THE DENSITY-CROWDING RELATIONSHIP: PLANNING IMPLICATIONS FOR HIGH DENSITY HOUSING

by

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ABSTRACT

This study examines planning implications which may result when human crowding considerations are incorporated into high density housing controls. As most current density controls do not reflect the relationship between high density and perceptions of crowding, ensuring liveability has been left largely to chance. The inclusion of human requirements, which can ultimately prevent crowding and ensure greater liveability, may be more systematic if a framework is provided which suggests ways to incorporate technical measures of density with human crowding considerations.

To pursue this end, an interdisciplinary study is undertaken which explores the two concepts of density and crowding as well as the planning implications which may result from their interrelationship. Using a heuristic process, a conceptual framework is proposed which organizes current density-crowding knowledge into a format that may allow greater consideration for human needs in high density planning. Components of the study which assist in developing this framework are as follows:

1. A description of the history of density thought which traces the Centrist and Decentrist movements and serves to place research related to high density planning into its context.

2. A description of what "density" means and its classification into a taxonomy of the various measurements of density.

3. A description of what "crowding" means and its organization into a taxonomy of the human crowding considerations which influence the liveability in high density housing.

4. An exploration of the complex interrelationship between density and crowding so that a better understanding of the resultant planning implications is gained. Necessary and sufficient pre-conditions to the human crowding response are identified.

5. The development of a conceptual framework as based on the two taxonomies which explores ways to integrate density measures with crowding considerations; some planning implications for sensitive development controls are identified. The goal of this approach is to encourage the application of current density-crowding knowledge so that the quality of life in high density housing environments is ensured. The proposed framework therefore is the main contribution of this study.

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CHAPTER I

INTRODUCTION

A. THE RESEARCH TOPIC

1. General Statement of Issues

One of the objectives of land use planning is to enhance the quality of life[1] in our urban neighbourhoods. This preoccupation has resulted in a myriad of development controls intended to achieve this objective.

As the process of change in modern cities has become increasingly complex, so too has the task of urban planning. One of the most challenging of these tasks is to create the best possible living environments within the constraints of diminishing financial and land resources. An integral part of this concern relates to the notions of what is density and what is crowding. This study presents a discussion and analysis of both density and crowding with the objective of developing a better understanding of how they interrelate. Development controls might better incorporate knowledge of human crowding considerations if planners were to be more sensitive to these issues. Ultimately, the purpose of this approach is to improve the planner's ability to enhance the quality of life in high density housing through sensitive development controls.

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[1]For a concise definition of quality of life, see Hans Blumenfeld. "Criteria for Judging the Quality of the Urban Environment", Urban Affairs Annual Reviews, ed. H. Schmandt and W. Bloomberg, Volume 3 (1969): 137-163.

2. Problems Regarding Present Density Usage

a. Definitions:

Unfortunately, density as it is commonly used appears to be an illusionary concept of questionable value when used by itself as a development control. The concept of density as it relates to the intensity of land use for housing is laden with misconception and ambiguity. The British Department of the Environment density study found that measures of density," vary widely from one local authority to another and may vary within the same authority."[2] This appears to be the case in Canada as in Britain. Three factors in particular seem to contribute to the problems which surround the contemporary usage of density and its measures. First is the confusion over the meaning of density and its measures. This confusion results from the many connotations, definitions and units of measurement which are commonly used. This has lead one writer to lament, for example, that some implications or, "influences of density are better described by some definitions than by others".[3] In other words, by using different definitions, or particular measurements of density, one can achieve very different results or affect different outcomes from density controls. The plethora of contexts and the resulting planning implications arising from these meanings necessitates an accurate and concise, if not

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[2]George Woodford, et al., The Value of Standards for the External Residential Environment, British Department of the Environment (London: Her Majesty's Stationary Office, 1976), pp. 39-48.

[3]E. Borukhov, "The Tradeoff Between Density and Other Objectives", New Trends in Urban Planning, ed. P. Soen; (New York: Pergamon Press, 1979), p. 179.

universal, framework of density usage which may improve communication between local governments, the development industry and the public.

The second factor contributing to confusion in the use of the term can be linked to density's incorrect and often synonymous use with notions and perceptions of crowding.[4] As will be discussed at some length later in this study, density and crowding are two distinct, although intimately related, terms. However it is their close interrelationship which requires a better understanding. In view of these two concerns, some students of the subject question the utility of relying solely on present density measures as high density controls. Therefore, the third factor concerning density controls relates to the wisdom of using density measures as a legitimate basis for planning mechanisms which are sensitive to human needs in housing environments.[5] More application of crowding knowledge is required to achieve liveable high density housing. It is timely then to examine in more depth another mechanism for development controls which may more systematically address these human crowding considerations.

b. Limited Scope of Definition:

Perhaps the most damning attack on the concept of density has been levelled by Amos Rapoport when he concludes that, "at the moment

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[4]Amos Rapoport, "Toward a Redefinition of Density", Crowding in Real Environments, ed. Susan Saegert. (London: Sage Publications Inc., 1975), pp. 7-32.

[5]See for example; J. Marshall Miller, "Relating People to Space Rather than to Ground Area", Journal of the American Institute of Planners (Feb. 1961): 77-78.

density is not a very useful concept in human terms because it is seen largely as a matter of the number of people per unit area and this is not a very useful approach";[6] more care must be taken to look at the impact on humans of density levels, in other words consideration for crowding is the missing component in current density controls. Miller has also found serious fault in the traditional use of the term density. For as he points out, "the use of the term to indicate a ratio of people per unit area is outmoded and often fallacious".[7] As Miller explains, it is a narrow approach to rely on density formulae as a means of regulating residential environments.[8] Given these concerns, a further case can be made for the need to examine the concept of density, its measurements, its relationship to crowding, and the various human requirements which prevent crowding in high density environments in order to plan housing more sensitive to quality of life criteria.

3. An Introduction to the Density and Crowding Concepts

Many definitions and measurements of density have been utilized at different times and places throughout the world. In Canada and the United States, residential densitites are generally expressed as quantitative formulae such as a floor space ratio (FSR) which is the ratio of the floor area of a building to its site area. This measurement has been used in the Vancouver region since 1965 as a major component of the regulation of high density residential development. To

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[6]Rapoport, p. 7.

[7]Miller, p. 77.

[8]Ibid.

understand the implications of density, however, one must go beyond an investigation of such quantitative formulae and examine the broader concept of how density relates to crowding.

What then, is the best definition of "density" and how does it differ from popular notions of crowding? A cursory review of land use planning literature reveals that the traditional meaning of density generally reflects a numerical formula used to measure the number of people or the amount of accommodation within a specified area of land.[9] One of the foremost authorities on density, Amos Rapoport, concludes that density is conventionally seen as a site measurement.[10]

Crowding on the other hand is conventionally viewed as a negative perception in response to human concentration within a dwelling (although it may also apply to dwelling concentration on a given land area). By way of differentiating the two, Rapoport has suggested the following principle:

> "density can be seen as a measure of people per unit area and crowding as a negative perception of excessive density - a subjective experience of sensory and social crowding."[11]

As can be seen, although not unrelated, density and crowding are in fact two distinct terms. However, given the close interrelationship between the two terms, special care must be taken to avoid their misuse. The concern raised here is that when such uncertainty surrounds the interrelationship between the concepts of density and crowding, they

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[9]Rapoport, p. 8.

[10]Ibid.

[11]Ibid.

may be applied in an improper manner and fail to achieve intended objectives.[12]

4. A Conceptual Framework for Integrating Crowding with Density

There is little question that the concept of density will continue to play an integral part of standards which regulate urban housing environments. Local governments and planning agencies have long utilized density to achieve varying and at times conflicting planning objectives and will continue to do so. Some of the concerns involving the concept of density are referred to above. This, however, should not lead the reader to conclude that density is a worthless concept. In some ways, density as it is presently used has proven to be an effective planning tool. For example, minimum density formulae have been used to ensure land economy when land is viewed as a scarce resource.[13] However, density is less successful in addressing qualitative human requirements of sensitive housing environments. This is especially true with regard to its social and psychological effects. Density not only indicates variations in the number of occupants or amount of buildings per unit space, but it also affects potential perception of social and physical density, symbols and associations of a high density environment, as well as socio-cultural notions of crowding and human

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[12] G. Woodford, et al., p. 36.

[13] This position is generally sited by proponents of high density housing on the basis that low density development is extremely costly on energy, environmental and fiscal grounds. See for example, Real Estate Research Corporation, The Cost of Sprawl: Literature Review and Bibliography. (Washington, D.C.: U.S. Government Printing Office, 1974), pp. 5-18.

requirements which influence crowding.[14] These ramifications ultimately influence the level of satisfaction experienced by residents of high density development.

It is important that planners incorporate crowding considerations of high residential density into housing development controls. There is evidence to suggest that the level of crowding an individual experiences in response to the density level is an important indicator of the environment's liveability. Further research seems to be needed to identify mechanisms which might operationalize crowding considerations into sensitive development controls.

B. THE RESEARCH PROPOSAL

The description of housing at high density has in the past been viewed largely in numerical or quantitative terms (for example, the current practice of controlling high density housing developments through density measures such as FSR). This study will examine if other approaches might be more successful in systematically incorporating human crowding considerations into the planning of high residential density environments. If public policy is to create high density environments of the highest possible level of health and satisfaction to residents, it may need to proceed on a basis of incorporating human crowding considerations to a greater degree. There is a need for planning which is more sensitive given the demand for such housing.

Considering new knowledge about human crowding and its interrelationship to density, present high density development controls

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[14] Rapoport, p. 8.

might be made more effective by providing for human psychological, physiological and social/cultural requirements. This study therefore asks, can such crowding considerations be incorporated in a meaningful way with current density control mechanisms?

1. The Purpose

In view of the previous introductory statements, the purpose of this research is to organize current density and crowding knowledge in the form of a conceptual framework from which more sensitive high density housing development controls can be drawn. This research is not intended as a defense of the benefits or necessity of higher housing densities. Rather, it accepts higher density as a given, and it goes on to suggest how the quality of life may be better ensured in these environments.

In order to address the problem of more sensitive high density housing, there are several contributory objectives of the balance of this study:

1. To explore the history of density thought so that the study of new approaches in high density planning can be put into some perspective or context.
2. To describe what "density" means and classify into a taxonomy the various measurements of density.
3. To describe what "crowding" means and organize into a taxonomy the human crowding considerations which make high density more liveable.
4. To explore the interrelationship between density and crowding so that a better understanding of resultant planning implications is gained.

5. To propose a conceptual framework which might assist the planner to integrate density measures with crowding considerations and to draw some planning implications for sensitive high desity development controls.

2. Definitions of Terms Used

In the preceding discussion various terms have been introduced. It is useful at this time to more specifically define them as used in this study.

(a) Density/Density Measure:

Refers to a measure of a physical space condition.- It is often incorrectly used however to describe a crowding condition. Participants of current density debates often lack a common informed understanding of the proper and distinct definition of each, (i.e., to say, "one is suffering from density," is incorrect. One might actually be, "suffering from crowding or perceptions of excessive density").

A density measure is a numerical formula based on technical considerations used in land use planning to measure (1) the number of people per dwelling unit, (2) the number of dwellings or amount of building per land area (i.e. neighborhood), or (3) the site coverage and height of residential buildings on the land area.

(b) High Density:

For the purpose of this discussion, it refers to a range of 100 to 300 persons per net acre of land

in residential developments.[15] Although this is an arbitary figure, it represents the apparent current standards in the Canadian context.

(c) Quantitative components of density measures:

The taxonomy (refers to a system of orderly classification) of density measures consisting of three main types: (1) surface area, (2) population and (3) building bulk.

(d) Crowding:

A negative perception of excessive density or a subjective experience of sensory or social crowding;[16] an individual's feeling of sensory and social disruption resulting from either a physical state of excessive density or an emotional state of feeling lack of space; a psychological condition.

