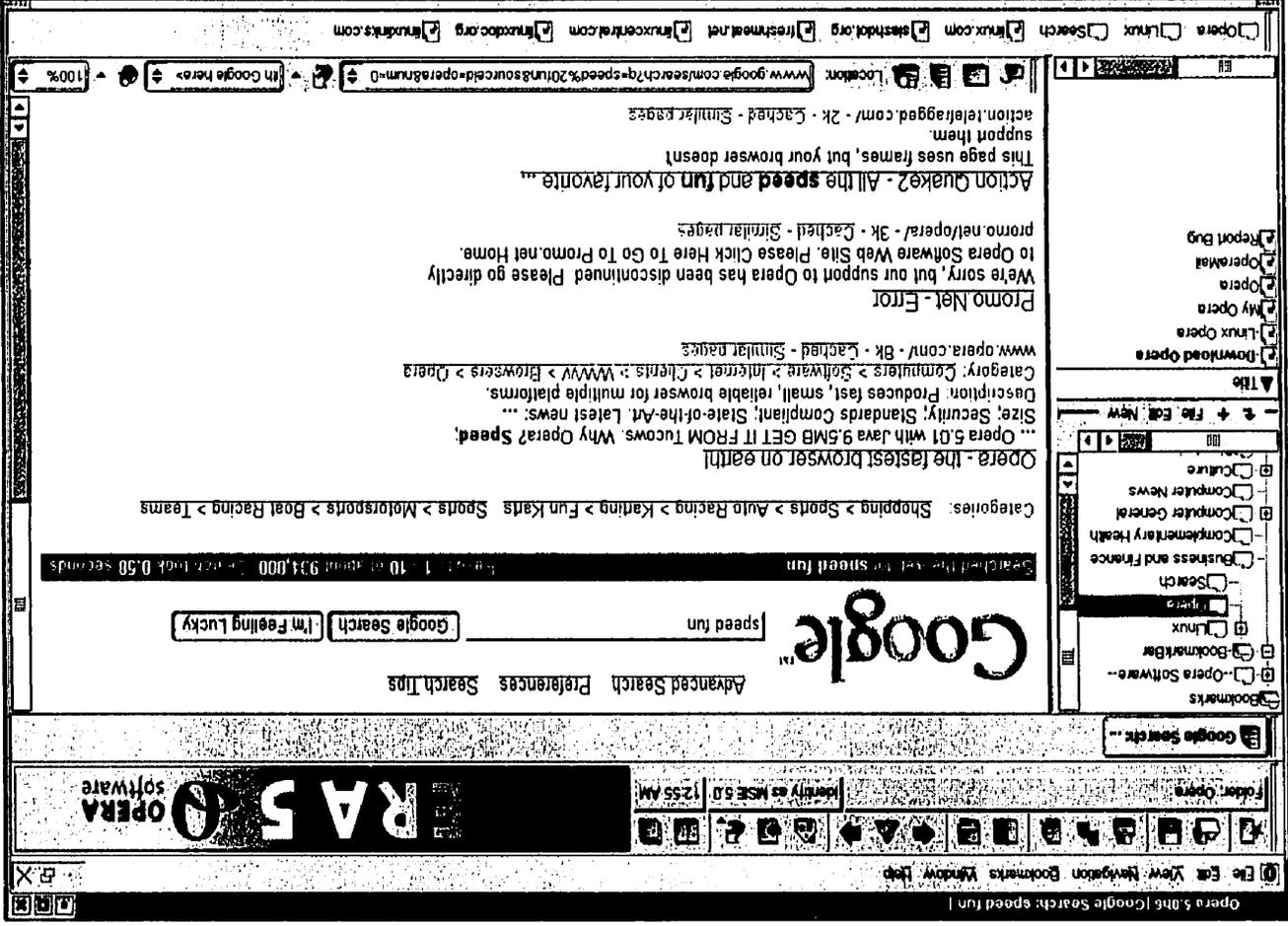
Cubic Eye Browser Example 2

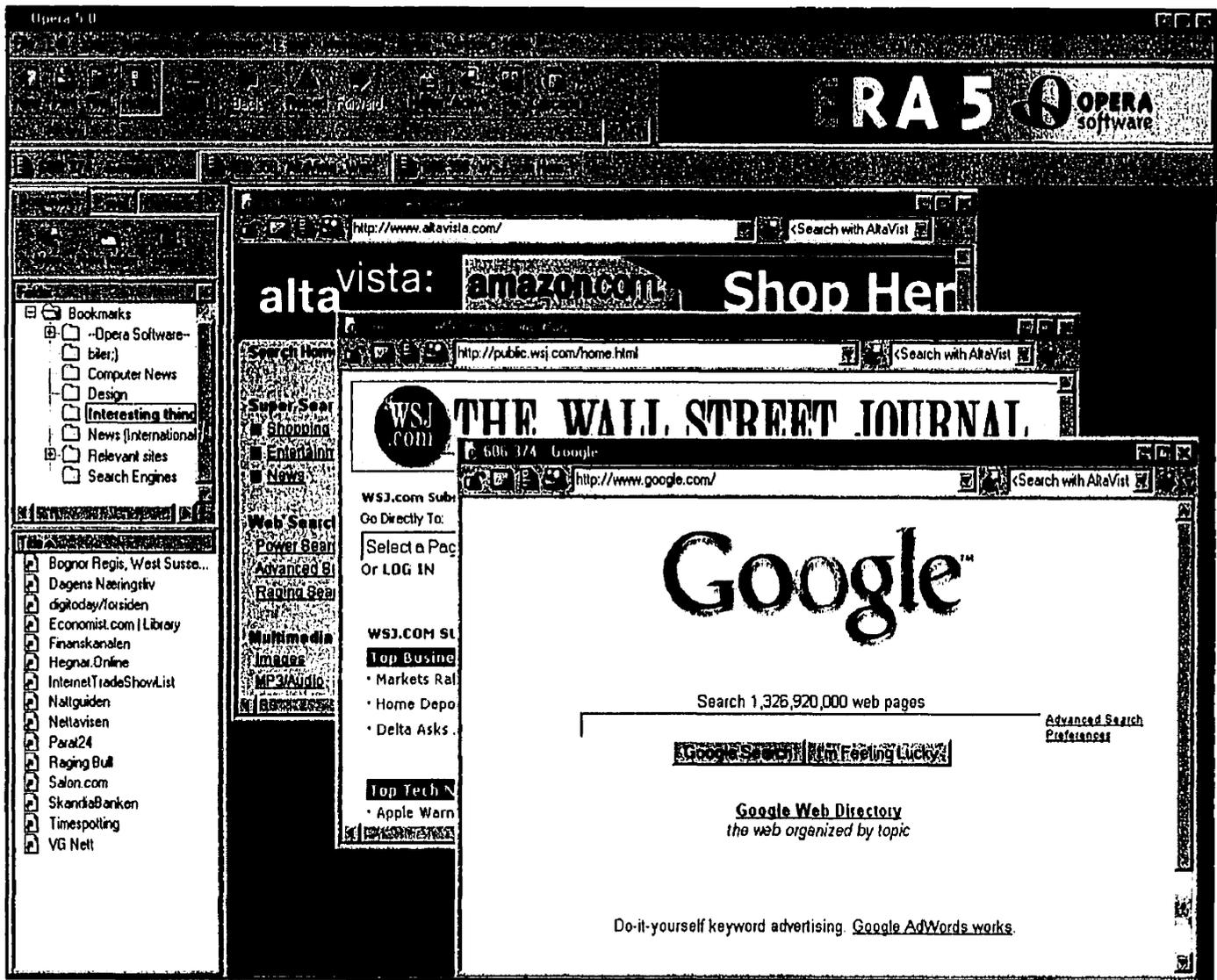


Cubic Eye Browser Example 3



Opera Browser Example 1





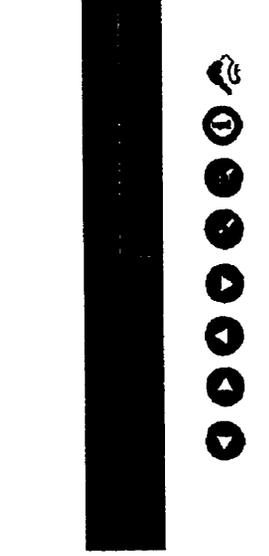
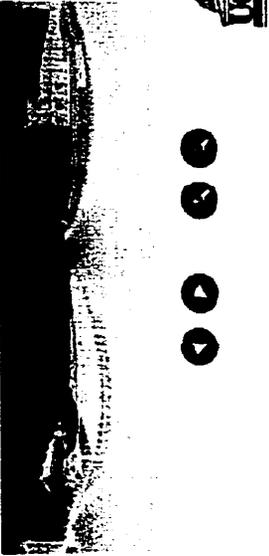
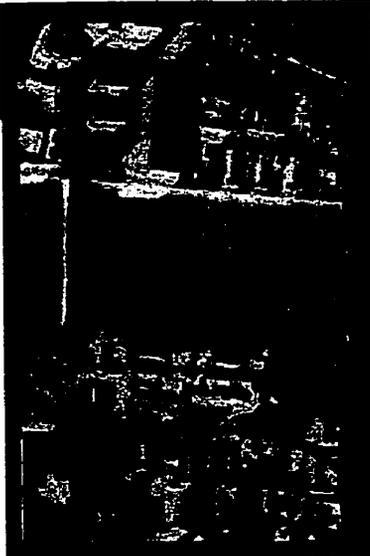
Virtual London Browser, CASA, London

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● Further Information available - Click for options



Appendix II

CD-ROM, containing the electronic format of Document and the prototype. (PC Version)