(e) Over-crowding:

A negative, emotional term often used, though erroneously, to indicate an excessive and harmful density level; it is a seperate and distinct term from "crowding"; it is a lay term not used by scholars in this field. To avoid confusion, the term "over-crowding" should not be used when one is actually referring to excessive density.

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[15] House and Home, 133-154.

[16] Rapoport, p. 8.

(f) Qualitative components of crowding considerations:

The taxonomy of human crowding considerations consisting of three main aspects: (1) social/cultural, (2) psychological and (3) physiological. The impact of a high density environment on these components influence perception of crowding and ultimately affect the quality of life experienced at high density.

(g) Quality of life/liveability:

The conditions of a human environment which address acceptable public health and safety standards while at the same time offering a satisfactory level of comfort and convenience deemed necessary by a society at a given time, and also provides the population a healthy, fullfilling life.[17]

(h) Conceptual model/framework:

A means of organizing a complex body of knowledge so that it is more meaningful.

3. Thesis Organization and Methodology

Discussion of the integration of density and crowding knowledge, though not well organized in the current literature will be the focus of this study. The research organization is described here as a way of

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[17] Adapted from Maslow's Hierarchy, see; A. Maslow, Motivation and Personality (New York & Harper & Row, 1954). Also, see; C.A. Doxiadis, "An Attempt at a Scientific Approach to the Problems of Human Settlements", EKISTICS, Vol. 33, No. 231 (Feb 1969): pp. 359-360.

introducing the discussion.

Chapter II puts the study into context by tracing the history of high density thought. The reseach methodology of Intellectual History is employed to study the origins of density as a popularly held idea in a society of a given time. This chapter begins by describing the advent of modern orthodox planning and the historical forces in the society of the time which influenced this movement. The notions of housing density, as introduced by Ebenezer Howard in the New Town planning movement, and which was later to stimulate two divergent schools of planning thought on density, is presented. A review of high density thought of four representative utopian planners serves to organize the remainder of the chapter.

Chapter III offers a general description of what density means and presents a system of organizing three component types of density measures. Specific types of measures used to control high density housing development are presented. Chapter IV examines what crowding means and how it interrelates with density. It also present a system of organizing three groups of specific human requirements which, if met in high density environments might improve its liveability.

Chapter V applies the two density and crowding taxonomies from Chapters III and IV and draws implications for innovative approaches to the planning of high density housing. A proposed conceptual framework sets up a system for integrating the three quantitative components of density measures with the three qualitative components of human crowding

considerations. It describes potential mechanisms to link human requirements more closely with various quantitative formulae. Chapter V proposes a possible solution to the problem of ensuring a satisfactory quality of life at high densities.

The final chapter consists of the summary of the research findings, planning implications, limitations, and suggestions for further study in this area of planning.

C. THE CONTEXT AND ASSUMPTIONS OF THE RESEARCH

1. The Research Context

Present trends in urban land use planning indicate that density will continue to be a contentious public policy issue for years to come. Todate, no consensus has been reached on this important issue. The opponents of high density housing development (over 100 people per acre) remain as numerous as the proponents. However, increasing numbers of students and practitioners of planning are endorsing the belief that many present day problems faced by modern cities can be alleviated through policy which intensifies all land use for housing purposes. Jacobs and others cite research documenting some positive aspects of higher urban density.[18]

Any movement toward higher density residential environments must be preceded by careful study of the consequences. Consideration of

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[18]Jane Jacobs, The Death and Life of Great American Cities (New York: Random House, 1961), pp. 4-25. For economic advantages of high density see, Real Estate Research Corporation, The Cost of Sprawl: A Detailed Cost Anaysis (Washington, D.C.: U.S. Government Printing Office, 1974).

both the positive and negative factors of increased density should serve as the basis for rational decision-making regarding density controls.

Opponents and proponents alike agree that there are penalties related to high density. The debate continues as to whether or not the penalties outweigh the gains. Further, it is questioned, what groups or individuals are the recipients of these gains and penalties? Due to the limited scope of this research, this issue will not be covered here. The study however, recognizes that the argument over who benefits in monetary terms from high density is indeed a legitimate one. On the other hand, the discussion of the merits of high density should also proceed in the context of a fundamental concern for the physical and emotional well-being of the residents of high density environments, and not outworn biases.

2. The Research Assumptions

The purpose of this thesis is not to argue the advantages of high density housing. Rather, high density housing will be considered a given so that the focus will be placed on how to best ensure improved liveability based on present knowledge. Therefore to limit the scope of this study, it is appropriate here to list several assumptions on which it is based. It is assumed that:

(a) Higher densities will be a continued trend:

> Particularly in the Vancouver region, the concentration of populations in a limited land area indicate that future housing needs will be met at much

higher densities.[19] Changing demographic makeup of the Canadian population, as well as escalating land and construction costs may necessitate more intense residential land use than presently experienced in most regions of Canada. Also jobs, stores, community services and other amenities can be offered to a larger number of citizens within walking distance of their homes.

(b) Quality of life can be better ensured in high density environments:

A satisfactory quality of life can be offered to residents in high density developments through the organization and application of existing knowledge regarding the desireable quantitative and qualitative components of high density. In particular, the application of crowding knowledge will influence high density residential development by improving the quality of life to its residents.

(c) Application of crowding/density knowledge can assist in planning sensitive high density housing:

The exploration and organization of state-of-the-art knowledge regarding density and crowding and the implications of their

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[19] See for example; E.M. Gibson, The Urbanization of the Strait of Georgia Region (Ottawa: Lands Directorate, Environment Canada, 1976).

interrelationship are necessary initial steps towards the development of a conceptual framework which may assist in high density planning. Enhanced understanding of the concepts of density and crowding and their application to high density environments will be of use to municipal planners, the development industry and the public at large, and will ultimately provide housing that is more sensitive to quality of life concerns.

D. SUMMARY OF CHAPTER I

In this introductory chapter the need for and the feasibility of developing a conceptual framework with greater emphasis on human needs at high density, was presented. A brief description of the concepts of density and crowding was cited, which suggested how crowding knowledge can be of value in planning liveable high density housing. Problems regarding current density usage was also given to place the research proposal in context. Overall, the research aim was cited, that of developing a system which integrates density and crowding knowledge into a more manageable form from which future planning mechanisms for more liveable high residential density environments might be derived.

CHAPTER II

THE HISTORICAL CONTEXT OF HIGH DENSITY THOUGHT

A. THE VALUE OF INTELLECTUAL HISTORY

This chapter traces the history of the concept of high density as used in residential development. The research methodology employed is that of Intellectual History, defined as the academic study of the origins of a popularly held idea in a society of a given time. This chapter begins by describing the advent of modern orthodox planning and the historical forces in the society of the time which influenced this movement. The notions of housing density, as introduced by Ebenezer Howard in the New Town planning movement, and which was later to stimulate two unique schools of planning thought on density, is presented. A review of residential density thought of four representative utopian planners serves to organize the remainder of the chapter.

In order to study density and its relation to crowding, as proposed in this study, an understanding of its beginnings is essential. However, the historical roots of high density thought is not well documented in the planning literature. This historical background is presented at this point in order to offer some further undertstanding of high density and crowding through the works of acknowledged authorities. In particular the goal of this chapter is to present the historical argument underlying the belief that sensitive high density is a reasonable solution to urban housing problems. It is this belief that

further justifies the need to pursue research into the planning implications of a framework which incorporates crowding and density knowledge.

As previously mentioned, density is an often misunderstood concept. The complexity of an exercise which defines such a popular term has been summarized by A.P. McKillop when he writes, "the study of ideas or concepts like "density" can be described as an endeavor methodologically amorphous to nailing jelly to a wall."[1] For one to clearly comprehend a concept such as density, intellectual scholars have employed a methodology which traces the use of a specific term through history to determine its proper meaning. This involves seeking the original context in which the seminal author introduced the use of the term to a discipline such as planning. The noted Canadian historian, Frank Underhill, has expressed the importance of this approach when he writes, "that if we are to understand ourselves better we need to devote a great deal more study to our intellectual history, to the values, to the guiding ideas and ideals, that have influenced the minds of different groups of Canadians".[2] This holds true in understanding the past and therefore future use of the concept of liveable high density housing in planning.

B. THE HISTORICAL CONTEXT

1. The Forces Behind Density Thought

Density, in the modern city, is a relative term. What might be

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[1]A.P. McKillop, "Nationalism, Identity and Canadian Intellectual History", Queen's Quarterly Vol. 8 (Winter 1974): 534

[2]F. Underhill, The Image of Confederation (Toronto: CBC Publications, 1964), p. 60.

viewed as an excessive concentration of housing in one era might appear wasteful in another. The same might be said of the land use controls which are implemented by such cities as a means of controlling density. Housing density is closely tied to market forces. However, popular demands for the redesign of urban environments, including alteration of density controls, also arise from the forces of change in the modern city. For example, to many residents of Vancouver City, change is viewed as progress which results in jobs and increased economic activity. Still others view such change in negative terms such as block busting, over-crowding, environmental destruction, and pollution. From an historical perspective, change has always placed a strain upon planners to reach a concensus or find a solution to such an unsolved and chronic problem as establishing acceptable housing densities. The planner has continually been called upon to offer proper direction for change or growth as the city evolves. On this point, Nathaniel Litchfield has commented:

> "Urban planning is carried out by governments in an attempt to remedy the deficiencies of their urban areas and to steer their growth and change towards a better future than would emerge without such planning".[3]

It has long been recognized that the "better future" Litchfied refers to, often requires a revitalization or urban renewal in the core areas of large cities. The focus of urban renewal schemes often centers on plans to assure an adequate stock of housing, usually at higher

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[3]Nathaniel Lichfield, "From Urban Planning to Settlement Planning", Studies in Housing, Urban Design and Planning, ed. Pan Soen. (Oxford: Pergamon Press, 1979), p. 7.

densities. This is no simple task. The provision of sufficient numbers of housing units in the modern city involves much more than simply supplying basic shelter for its residents.[4] Housing form, neighborhood environment, economics and particularly density have always posed major concerns to the planners and the public.

It is hoped that the inclusion of the historical context behind density thought will place the contributions of the remainder of this study into a clearer perspective. The teachings of noted utopian planners form the basic thesis that higher density housing environments can be liveable given more consideration for human needs in their planning. This premise is threaded through the remainder of the study. Crowding considerations can be related more closely to density measures and a conceptual framework can be developed which guides the planner in applying density and crowding knowledge. It is the aim of this chapter then to explore the history behind current density trends so that new planning approaches in high density housing are placed into their proper context.

2. The Implication of Social, Scientific and Technological Change

The turn of the twentieth century heralded the beginnings of the

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[4]Lichfield, p. 8.

"Modern City".[5] The transition from the "Post-liberal" city was a time of rapid change to both the physical structure and the urban society. Society was not only confronted with a back log of unsolved urban problems, but also a myriad of new problems which resulted from the technological advancement of the period. Imagine a city's population which was experiencing rapid increases, being housed in obsolete aging physical structures while being inundated by the many impacts of these new inventions. Take for example, the advent of the "Bessemer Process" in 1856 which first produced steel; it was to forever alter construction technique and built form in the modern city. Imagine the reaction of residents of cities like Chicago in the late 1900's who were the first to witness the construction of twenty to thirty story buildings and the resultant problems of automobile traffic, congestion and air pollution.

Many major inventions took place during this period which were to irreversably alter the face of the modern city. In 1869, the dynamo was developed which effectively harnessed electricity as a practical and clean energy force. Other notable inventions such as the telephone in 1876, the electric light in 1879, the internal combustion engine and the elevator in 1885, all contributed to an environment of phenomenal change. The cumulative effect of these new inventions not only dramatically altered the manner in which cities were administered, but

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[5]Urban Historians are in general agreement that the "post-liberal" city ended near the end of the 1900's and was replaced in the western world by the modern city. See for example; Leonards Benevolo, The History of the City (Cambridge, Mass.: The MIT Press, (1980).

perhaps more importantly how their growth and change was planned. There is little wonder that the societal leaders of the day were quick to embrace a belief that the solution to many urban problems would soon be solved by technology and the machine age.[6]

3. The Impact of Change on Planning Thought

As in the fields of science and technology, leaders in the planning profession toyed with the idea of discarding old ways of doing things in favour of entirely new ideas. To the planner of the early modern city, the dream of constructing entirely new machine-age cities appeared to be within their grasp in their own lifetime. Noted utopian planners, such as Ebenezer Howard, were the products of this heady period of reformist ideals and demands which called for change to not only the structure of cities but more importantly to the basic fabric of society. It was in this setting and in response to these demands, that several innovative conceptualizations of the "ideal city" form were proposed. Perhaps as a spin-off of the wide public recognition received by major advancements in other fields, futurist planners of that period were motivated by the possibility of serious popular consideration for their city plans.

The followers of these utopian planners were to present ideas that ranged far beyond the intellectuals of that time however. As in Ebenezer Howard's case, his Garden City plan was to become the focal

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[6]For a indepth discussion of the effect technology and the machine age had on urban planning see; Lewis Mumford, Technics and Civilization (Cambridge Mass.: The MIT Press, 1934).

point for a major social movement which greatly influenced planning in both Europe and North America. Howard's success, however, is an exception to the rule. Few of the futurist planners of his day received a fair hearing of their ideas. Of these, only a minority were ever given an opportunity to implement and thus test new ideas in city planning. The success or failure of these early planners should not be gauged only by their ability to implement their plans. In retrospect, perhaps their greatest contribution to the field of urban planning was the introduction of new concepts and ideas which began a debate on urban problems and their ideal solutions. It was this dialogue, began in the early twentieth century by the futurist planners, which not only defined many modern urban problems, but also focused discussion on such specific issues as housing density. This process eventually identified and refined many new solutions to age old urban problems. One noteable example of such an idea was that of increasing the density of housing in the core of a city rather than opting for less complex suburban housing development.

It was these ideas, pioneered by the utopians, which were to lay the groundwork for the planning and development of the modern city. Additionally, many present day planning practices and concepts have their origins in the works of these early planners. As will be shown from the application of some of the futurists ideas in this study, other of their dreams have yet to be fully refined. For example, the notion of being more sensitive to human needs in planning high density environment is an idea not yet fully incorporated into planning

practise. It is the aim of this study to explore and operationalize some of these early concepts.

In the determination of urban housing density, Ebenezer Howard has inspired the advocates of a decentralized or low density urban development (also called new town planning thought). Howard's seminal ideas about new urban environments met with a dramatic opposition by other early planners of the modern city, such as Le Corbusier. For example, as Maurice Besset points out, "it was the reading of these pioneer books (like Garden Cities of Tomorrow by Ebenezer Howard) whose proposals he later violently condemned, that set Le Corbusier seriously thinking about town-planning problems".[7]

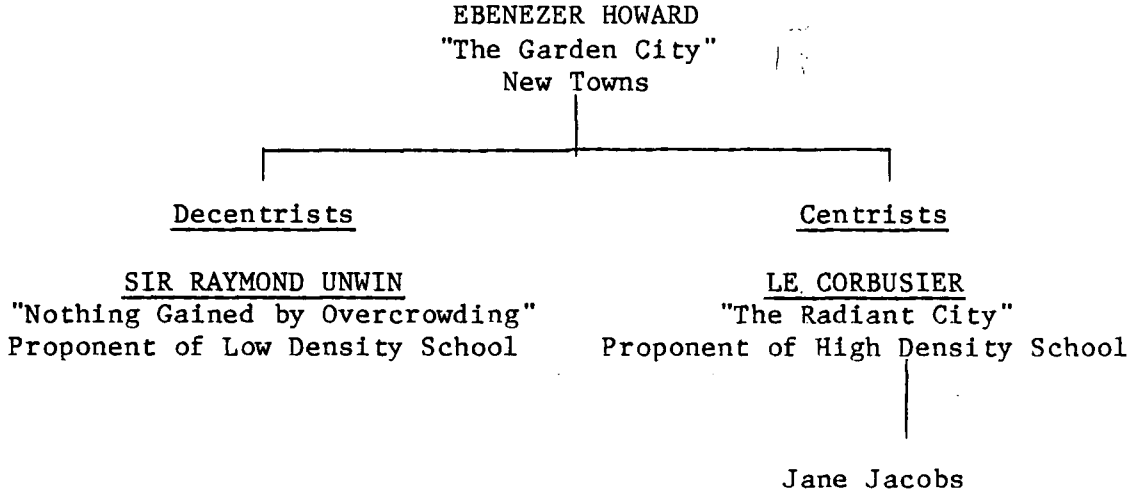
C. THE DEVELOPMENT OF DENSITY THOUGHT

The following diagram illustrates the two divergent schools of density thought. As can be seen, Ebenezer Howard was the seminal influence. Only the four individuals addressed in this study are included in the figure; there are however other planning futurists and theorists that tend to follow one school or the other, such as Fredrick Law Otmstead, Henry Wright, Clarence Stein, Lewis Mumford and Catherine Bauer as Decentrists, and Daniel Burnham as a Centrist. An overview of the two schools of density thought stemming from Howard's work will be presented in this section. Although most planning theorists can be placed in one or the other of the two schools, the discussion in this chapter will focus on four individuals in an effort to describe the

[7]Maurice Besset, Who Was Le Corbusier? (Geneva: Editions d'Art Albert Skina, 1968), p. 151.

beliefs surrounding both schools: Ebenezer Howard, Sir Raymond Unwin, Le Corbusier, Jane Jacobs.

FIGURE I - THE TWO SCHOOLS OF DENSITY THOUGHT



Planning history suggests the presence of two distinct schools of thought which pertain to housing density. The first, which will be referred to as the "Decentrist" school, consisted of devout followers of Ebenezer Howard and the Garden City movement. This movement was initiated by Sir Raymond Unwin. These planners were of the religious belief that high density housing was an evil to be stamped out. In the late nineteenth century context many negative consequences were experienced in high density low quality family housing in Great Britain.

During this same period, a radically different school of density thought was to develop under the architect, Le Corbusier, whose teachings advocated high density as an exciting, practical aspect of

life in the modern city, given proper design, adequate construction and ample park space. It is the Le Corbusier inspired "Centrist" school of density thought from which many present notions promoting high density have originated.

D. THE UTOPIAN PLANNERS AND THEIR HIGH DENSITY THOUGHT

1. Ebenezer Howard

Planning historians are in general agreement that modern city planning began with the publication of the book, Garden Cities of Tomorrow in 1898 by Ebenezer Howard.[8] Howard, one of the first new "town planners", was to initiate many of the ideas and ideals which have dominated the planning profession from that date. Howard's contribution to planning theory was the development of a fully planned, small scale new town for Britain. His desire for new towns was in response to the unhealthy crowded living conditions he had experienced in late nineteenth century British cities, particularly London. This Garden City idea was to construct new, self-sufficient cities on a much smaller scale with a population of about 30,000 in the core and about 2000 in the surrounding agricultural estate. The town was to contain 3,500 building lots of an average size of 20 feet x 130 feet - the minimum space alloted for the purpose being 20 x 100.[9] Howard's design was intended to improve the quality of life for its residents by, for

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[8]G.B. Dantzig, and T.L. Saaty, Compact City (San Francisco: W.H. Freeman and Company, 1973), p. 18.

[9]Ebenezer Howard, Garden Cities of Tomorrow (Cambridge, Mass.: reprinted by The MIT Press, 1965), p. 54.

instance, creating open spaces in the urban core. Also care would be taken to shield residential areas from negative industrial impacts. Greenbelts would surround the Garden City to offer its residents easy access to green space and fresh air. Finally, the idea of offering jobs closer to the worker's residence reduced the need for expensive transportation which might affect air quality. Howard based his model city on two key assumptions:

1. That people would rather live in smaller, cleaner, more efficient cities than in large cities.[10]
2. That a decentralized urban area and therefore decentralized social order would offer a more pleasing living environment than large cities.[11]

Howard successfully planned and constructed a demonstration project at Letchworth, England which was to become the focal point for an expanding Garden City movement amongst city planners of the twentieth century.

It has been assumed that Ebenezer Howard was opposed to high density residential construction and was a proponent of low density. However, Lewis Mumford, a noted author, writes of Ebenezer Howard that he had no conscience commitment to either low or high density although his Garden City was an attempt to relieve the congestion of the large city. Mumford argues that, "Howard's alleged plan for lowering the density of population to twelve houses to the acre . . . is a fantastic

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[10]Howard, pp. 50-57.

[11]Ibid, pp. 138-150.

error: you will look in vain through the pages of Garden Cities of Tomorrow for even the hint of such a proposal".[12]

What exactly then did Ebenezer Howard have to say about the density of housing? Mumford explains that Howard's beliefs about the actual numbers involved in housing densities were "on the conservative side".[13] As has been pointed out, Howard specified an average lot size in Garden City of 20 x 130 feet with a minimum of 20 x 100 feet. Mumford translates these dimensions, (given the average family size of the day as five persons) into 90 to 95 persons per residential acre, or in present day terms of smaller family units, about 70 persons per acre to be housed in single family units.[14] Howard did not specify what density he had in mind for Garden City. He did however recommend a minimum lot size which indirectly did limit density levels. The commonly held belief that Ebenezer Howard was the initiator of modern concepts of low density is in fact an overstatement.

Who then did begin the planning movement which pursued the idea that low density development provided the best living environment? Conversely, from where did the idea that modern cities could be constructed with high density residential components obtain its origin? For these answers, this discussion will now focus on the contrasting

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[12]Lewis Mumford, "The Garden City Idea and Modern Planning", Garden Cities of Tomorrow, ed. Ebenezer Howard (Cambridge, Mass.: reprinted by The MIT Press, 1965), p. 30.

[13]Howard, p. 31.

[14]Ibid, p. 32.

ideas and ideals of the followers of Ebenezer Howard's Garden City movement, Sir Raymond Unwin and Le Corbusier. It is these two individuals who brought the density debate to a focus, one an opponent and one a proponent of high density.

2. Sir Raymond Unwin

Sir Raymond Unwin was a co-planner with Ebenezer Howard during the construction of the first Garden City at Letchworth. As Lewis Mumford discovered, it was Unwin, not Howard, who argued in favor of lower densities for housing. Unwin's main contribution to planning is the notion that there is "Nothing Gained by Overcrowding", a classic essay in 1903.[15]

Unwin argued from an economic standpoint that higher densities should not be implemented in response to high costs of urban land. He argued that less congested cities would be more economical by not wasting money on excessive street area and expensive paving; the savings would provide instead more public space such as internal parks and play areas. He also felt that lower cost suburban development presented a better option when faced with rising city core land values.

Lewis Mumford is critical of Unwin's "rigid mechanical application of a density standard" associated with his "overcrowding" notion. Unwin's suggestion of a density of 36-48 persons per acre is,

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[15]Raymond Unwin, "Nothing Gained by Overcrowding", (1912) The Legacy of Raymond Unwin, ed. W. Creese (Cambridge, Mass.: The MIT Press, 1967), pp. 109-127. The best short survey of Sir Raymond Unwin's works can also be found in Creese's book.

in Mumford's belief, far below the density limit compatible with health and good living.[16]

One can find the beginnings of modern adversity to high density housing in the writings of Sir Raymond Unwin.[17] Unwin's ideas received a wide following in the field of planning and continue to influence the density debate. Based on Unwin's teachings, many planners drafted and implemented density standards which were purposefully restrictive in nature. The objective was to hinder or discourage high density urban development based on Unwin's assumptions about the ill-effects of crowding at high density. Catherine Bauer has labeled this the "Decentrist School" of planning thought.[18]

Unwin was one of the first of the decentrist school to recognize the need for land use controls to regulate density as a means of preventing the ill-effects of crowding. Such regulation, he wrote, must recognize, "two important and different considerations which make some sort of limitation desirable".[19] The first was the need to limit the ground area coverage and height of buildings on a site. The second

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[16]Mumford, p. 31.

[17]See for example, Sir Raymond Unwin, Town Planning in Practice (London: Ernest Bean Ltd., 1909).

[18]For further research on the "Decentrist School of Planning Thought" See: Fredrick Law Olmsted, Forty-eight Years in Architecture (Cambridge Mass.: The MIT Press, 1957), and Henry Wright, Rehousing Urban America (New York: Columbia University Press, 1935); and Catherine Bauer, Economic Development and Urban Living Conditions (United Nations, New York: Housing, Building and Planning Branch, Bureau of Social Affairs, 1957).

[19]Unwin, pp. 124-126.

related to a need to limit the population which was to inhabit the site. Unwin's proposed regulations to avoid crowding were based on these two assumptions.

Unwin's Letchworth density regulations reflect these two assumptions and give a clear indication of his commitment to low density development. For example, his Letchworth regulation specified:

> "1. That in the case of houses on ordinary sites, not more than one-sixth of the site should be covered by buildings.
>
> 2. That dwelling houses costing less than 200 pounds should not exceed 12 to the acre; houses costing from 200 to 300 pounds should not exceed 10 to the acre; houses costing from 300 to 350 should not exceed 8 to the acre and so forth."[20]

Unwin's ideas are still influential; his legacies continue in research on the ill-effects of crowding in residential environments which now spans several academic disciplines ranging from environmental psychology to planning.

3. Le Corbusier

If one is to search the origin of pro-high density housing ideas, it is to the works of Le Corbusier which one must look. Although Le Corbusier is generally claimed by the architectural fraternity, he has been recognized as the most noted and influential urban planning theorist to propose high density housing. He was the first of the futurist planners of the modern city to present a redevelopment scenario which was not only contrary but radically opposed to the planning ideas widely endorsed by the Garden City movement. This event was to be of

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[20]Unwin, p. 125.

major importance in the evolution of the acceptance and usage of high density developments as an alternative to suburban developments in meeting modern housing needs.

Who was Le Corbusier? What were his revolutionary ideas on the design of urban housing environments? Why have these ideas come to be recognized as synonymous with the development of high density housing of present day? These are some of the issues which will be covered in the following sections.

The contributions of Le Corbusier are viewed by his critics with disdain as exemplified by Lewis Mumford when he labels Le Corbusier's work "propaganda of urbanism".[21] The present day importance of his early concepts of urban development however warrant greater study, such as proposed in this research. In view of current trends in the planning of high density housing, it would be unfortunate to dismiss his ideas as abruptly as Mumford when he concludes that Le Corbusier's ideas are, "a sort of vulgar trade mark of modern form".[22] The relevance of Le Corbusier to urban planning is not only that he is a leading proponent of high density housing, but also that his ideas form the nucleus of a broad philosophy of modern city development which continues to influence a significant portion of present day planners. In this respect, for one

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[21]Lewis Mumford's distrust for Le Corbusier has been widely documented. Mumford discounts Le Corbusier as a "Propagandist of Urbanism" in The Culture of Cities (New York: Harcourt, Brace, Jovanovich, 1938).

[22]Lewis Mumford, The City in History (New York: Harcourt, Brace & World, Inc., 1961).

to understand urban housing environments and density, one must begin by understanding Le Corbusier.

The task of understanding Le Corbusier and his influence in both modern architecture and urban planning is aided by many biographic and critical studies. To begin, a short literature review of key sources will be given.

Dating from the publication of Le Corbusier - on l'architecture as service de l' homme[23] in 1944 by Maximillian Gautlier, Le Corbusier has continued to attract a vast amount of scholarly investigation. Although many of the early works on Le Corbusier are published in the French language, several have now been translated into English. Probably the best discussion of the intellectual development of Le Corbusier to date was written by Paul Venable Turner entitled, The Education of Le Corbusier: A Study of the Development of Le Corbusier's Thought, 1900-1920.[24] Initially presented in 1971 as a doctoral dissertation, Turner offers a valuable outline of the intellectual forces which contributed to Le Corbusier's development as a "functionalist" architect. Turner, however, focuses largely on Le Corbusier as Architect at the expense of Le Corbusier as Urban Planner. Turner's work is augmented by Russell Walden's book, The Open Hand:

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[23]Maximillian Gautlier, Le Corbusier - on l'architecture and service de l'homme (Paris: Massard Pub. Inc., 1944).

[24]Paul Venable Turner, The Education of Le Corbusier: A Study of the Development of Le Corbusier's Thought, 1900-1920 (New York: Garland Publishing Inc., 1977).

Essays on Le Corbusier,[25] which is a collection of several key essays dealing with Le Corbusier's intellectual development and orientation as a utopian city planner.

Of several biographies on Le Corbusier, perhaps the most valuable contribution comes from Norma Evenson.[26] She not only shows a clear understanding of Le Corbusier, but does so in an objective and thought-provoking manner. Evenson further identifies that Ebenezer Howard played a major role in the derivation and evolution of Le Corbusier's urban planning thought.

Among the more recent Le Corbusier studies, Robert Fishman in his book, Urban Utopians in the Twentieth Century,[27] sheds new light upon Le Corbusier's fundamental influences on planning, while at the same time comparing and contrasting his notions with that of Ebenezer Howard and Frank Lloyd Wright. This book is of particular interest in that it carefully outlines the conceptual plans for the "future city" which Le Corbusier developed over a period of forty years. Fishman organizes Le Corbusier's writings and thoughts on urban planning issues in a concise and easily read manner. As well, Fishman's observations and conclusions contribute much in identifying Le Corbusier as the founder of modern urban planning thought on high density.

"Le Corbusier", was in fact a pseudonym used professionally by Charles Edouard Jeanneret. Jeanneret was born of an artisan family in

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[25]Russell Walden, The Open Hand: Essays on Le Corbusier (Cambridge, Mass.: The MIT Press, 1977).

[26]Norma Evenson, Le Corbusier: The Machine and the Grand Design (New York: George Braziller Inc., 1969).

[27]Robert Fishman, Urban Utopians in the Twentieth Century (Cambridge, Mass.: The MIT Press, 1982).

the French-speaking region of Switzerland in 1887. Initially educated in an art school and later to learn the craft of watch engraving, he was to lead the life of a passive revolutionary. A change of name, the adoption of Paris as a home rather than Switzerland and his commitment to art forms, are all indications of a strong individual unafraid of change and committed to trying new ideas. Jeanneret once considered becoming a painter, however on the advice of his early art instructors was to become an architect. The completion of his first housing design in 1907 was to launch Jeanneret on a life course which would result in grand design for entirely new cities.[28]

Paris was to become Le Corbusier's working laboratory. It was in this vibrant, exciting setting that as a young man he was to develop many revolutionary planning ideas. If one was to summarize Le Corbusier's philosophy of planning in a few short words, it would be; geometric order, centralization of authority and a passionate commitment to a mass industrial society. This is of course a superficial explanation of the intellectual forces from which he was to derive his urban planning ideas. Fishman, however, concludes that, "Le Corbusier embraced and idealized precisely what repelled Howard and Wright in the modern city: its contribution to the centralization of society".[29]

To Le Corbusier, architectual design was a vehicle through which

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[28]For a more complete discussion of Charles-Edourard Jeanneret's early life see; Stanislaus von Moos, Le Corbusier: Elements of a Synthesis (English Translation) (Cambridge, Mass.: The MIT Press, 1979), pp. 1-36.

[29]Fishman, p. 193.

to achieve his utopian society. From this broad perspective on urban society, Le Corbusier set about to physically design a modern city which reflected these concepts. Le Corbusier's orientation as an architect was strongly influenced by the cubist[30] movement in painting. Mumford identifies Le Corbusier as a leader of the cubist movement among architects who, in his words, "ceased to concern themselves alone with the isolated architectural product: they passed on to the urban environment as a whole, and sought to place the entire process of building and rebuilding on a fresh foundation".[31]

An integral part of this new foundation was the incorportation of the machine into the design of modern cities. In certain ways, Le Corbusier shared many ideas with Ebenezer Howard, the most notable being to bring "sun, space and green" back into the city. This, however, is where Le Corbusier was to depart dramatically from the teachings of Howard. His solution to these goals was to rebuild the city, constructing tall sky scrapers for office buildings thus allowing an expansion of park space below and between then. As well, high speed elevated roadways would be constructed to move the modern automobile quickly from the center of the city outward in what Le Corbusier coined a "radiating" fashion. In residential areas, tall thin garden apartment

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[30]Cubism, is a style of art (especially painting) in which objects are so presented as to give the effect of an assemblage of geometric figures. For a discussion of "Cubism" as it relates to Le Corbusier, see Lewis Mumford, The City in History, pp. 412-415.

[31]Ibid., p. 414.

buildings were to replace existing housing. Le Corbusier envisioned a new urban environment which would accept more communal urban land use as a necessary trade-off in this new, geometrically ordered, convenient, machine age society. Most importantly, the proximity to a vast array of amenities, services and job possibilities would enhance the quality of life of the modern city dweller and also encourage his adaptation to this new way of life.

Throughout his life, Le Corbusier was to repeat these unique and novel ideas in his many writings. Of these, two books stand out as primary sources, Urbanismé and The Radiant City. The publication of Urbanismé[32] in 1924 presented many very controversial planning ideas for its day. Of special note from this book is Le Corbusier's suggestions about the density of housing in future cities as described below. One can find its logic in the broader principle of architecture, art and urban design around which le Corbusier's life revolved. Urbanismé is a futurist design for an ideal city which Le Corbusier labeled "The Contemporary City". Urbanismé was an innovative plan for a 1920's Paris, a city around which Le Corbusier spent a lifetime redesigning in concept.

It is in his Contemporary City plan that Le Corbusier was to outline an uncompromising stand on density. He wrote;

> "The more dense the population of a city the less are the distances that have to be covered. The moral, therefore,

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[32]Le Corbusier, Urbanismé (English translation) (London: Percy Lund, Humphries & Co., 1929).

> is that we must increase the density of the centers of our cities, where business affairs are carried on".[33]

In the words of the author, the Contemporary City plan was initially, "greeted with a sort of stupor; the shock of surprise caused rage in some quarters and enthusiasm in others".[34] Here, as in all of his writing, Le Corbusier attacked low density or suburban development as wasteful and inefficient. As an alternative to the Garden City (and also later Frank Lloyd Wright's Broadacre City), Le Corbusier advocated concentration of urban populations at the city's core. In his Contemporary City of tomorrow the prescribed density was as follows:

(a) The sky-scraper: 1,200 inhabitants to the acre. (This would translate roughly to an FSR of 12 or approximately four times the present density of the West End of Vancouver or similar to building density in the central business district in the downtown core of Vancouver)

(b) The residential blocks with setbacks: 120 inhabitants to the acre. These are the luxury dwellings.

(c) The residential blocks on the "cellular" system, with a similar number of inhabitants.[35]

Le Corbusier in fact did endorse the idea first initiated by the Garden City Movement, that of open green space as a fundamental

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[33]Le Corbusier, p. 174.

[34]Ibid.

[35]Ibid., p. 180.

component of urban design. In his Contemporary City plan, he specified that site coverage for the above density types must provide the following open space:

> Of the area (a), 95 per cent of the ground is open (For example 5% coverage at FSR of 10 would translate into 200 storey buildings) with squares, restaurants, theatres.
> Of the area (b), 85 percent of the ground is open with garden and sports grounds.
> Of the area (c), 48 per cent of the ground is open with gardens and sports grounds.[36]

As can be seen in the following diagram, Le Corbusier proposed vertical residential developments surrounded by open space. He referred to open space as the lungs of the city. Observing urban renewal trends of the 1920's, he wrote, "the towns of today can only increase in density at the expense of open spaces which are the lungs of a city".[37] Contemporary City proposed to increase both open space and density in the core of the city by vertical construction. Le Corbusier cautioned that residential quarters," must no longer be built along corridor streets full of noise and dust and deprived of light.[38] His solution was innovative design which built dwellings away from streets, with no internal courtyards but rather windows overlooking large parks. Garden patios and roof top gardens were to be incorporated into the design as a means of replacing ground orientation and at the same time give residents outdoor living space adjacent to their homes. Clean air, sunlight and, most importantly, privacy from neighbors were strictly

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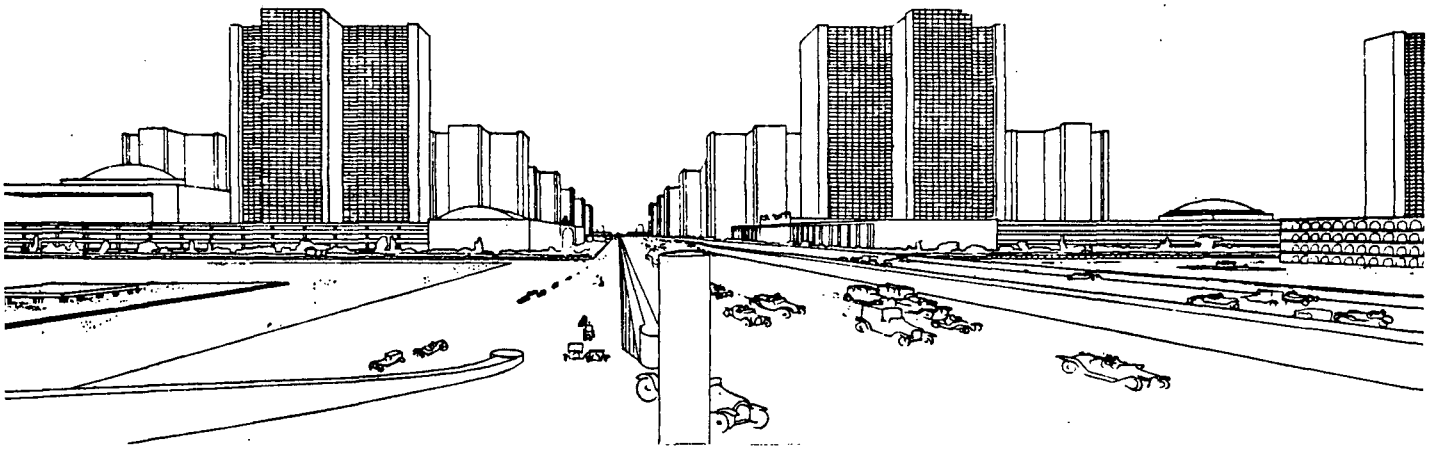
[36]Le Corbusier, p. 175.

[37]Ibid.

[38]Ibid.

achieved by Le Corbusier's design criteria.

FIGURE II - Le CORBUSIER'S CONTEMPORARY CITY



Le Corbusier endorsed the idea of "cubism", as described earlier, which viewed each dwelling unit as a three-dimensional cell structure which might be studied and arranged geometrically to maximize views, sunlight, and privacy. Dwelling units or flats in Le Corbusier's plans were likened to the cells of a beehive. It was not the communal lifestyle of multiple family housing which, "attacks our freedom and so we dream of a detached house",[39] but rather, he believed it was disorderly grouping of such cells that fostered the perceptions of crowding and loss of freedom held by their residents. Again, innovative design was Le Corbusier's solution to the problem of crowding. For, as he wrote, "it is possible by a logically conceived ordering of these

[39]Le Corbusier, p. 242.

cells to attain freedom through order".[40]

Stanislaus von Moos in his book, Le Corbusier - Elements of a Synthesis, clearly defines Le Corbusier's philisophy as a proponent of high density urban life. In the words of von Moos, Le Corbusier believed that, "if the modern metropolis no longer works, it should be brought back under architectural control, equipped with proper tools, and remain a cultural and architectural "whole" clearly distinct from its rural surrounding".[41] To summarize, Contemporary City outlines three distinct goals of future city planning: "(1) to increase the density, (2) to reaffirm the supremacy of the business center, (3) to bring greenery and nature back into urban life".[42]

Le Corbusier's Contemporary City of 3 million is unique in that it recognizes the existence of urban man as distinct from rural man. Le Corbusier's futurist conception of city form and density was based on two key premises. Firstly, that modern urban man has the ability to adapt to new living environments given sensitive architectural design. Secondly, that through orderly design of tall residential developments located in large park areas, planners could justify much higher densities than that which existed in the most congested randomly built areas of our cities. To Le Corbusier, a futuristic, high density urban environment presented, "the ultimate expression of man's ability to

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[40]Le Corbusier, p.226.

[41]Stanislaus von Moos, p. 191.

[42]Ibid, p. 192.

master nature".[43]

Waclaw Ostrowski observes that Le Corbusier's quest for new forms of housing was essentially an exercise in determining new forms of urban life.[44] Increased housing densities were the catalyst which would achieve this vital new society built on technological advancement.

Le Corbusier continued to refine his new town planning doctrine. In 1930 he published The Radiant City[45] which expanded upon the basic principles put forward by his Contemporary City plan for Paris. In the Radiant City plan, he furthered the belief that density meant much more than simply the number of persons which could be housed per acre of land. In the earlier Contemporary City plan, Le Corbusier had defined his population density on the assumption that fourteen square meters of dwelling space was required per inhabitant[46](it might be noted that this amount of space is very low by today's standards, which are roughly at least double this amount). Based on his building design, this resulted in a projected 400 persons per acre or 1000 per hectare density which is a reduction of density as outlined in his Contemporary City plan (a hectare is slightly less than 2 1/2 acres). These figures, Le Corbusier later explains in The Radiant City, are

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[43]Evenson, p. 11.

[44]Waclaw Ostrowski, Contemporary Town Planning (The Hague, Netherlands: International Federation for Housing and Planning, 1970), p. 78

[45]Le Corbusier, The Radiant City (London: Faber and Faber Ltd., 1933), p. 106.

[46]Evenson, p. 22.

borrowed from the housing designs of Loi Loucheur.[47] Briefly, Loucheur proposed that an ideal habitable space of a dwelling unit should be based on 45 square meters of floor space per 6 inhabitants (or 7.50 m^2 per person). The Loucheur type dwelling unit, as Le Corbusier explains, can be easily occupied by 6, 4, 3 or 2 persons. Le Corbusier took this basic measurement several steps further and recommended a rule of thumb to be used in designing housing of high density. The ideal habitable space of this type of housing should be:

> "in a unit occupied by 6 people: 7.50 m^2 per person.
> in a unit occupied by 4 people: 11.25 m^2 per person.
> in a unit occupied by 3 people: 15 m^2 per person.
> in a unit occupied by 2 people: 22.50 m^2 per person
> giving an average of fourteen square meters per person".[48]

As in most of Le Corbusier's futurist works, it was not his intention that his ideas be implemented directly. Rather, these ideas were to be used as a model. His legacy was not to suggest that all urban problems might be solved by concentrating population in tall architecturally ordered buildings. Rather, it was his intention to encourage new approaches to urban issues such as high density through abstract conceptualization.

Le Corbusier was the first noted urban theorist to articulate a correlation between density and the negative effects of crowding which

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[47] Le Corbusier, The Radiant City, p. 108.

[48] Ibid., p. 108.

resulted in a need for him to personally establish high density housing design guidelines. Le Corbusier's proposals for the number of persons per acre and the adequate living unit space per individual were based on how the high density environment affected one's perception of crowded living conditions. He first identified the fact that density controls which also addressed humanism were fundamental to planning and urban design.

Le Corbusier's ideas on density created interest in several urban related disciplines. The fields of design and construction were perhaps most receptive to Le Corbusier's proposals largely because of the economics of building at higher densities. The most vocal opposition came from some planners who drafted and legislated modern city land use and zoning ordinances. It may be suggested that their fears and apprehensions stemmed largely from the decentrist planning ideology as well as from widely-documented objectionable past experience with poor quality high density housing in Britain at the beginning of the twentieth century.

4. Jane Jacobs

In the introduction to her book, The Death and Life of Great American Cities,[49] Jane Jacobs also identifies a decentrist group, consisting of such leading regional planners as Lewis Mumford, Clarence Stein, Henry Wright and Catherine Bauer, as the most articulate opponents of Le Corbusier. Without belabouring the point, much of the

[49]Jane Jacobs, The Death and Life of Great American Cities (New York: Random House, 1961), pp. 4-25.

opposition to Le Corbusier's ideas are grounded in the classical ideological rift between centrists and decentrists. Much of their criticism of Le Corbusier must be viewed in this light. In the words of Jacobs, "the Decentrists, with their devotion to the ideal of a cozy town life, have never made peace with the Le Corbusier Vision".[50]

Jacobs however observes that virtually all sophisticated city designers incorporate the ideas of both groups. This being the case, one would be hard pressed to determine which philosophy of urban design is best, that of the decentrists like Mumford or that of the centrists like Le Corbusier; for it is an inescapable fact that these two philosophies are the points of departure and form the major lines of thought on urban density today.[51] Although not an uncritical supporter of Le Corbusier, Jacobs has attributed him with much of the application of notions of high density in present day cities.

In her writings on density, Jacobs leaves no doubt that she is a proponent the Centrist school of high density thought. For example, she has written:

> "High dwelling densities have a bad name in orthodox planning and housing theory. They are supposed to lead to every kind of difficulty and failure. But in our cities, at least, this supposed correlation between high density and trouble, or high density and slums, is simply incorrect as anyone who troubles to look at real cities can see".[52]

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[50] Jacobs, p. 23

[51] Ibid., p. 24.

[52] Ibid., p. 202.

To organize Jane Jacobs' thoughts regarding high density, her opinions about four main requirements necessary for the planning of liveable high density environments will be presented.

a. The Need to Distinguish Between Density and Crowding:

To Jacobs, the reason popular wisdom supports the idea that low density cities are in some way better than high density cities, centers on a general confusion in distinguishing between density and crowding. To attempt to clarify this confusion, Jacobs explains:

> "high density means large numbers of dwellings per acre of land. Crowding means too many people in a dwelling for the number of rooms it contains. The concensus definition of overcrowding is 1.5 persons per room or more. It has nothing to do with the number of dwellings on the land, just as in real life high densities have nothing to do with overcrowding."[53]

As will be discussed in Chapter IV in a review of the literature on crowding, Jacobs observations have been confirmed in many recent studies. For example, a density-related survey undertaken in 1975 by C.S. Fisher, et. al. concluded that, "density though perceived as unpleasant does not appear to have definite and consistent detrimental social effects."[54]

Jacobs places considerable blame for such confusion on the decentrist planners lead by Sir Raymond Unwin. To Jacobs, it is their dogmatic and often incorrect belief about high density which continues

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[53]Jacobs, p. 205. (Jacobs use of the term overcrowding here refers more to excessive internal density levels and should be distinguished from the term crowding as used in this study)

[54]C.S. Fischer, M. Baldassare, and R.J. Ofshe, "Crowding Studies and Urban Life: A Critical Review", Journal of the American Institute of Planners 41 (Nov. 1975): 406-418.

to offer improper planning direction in large modern cities.

b. The Need for a Qualitative Component in Density Controls

Jacob's also identifies the use of strict formulae as another factor which contributes to the improper planning of high density housing. This she labels "a statistical monstrosity" which was developed by short-sighted housing reformers primarily concerned with preventing high density at any cost. The statistical monstrosity she refers to is the use of numerical calculation to specify the number of persons per acre of land as exemplified in the various density measures defined in Chapter III following. Jacobs suggests that the utility of development controls based solely on arbitrary quantitative density measures is highly questionable, as the physical space conditions they enforce do little to achieve the objective of preventing crowding. It is Jacobs' belief that if planners are to be successful in designing regulatory devices to control crowding they must focus on regulating the number of persons in a dwelling or per room of a dwelling,[55] as well as controlling the density of dwelling units or site coverage of buildings, as a way to ensure greater liveability.

The consequence of crowding is commonly associated with high density. However, it is Jacobs' contention that as many glaring examples of crowding can be found in low and medium density developments. If one were to pinpoint the cause of crowding, it would more realistically be identified as a symptom of poverty or poor quality building design than one of density alone.[56] Without pursuing this

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[55] Jacobs, pp. 205-206.

[56] Ibid., pp. 206-208.

point, it is important to recognize that Jacobs, not surprisingly, found a correlation between the more affluent socio-economic groups and the quality and cost of construction of buildings, to the success or failure of high density environments.

Crowded urban housing conditions relate to a broad range of social issues. Concerns for this however should not obscure a discussion of designing or regulating habitable high density housing. For, as Jacobs distinguishes, one doesn't live in crowded conditions by choice, but one may choose to occupy housing at high density. Therefore, a qualitative component is needed in density controls to prevent crowding, thus ensuring a more satisfactory quality of life at high density for those who chose this lifestyle as an alternative.

c. The Need for Diversity with High Density:

Freedom of choice and diversity are continuing themes throughout Jacobs' writings on liveable urban environments, with high density being the foundation of her beliefs. It is from the diversity of culture, lifestyle, amenities and services afforded by high density that Jacobs derives her unwavering support for it.

The determination of the proper density, Jacobs writes, should be viewed as a matter of performance. She draws an analogy of density to the intake of calories or vitamins by stating, "right amounts are right amounts because of how they perform. And what is right differs in specific instances",[57] or in other words high density works when it is compatible with the individual's needs and personal taste.

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[57] Jacobs, p. 219.

Jacobs suggests that there are upper limits within which high density must be curtailed for residential life because of its impact on another aspect of diversity. It was her observation that excessive density environments tend to diminish needed diversity. She believed that concentrated environments succeeded best when such diversity existed or was consciously planned for. A situation of bad density exists, in her view, when the visual diversity of buildings disappears in favour of the standardized design of entire neighborhoods. Proper high density environments must contain a mix of building form, such as tall apartments, low rise apartments and various more unique forms of stacked housing. Different combinations or concentrations of these forms should take advantage of specific site characteristics. In retrospect this is perhaps where Le Corbusier's Radiant City would have produced a poor living environment as his cubist design lacked such planned diversity.

d. <u>The Need for Open Space with High Density</u>:

Her final concern regarding high density related to the ground coverage of buildings and the preservation of open space. A rule of thumb Jacobs suggests is that site coverage of high density must be controlled when it approaches seventy per cent of the total site. Without such controls, a condition of crowding might result.

Jane Jacobs of course had much more to say in favour of high density than has been briefly presented here. In summary, Jacobs is committed to the creation of healthy satisfying and safe urban

environments. This is dependant upon a reasoned acceptance that high density can be positive provided that crowding considerations are incorporated into building design. It is this acceptance of high density as a concept upon which the, "job of intelligently developing genuine city life and increased city economic strength depends".[58] In pragmatic terms, the continued trend toward concentrated populations and therefore high density housing is inevitable.[59] Therefore to its opponents, it will ultimately become a necessary evil, unless there is a clearer understanding of high density and its relation to crowding. There are many North American examples in which high density environments do work.[60] It is to these examples that future city planners must look. Given that high density seems inevitable, the task then becomes to develop innovative approaches which may better ensure the planning and construction of high density urban environments which offer a high level of liveability to its residents.

E. SUMMARY OF CHAPTER II

In summary, this chapter suggests that it is now time to discard the defensive posture of the past concerning the density issue. Once the seemingly painful concensus is reached in favour of high density housing, special care must be taken to construct housing which is sensitive to the many requirements, needs and wishes of future residents

[58]Jacobs, p. 220.

[59]See for example, Vancouver Sun, May 29, 1984, p. 1.; and Jacobs p. 220.

[60]See for example, House and Home, The Case For High Density Housing, April, 1962, pp. 133-154.

of such intense urban environments. Planners, politicians and the public at large, when they reach such a consensus and understanding of the density-crowding relationship, may then approach their planning with objectivity as well as receptiveness to new ideas and concepts. Such a planning process should mold the knowledge and experience of the past with image or vision of the future as described by our leading urban theorists. It is hoped that through the methodology of intellectual history, the works of the great utopian planners such as Ebenezer Howard, Le Corbusier and Jane Jacobs will serve as an introduction to this study by way of clarifying the origins of schools of high density thought. Further, history has given us the centrist movement which provides some historical rationale for the pro-density side of the argument.

This chapter has, not suprisingly, raised many questions regarding density and crowding which will be addressed in the balance of this study. Such questions are:

1. What does "density" actually mean and how is it currently measured?
2. What does "crowding " mean and what exactly is its relationship to density?
3. What are the various aspects of human crowding considerations at high density?
4. What are some planning implications of the crowding-density relationship and how can crowding concerns be better incorporated into high density planning?

CHAPTER III

THE CONCEPT OF DENSITY: THE QUANTITATIVE COMPONENTS OF DENSITY MEASUREMENTS

A. BACKGROUND AND INTRODUCTION

Inconsistency in definition or application of density and its measures is common. When undertaking the study of density, one encounters frustration in the writings of those who have attempted holistic investigation of this term. This tendency results from an abundance of density-related definitions, connotations and measures.

In the literature, many studies are further complicated by the emotional and value-laden nature of the term's usage. Researchers have therefore found it necessary to define density and its measures as a prerequisite to any discussion of this unruly subject. This then, becomes the objective of this chapter. Density will be described in its general meaning, followed by the description of a system which categorizes measures commonly used in the planning and regulation of housing environments. This chapter is intended to provide a framework for the systematic organization of density knowledge.

A brief evaluation of the strengths and weaknesses of the various measurement techinques will be offered with the intent of determining what, if any, single or combination of measurements are best used to quantify density. As perceptions of density play an important role in determining how one approaches a discussion of density, a brief review and graphic description of a range of housing density types will

serve as an introduction to the Chapter IV discussion of the interrelationship between density and crowding.

B. THE GENERAL MEANING OF DENSITY

Urban planning has long concerned itself with the problem of establishing the relationship between number of people and the amount of land required to accommodate residents' housing needs.[1] To aid in the resolution of this problem, the concept of density is utilized as the basis of land use controls and standards which are implemented to achieve this goal. Webster's Third International Dictionary defines density as follows: "the average number of individuals or units per space unit".[2] In the literature, one can find many variations of this definition. However in general, density as used in planning, remains only a physical measurement or a ratio of some count of persons or accomodation divided by some measure of area.

C. A METHOD OF ORGANIZING DENSITY MEASUREMENTS

A useful study which addresses the measurement of density was published by Henry S. Churchill and William H. Ludlow in 1944, entitled Measuring Urban Population Densities.[3] This often overlooked study of

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[1]For a good overview of residential density see; Ministry of Housing and Local Government, The Density of Residential Areas (London, Eng.: Her Majesty's Stationary Office, 1952).

[2]Webster's Third International Dictionary (Springfield, Mass.: G. and C. Merriam Company, 1976).

[3]William H. Ludlow and Henry S. Churchill, "Measuring Urban Population Densities", Pencil Points 4th ed.. (June 1944): 87-101.

density measurement, is perhaps the most concise to be presented to date. Their approach is unique in that they recognize that most density measures may be classified into three distinct components: density in area terms, density in population terms, and density in bulk terms. Their categories serve as the basis for the following discussion.

Residential density is most often computed by dividing the number of persons or families or a measure of the bulk of a building by a specified area of land. However, problems often arise in defining the surface area being considered, the method of counting persons or families, or the measurement of the bulk of a building. For example, Borukhov explains there are, "several situations in which one measure of density will increase when another falls and vice versa",[4] based on different applications of these three components of density measurement.

1. The Surface Area Component of Density

One's attempt to measure density must begin by specifying the surface area which is to be applied to the computation. Woodbury[5] has observed that planners have used a range of surface areas when measuring density. These range from a space as small as the size of an individual room within a housing unit to as large as an entire city or metropolitan area. Again, when referring to these one must distinguish between

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[4]E. Borukhov, "The Trade-off Between Density and Other Objectives: A Re-examination of Planning Norms," Geojournal, Vol. 2.1 (1978): 74.

[5]Coleman Woodbury, ed., Urban Redevelopment: Problems and Practice (Chicago: The University of Chicago Press, 1953), pp. 105-120.

population density and residential density, both net and gross. A precise area definition is required for accurate density measurement. For simplification, the following area definitions as taken from Ludlow and Churchill will be presented in the order of successive decrease in the size of land area considered:

> "Urban Area: refers to all land within a single municipality, a large subdivision thereof, or a group of adjoining municipalities forming a metropolitan area. This can be further divided into sub areas such as Total urban area and Developed urban area.
>
> Residential Area: refers to residential sections of a metropolitan area, a single municipality or portion thereof at least large enough to support a school and reasonably wide variety of business facilities and public and private institutions. This can be further divided into Developed residential area and Predominantly residential area.
>
> Gross area: refers to the same as net area (as follows) except that public streets shall be included up to the center line of bounding streets. It must be noted that there are many ways in which to compute street measurements, another factor which serves to complicate density measurement.
>
> Net area: refers to all land used for dwellings and incidental services normally furnished on the dwelling lot and shall include; driveways, small storage garages, parking areas, play spaces for children. Excluded in this calculation are:
>
> 1. Industrial, railroad and airport properties.
> 2. City-wide business districts.
> 3. Large parks and parkways, cemeteries, golf courses and other recreational or institutional uses. Playgrounds in large parks however, may be allocated to the residential areas they serve.
> 4. Vacant land or land undeveloped for urban use.
> 5. Public streets.
> 6. Local business not directly beneath dwelling space.
> 7. Garage space for 3 or more cars not directly below dwelling space.
> 8. Public parks and playgrounds for older children."[6]
>
> (Note: Net area can also be referred to as Net site area.)

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[6]Ludlow and Churchill, p. 99-100.

Depending upon what one wants to achieve from the use of these various surface area descriptions, some can be found to be more precise measures than others. In most cases, however, their application depends largely upon the availability of the necessary data. Care must be taken to select the appropriate area to ensure density measurements which provide the intended information. To aid this process the two main types of surface measures of gross and net density are outlined.

a. Gross Density and Net Density Measurements:

Borukhov cautions that when one is attempting to analyze residential density, that, "one has to be careful not to confuse the various definitions".[7] It is therefore important to make a clear distinction between net and gross density. Borukhov explains that Net density refers to, "the net residential area (land covered by the buildings and private accessory uses; gardens, yards, parking areas, etc.) while Gross density refers to a larger or entire neighbourhood area (the net residential area plus the streets, sidewalks, public open spaces; public parks, playgrounds, parking areas, and areas occupied by public services such as schools)."[8]

A short description of gross and net density in British Columbia can be found in the Ministry of Municipal Affairs handbook, Residential Services and Site Planning Standards.

As described in this document:

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[7]E. Borukhov, pp. 71-80.

[8]Ibid., p. 73.

"a. Gross density is applied to the entire neighbourhood or a large part of it. It states the number of dwellings with respect to a land area which includes roads, parking, services, and non residential uses such as parks, recreation facilities, school sites, and local commercial development.

b. Net density usually refers to a group of dwellings within a neighbourhood, although in some cases, overall neighbourhood density will be stated in terms of net density. To determine net density, certain uses are excluded from the land area: arterial roads, major utility easements, parks, recreation facilities, school sites, and commercial development. The net density calculation will include collector, local and cul-de-sac roads, local parking serving residential uses, and small areas of public open space serving decoration or buffering functions."[9]

As can be seen in the preceding definitions, inconsistency often occurs. For example, Borukhov's net density is viewed only in neighborhood wide terms and does not refer to a group of dwellings within that neighborhood as in the second definition. However, both Borukhov's and Municipal Affair's definition in general terms agree on what physical considerations are to be included in the computation of net or gross density. One exception is that Borukhov excludes all streets from net density while Muncipal Affairs includes local streets in their computation.

There are variations within these two measures which distinguish

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[9]Associated Engineering Service Ltd., Residential Services and Site Planning Standards (Victoria, B.C.: The Ministry of Municipal Affairs, Government of British Columbia, 1980).

residential and population densities.[10] For example there are differences between, net population density and net residential density, or gross population density and gross residential density. Again, Borukhov offers a definition of gross or net residential and population density:

> "NET POPULATION DENSITY (N.P.D.): refers to the number of persons per unit of net residential land.
>
> GROSS POPULATION DENSITY (G.P.D.): refers to the number of persons per unit of gross residential land.
>
> NET RESIDENTIAL DENSITY (N.R.D.): refers to the number of dwelling units per unit of net residential land.
>
> GROSS RESIDENTIAL DENSITY (G.R.D.): refers to the number of dwelling units per unit of gross residential land."[11]

A further example of lack of consistency is made by Stuart Chapin when he attempts to delineate the various terms somewhat differently than has already been discussed. For example, Chapin differentiates between gross residential density and neighbourhood density. Under his definition, gross residential density refers to dwelling units per area of land used for residences and traversing streets, while neighbourhood density refers to dwelling units per area of land used for residences, local shopping, schools, public open spaces

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[10]Distinctions between different types of net density are explained in; George Woodford, et al., The Value of Standards for the External Residential Environment, British Department of the Environment (London: Her Majesty's Stationary Office, 1976), pp. 39-48; and in Philip Cooper, et al., New Towns: Analysis of Activities and Their Densities, Working Paper 73 (Cambridge, Mass., University of Cambridge Press, 1973), pp. 28-44.

[11]Borokhov, p. 74.

and streets.[12]

2. The Population Component of Density

a. The Person/Net Acre Measurement:

The most often used population component of a density measurement is expressed in terms of "persons" or "families". The use of "persons" is an efficient approach to density measurement because it can draw on data contained in the census. The measurement of persons per net acre is the most commonly used density measurement. It is used to indicate population in either established or planned neighbourhoods. It is also used in conjunction with related density measurements such as; rooms, dwelling units or floor area. There are two other density measurements that fall within the person component which are described below.

b. The Person or Family Capacity Measurement:

There are disadvantages to using persons as a density measurement. Person density can change without any effect on either buildings or the number of dwelling units, and is therefore difficult to apply at the planning or construction phase of a community when no population exists and when occupancy rates have to be assumed. This problem has been solved through the use of a surrogate measure, persons capacity.

Persons capacity can be applied to buildings at the planning

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[12]F. Stuart Chapin and Edward J. Kaiser, Urban Land Use Planning (Chicago: Universiy of Illinois Press, 1979), pp. 453-456.

stage or in partially built areas as an estimate of population. The only way in which this measure changes is through demolition of residential units. The estimation of person capacity varies dramatically for different income levels or types of families involved. Person capacity is defined as an estimate of a standard number of people per size of each dwelling unit; or for each bedroom; or for an average of the rooms within a dwelling unit. Care must be taken when basing person counts on room counts as these vary greatly in definition and measurement.

A second widely used unit of the population component is the family, and is the same as above with "family size" the population consideration. The problem encountered in using this measurement is that it is dependent on family size. Furthermore, family is not always equivalent to households or the number of occupied units. Whether or not to include single person families in the calculation also presents a problem.

c. **The Persons/Room Capacity Measurement:**

A third population component to be implemented as a measurement of density, is the measurement of persons per room. Persons per room is a useful tool in controlling crowding within dwelling units. It is computed by dividing the number of persons by the number of rooms within the dwelling unit. Again there are several variations; for example, rooms which are not used for sleeping have been left out of this ratio. Persons can also vary in this measurement with, in some cases, young

children counted as half persons or infants left out of the count all together. However, the use of persons per room serves no practical purpose in controlling crowding outside of housing units. Special care must be taken when using this measure due to the inconsistency in methods used to count persons and rooms.

Density has also been measured in terms of habitable room per acre and bedspaces per acre. These however are both ambiguous terms in practice and have the same problems encountered when using persons per room.

3. The Building Bulk Component of Density

The majority of land use controls which are presently used in North American cities to control density, focus on regulating the site coverage, height and floor space of residential buildings. These form the third major category of density measures identified by Ludlow and Churchill. It is acknowledged in the density literature that building bulk measures are relatively successful in ensuring the efficiency of land use as well as being sensitive to considerations of view preservation and access to daylight and sun light. This section investigates some of the pros and cons of the different measurements.

a. Cubic Density Measurement:

Three kinds of bulk density measurements are described in the literature. The more obscure is cubage or cubic density, based on the concept of three-dimensional space. Kevin Lynch defines cubage as

intensities per unit volume.[13] He rationalizes that man inhabits three-dimensional space, and therefore density measurements should conceptualize such space. Cubage as a bulk measurement of density, only appears in theoretical terms in the literature. Only very brief descriptions of its components and possible application exist. There is possible merit in further research and development of a practical cubage measurement. It also might prove effective in regulating for adequate light, open space, view presentation and become an effective tool for regulating the many innovative housing forms experienced at high density. There is no doubt that cubage would allow flexibility in building design which goes beyond that which is provided by commonly used, two-dimensional bulk measurements, such as FAR or FSR described below. In support of the development of a cubage measurement of density, Lynch suggests that, "in the future, as activity increases, and as technology weakens the connection of structures to the ground or makes possible three-dimensional circulation systems, we may turn to measures of cubic density."[14] Until such time, however, planners will continue to use such two-dimensional tools to regulate density.

b. **Floor Area Ratio (FAR) or Floor Space Ratio (FSR) Measurement:**

Floor area or space ratios, another category of bulk measurement of density, is the total floor area of a building divided by the net

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[13]Kevin Lynch, Site Planning (Cambridge, Mass.: The MIT Press, 1971), p. 32.

[14]Ibid, p. 33.

residential land area.[15] Ludlow describes FAR as, "the total area in square feet of all floors used for residential purposes including public halls, stairwalls and elevators serving the dwelling units. It does not include the floor area of basements not used for dwelling purposes, community rooms, and other non-residential space."[16]

The advantage of using this measure to regulate density is that it is easily computed for single buildings and small areas by dividing the gross residential floor space by the site area. The measures FAR and FSR are technically the same and will be used interchangeably in this section. The use of FSR, however, becomes more complicated when used to measure buildings with stores or other non-residential uses.

Furthermore, various high density housing forms yield the same measurement. For example, Ludlow states that, "an FAR of 1.8 could indicate a building which was three floors high with a net site coverage of sixty percent; or a building which was six floors high with thirty percent net site coverage; or a building twelve floors high with fifteen percent net site coverage."[17]

A problem inherent in the use of FAR or FSR as a development control is that it has little direct effect on the internal space of dwelling units. Floor space ratios make no provision for differences in either room or overall dwelling unit floor space. This is unfortunate

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[15]Borukhov, p. 74.

[16]Ludlow, p. 100.

[17]Ibid.

given that market forces encourage minimum room and dwelling sizes in a significant amount of current high density housing development.

Historically, floor space measurements of density were developed in British planning practice. Planners and architects have long recognized a relationship between density of people and the bulk of buildings. Paul Evans contends that floorspace is possibly the least ambiguous of the density measures and, "the one most directly linked with the geometric determinants of form."[18] The use of this measure has sometimes been extended to give an indication of the population to be accommodated in buildings, an application of questionable rationale.[19]

Although the floor space ratio measure is used as a density control, it is obviously more a building design control than a control of population density. It controls population density only by implication and is a poor surrogate when used in general discussions of density.

These criticisms have encouraged planners to modify floor space measures by incorporating person measurements into their density computations. For example, theorists have suggested expanding floor space ratios to incorporate minimum standards of floor space per person

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[18]Paul Evans, Housing Layout and Density (Cambridge: Cambridge University Press, 1973), pp. 9-21.

[19]Leslie Martin and Lionel March, Urban Space and Structures (Cambridge: Cambridge University Press, 1972), p. 33.

in a dwelling.[20]

In Evan's view, floor space ratios are effective for several reasons. First, they are relatively successful in ensuring a high level of efficiency of land use. Secondly, floor space ratios are successful in ensuring open space surrounding buildings by providing for view, access to sunlight and circulation of air.

It might be said that planners and architects have opted to use FAR or FSR largely for expediency. FSR allows the architect considerable latitude in design. Planners have adopted FSR because it has become a convenient means of regulating building bulk.

4. Confusion Between Density Measures

It can be suggested there is a lack of consistency in the literature on the meaning of commonly-used density terms. Stuart Chapin has made an attempt at delineating the various terms. Authors,such as Lewis Keeble,[21] have found it necessary to make distinctions between types of density. All of these works have attempted to develop better definitions of density by continuing to distinguish, label and meaningfully organize an increasing number of density measures. This approach has failed to achieve clarification and has generally resulted only in further confusion and ambiguity of the measures. Further investigation would reveal other labels of similar aspects of

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[20]Chapin and Kaiser, pp. 453-456.

[21]Other density types have been outlined in: Lewis Keeble, Principles and Practice of Town and Country Planning (London: The Estates Gazette Limited, 1969), pp. 252-266.

measurements of density.[22] This study will not seek to further elaborate on these sub-types here. Their existence, however, underscores and validates earlier statements in this thesis which suggested that these many definitions only serve to confuse rather than clarify the method of measuring density and the intended purpose of that measurement. The inconsistency of density measures and their

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[22]For example the following measures appear in the literature by Ludlow, pp. 108-111.

a. "Floor and room density, used to measure the degree of crowding and privacy within individual dwelling units, including both houses and apartments. The most frequently used measure is persons per room.

b. Lot density, used to indicate the adequacy of open space around and between buildings which affect light, air, privacy, noise and outdoor living space immediately adjacent to the dwelling.

c. Residential area density, defines the neighbourhood as the smallest area for making this type of density measurement and generally comprises the district served by at least one elementary school. The land use include, in addition to residences and streets, are commercial and community facilities that serve primarily the residents of that area, such as playgrounds, small parks, local stores, service establishments, churches and neighbourhood centres. High schools and colleges, hospitals and business or industries serving a large section of the city are commonly excluded. Such densities may be measured in terms of persons, or families per acre or per square inch. (Note: this measurement is similar to net residential density as described by other authors).

d. City-wide and metropolitan density, is usually made in terms of persons per square mile or per acre. It gives a general impression as to the relative degree of concentration of population and urban land uses. When stated in terms of acres per 100 or 1,000 persons, it can be broken down to indicate the relationship between population and the area of land use for specific purposes such as residence, commercial, industry, streets and other public and private uses. In measuring city-wide density, all underdeveloped vacant parcels and all parcels used primarily for farming are often excluded for some purposes, but included for others."[9] (Note: This measurement appears to be similar to the gross density type as described elsewhere).

interrelationships do in fact render the term density confusing in practical terms when applied to land use planning.

D. SUMMARY OF CHAPTER III

The preceding discussion has shown that residential density can pertain to several referents. Density is most often measured by internal density levels such as population ratios or by external density levels such as floor space ratios.

In person terms, density has been expressed in several ways. For example, density can be an actual or estimated count of the number of persons inhabiting either individual rooms within a dwelling unit or within the dwelling as a whole. Another type of person density refers to the number of residents within a defined surface residential area. In terms of using the housing unit as a surrogate measure of concentrations of human population several indexes are used to indicate density. Of these, a ratio of the number of dwelling units per acre, is the most widely used.

Those who use the term density should be aware of the various components of density, clearly understand the definition of each, be sensitive to the differences between the measures, take special care to select an appropriate measurement which achieves their specific needs, and apply that measurement in its proper context. The previous discussion might lead one to conclude that the problems encountered with use of density and its measures can result from a failure to do so.

CHAPTER IV

THE CONCEPT OF CROWDING: THE QUALITATIVE COMPONENTS OF HUMAN CROWDING CONSIDERATIONS

A. BACKGROUND AND INTRODUCTION

1. Implications of Crowding Theory On Density Planning

There are indications that present density controls have not been developed with systematic consideration for the possible harmful effects on humans inhabiting high density housing. It is hypothesized that such planning mechanisms can be improved through the application of existing human behavioral knowledge found in crowding research. There are several problems which must be solved, however, before such a combination of density practice and crowding theory can be operationalized.

Research on the possible effects of crowding on humans has been the focus of a massive volume of literature. For example, numerous academic disciplines and sub-disciplines have produced bodies of crowding literature with only rare instances of cross-disciplinary exchange of information. Environmentalists, biologists, psychologists, ethologists, physiologists, sociologists, anthropologists, geographers, architects and urban planners have studied crowding from countless perspectives. This has created information overload whereby the shear volume of crowding theory has perhaps resulted in little of this knowledge filtering down to the level of planning practice. In other words, the disorganized, multifaceted wealth of knowledge on crowding is too discipline-specific and complex for useful application.

There is a tendency for crowding research to be inconclusive in its findings, contradictory in nature, as well as difficult to apply to disciplines outside of the area of the original research.

Systematic organization and select use of substantiated crowding knowledge, however, promises to advance the planner's effectiveness in the area of high density planning. If the planner was enabled to become conversant with the knowledge of how humans react to high density environments and thereby supplement more technical density controls with this knowledge, effective improvements in high density planning might be realized. Such an approach will be a positive step towards providing healthy, fulfilling and comfortable housing environments at high density, as well as dispelling the popular belief that high density of any form must necessarily result in crowding.

2. Limitation of Crowding Studies

Crowding research in part follows from intuitive public concern for the adverse effects of crowded living conditions. Some of this concern stems from the sensationalized reporting of non-human (i.e. rat) behavior in crowded living conditions. Such studies have indicated such maladies as; infant mortality, increased aggression and a variety of sexual or social pathologies resulting from high density environments. This belief, coupled with environmentalists' warnings of impending shortages caused by increasing populations, have inspired many unpleasant scenarios about impending life under "crowded" conditions at high density.

Since the late 19th century, many scholars have harboured a belief that there is a relationship between density in housing environments and undesirable human behavior caused by crowding. This notion for example, was introduced by the British planner Sir Raymond Unwin in the 19th century. There can be little question that conditions of excessive density and poor design of that day did cause much human suffering. However, to correlate all of these problems with high density in the modern city is a superficial approach to this complex phenomenon.

The assumption that high density housing of any form results in crowded conditions, has fostered an anti-urban bias amongst many intellectuals.[1] In turn, many intellectuals have engaged in academic gymnastics designed to produce definitive proof of this belief. This kind of research has recently attracted strong criticism which questions the logic, conclusions and supporting evidence of non-human crowding research.

Commenting generally on crowding research, Claude Fischer et al. concludes that most findings are speculative in nature. In particular, he writes that all biological-ethological studies particularly based on non-human experiments, "have obtained little empirical support, for human reactions to density are much more a function of the social and architectural situation and of culture".[2]

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[1]M. White and L. White, "The American Intellectural Versus The American City", Daedalus (Winter, 1961): 166-179.

[2]Claude Fischer, Mark Baldassarc, and Richard Ofshe, Crowding Studies and Urban Life: A Critical Review (Chicago: University of Chicago Press, 1974), p. 19.

In his critical review of crowding studies, Fischer concluded that, "those who draw firm conclusions about density and human behavior are either speculating or making astounding leaps from flimsy evidence".[3] In particular, sensationalist research such as Calhoun's[4] now infamous caged rat experiments have done much to perpetuate the popular belief that crowding and density have proven serious negative effects on human behavior. Fischer is highly critical of Calhoun's findings which linked human behavior to rat behavior in over-populated pens. In Fischer's opinion, Calhoun's suggestion that high density and crowded human conditions may result in infant mortality, increased aggression and a variety of sexual and social pathologies can not be substantiated by present knowledge. Fischer believes that few if any clear consequences of density have been produced by the bulk of non-human crowding experiments.

Fischer has also found fault generally in present studies of humans under the condition of high density. Again as he points out, these studies fail to produce evidence of either negative or positive human consequences.[5] He suggests that the logical connection of the emperical level to the theoretical or substantive level of analysis is weak or non-existent in the majority of crowding studies. Specifically, Fisher explains, that often obvious procedures such as measuring density

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[3]Fischer et al., p. 21.

[4]John Calhoun, "Population density and social pathology", Scientific American, (No. 206, 1962): 139-148.

[5]Fischer et al., p. 42.

in units equivalent to the units in a study's theoretical propositions are ignored by the researcher. The absences of the logical examination of the relevance of research findings is common in the majority of crowding studies. This renders much of the existing research on crowding of dubious value. To improve future crowding research, Fischer recommends that:

> "Researchers and planners alike must attend, first, to their definition of density and crowding. They must know of what they speak and its relations to their problem, whether it be housing, neighbourhoods, or cities. Beyond that, it is important to have clearly thought out objectives and a theoretical perspective; loose analogies drawn from animal behavior will simply not do."[6]

Another work on crowding by Jonathan Freedman[7] supports Fischer's reservations and criticism of much of the crowding literature. Freedman's work on crowding in human environments produced two major findings relevant to this discussion. Briefly, Freedman found:

> "First, high density (crowding) does not have generally negative effects on humans. Overall, with other factors equated, living, working, or spending time for any reason under conditions of high density does not harm people. It <u>does not</u> produce any kind of physical, mental or social pathology. People who experience high density are just as healthy, happy and productive as those who experience lower density.
> Second, high density <u>does have</u> effects on people, but these effects depend on other factors in the situation. Under some circumstances high density makes people more competitive and aggressive, but under others it has the

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[6]Fischer et al. p. 42.

[7]Jonathan Freedman, <u>Crowding and Behavior</u> (San Francisco: W.H. Freeman and Company, 1975).

> opposite effect. High density can cause people to be friendlier and also less friendly. And under certain conditions, the reactions are different for men and women."[8]

Freedman eloquently summarizes present knowledge on crowding and human behavior making reference to many sources.

Fischer's and Freeman's reservation about crowding research have not been presented with the intention of discounting all such research. It is important however for those using this literature to be selective when applying the findings as a basis for proposed solutions to problems encountered in human environments. The researcher can select useful crowding knowledge by screening research for relevance and substantiation. As outlined later in this chapter, current human crowding literature can be organized under the categories of social/cultural, psychological and physiological aspects of human crowding considerations which later serve as part of the framework for relating crowding knowledge and density measures.

3. Scope of This Chapter

The following discussion, based on crowding literature which was selected from several disciplines, will emphasize human crowding studies only. As a means of limiting the scope of this chapter, three qualitative components of human crowding considerations will be emphasized based on the assumption that these categories encompass the major forces which influence the quality of life[9] experienced by

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[8]Freedman, pp. 7-8.

[9]See page 11 for definition.

residents of high density housing. The three components which represent subsystems of basic motivations of human behavior; social/cultural, psychological and physiological, build on Maslow's[10] preliminary framework of human needs. The qualitative components used in this chapter are adapted from the work of Talcott Parson[11] on the motivations of human behavior. Parson initially suggested that the basic motivations of human behavior are influenced and conditioned by a

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[10]A. Maslow, Motivation and Personality (New York: Harport & Row, 1954). Maslow developed the following framework of human needs which form a descending hierarchy from strongest to weakest:

1. Physiological Needs, such as hunger and thirst. Shelter may fulfill physiological needs, and in particular the quality of shelter is of great importance.

2. Safety Needs, which include, besides protection from physical harm, the opportunity to reduce psychic threats from others, to encourage personal privacy, and to promote self-orientation within the urban environment.

3. Affiliation Needs, such as love. This also includes the need for group membership which involves the urban designer in the difficult problem of producing designs which promote comfortable interpersonal interactions, and yet preserve privacy.

4. Esteem Needs, which relate to personal integrity (self-evalution) and the perceived esteem of others for oneself. The satisfaction of esteem needs is closely related to one's ability to personalize one's environment.

5. Actualization Needs, the need for self-fulfillment, according to one's capacities. This relates strongly to the individual's actual or perceived control of his environment.

6. Cognitive/Aesthetic Needs, relating to our personal concept of beauty and our need to learn.

[11]Talcott Parson, Societies (Englewood Cliffs, N.J.: Prentice-Hall, 1966), pp. 20-30.

variety of subsystems of behavior which encompass; physiological, social, cultural and personality subsystems as summarized below:

"1. Physiological Subsystem - Physiology clearly controls and limits human action. Our knowledge from past experience of these limitations strongly effects our activities. Important physiological constraints on human behavior are age, sex and somatic imperfections.

2. Cultural Subsystem - This refers to the values, norms, traditions and beliefs held by particular groups, and which color and constrain the individual's behavior. National, ethnic, and subethnic groupings are of importance here.

3. Social Subsystem - The process by which groups are held together within a particular culture clearly affects the roles which an individual plays within and without the group. In particular, one of the major determinants of a person's behavior may be the role he is expected to play within his particular learning, working or socialization group.

4. Personality Subsystem - This is the complex subsystem of predispositions to action, such as preferences, opinions and attitudes, which make each individual's covert reaction to an environmental stimulus unique, though his overt reaction may be constrained by physiology, social grouping and culture."[12]

For the purpose of this thesis, Parson's four subsystems have been recast into three qualitative components of human crowding considerations. The following discussion of these components is intended to summarize sufficient crowding knowledge and provide a basis from which to develop a conceptual framework for relating density measures and crowding in a more meaningful manner.

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[12]Societies (Englewood Cliffs, N.J., 1966), cited by Douglas Porteous, Environment and Behavior (Don Mills: Addison-Wesley Publishing Company, 1977), pp. 31-65.

B. THE GENERAL MEANING OF CROWDING

Crowding is a word of negative connotation. It is most often used in reference to undesirable human conditions found in congested housing environments.

"Crowding" is derivative of the word "crowd" which Webster's New Collegiate Dictionary defines as:

> "Noun - 1) a large number of persons especially when collected into a somewhat compact body without order,
> 2) a large number of things together.
>
> "Verb- 1) to fill by pressing or thronging together,
> 2) to press, force or thrust into a small space."[13]

"Crowded" is defined as; "as state of being filled with numerous things or people often overly compacted or concentrated."[14]

Use of the term crowding is common in the fields of sociology and psychology, including their many sub-disciplines. The definition of crowding in the context of human behavior in housing environments is more specific as demonstrated by J.A. Desor's definition. He defines "crowding" as: "an experiential or psychological state of mind of an individual involving a feeling of dissatisfaction or discomfort with the amount of space one has at his disposal."[15]

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[13] Webster's New Collegiate Dictionary (Toronto: Thomas Allen & Sons Ltd., 1977), p. 270.

[14] Ibid, p. 270.

[15] John A. Desor, "Toward a Psychological Theory of Crowding", Journal of Personality and Social Psychology (Vol. 21, 1972): 79-83.

Daniel Stokols agrees with this definition. He states that, "a state of crowding exists and is perceived as such by an individual, when the individual's demand for space exceeds the available supply of such space."[16] Stokols argues that crowding does not refer to a physical condition involving the limitations of space. Rather, crowding is a situation in which the restrictive aspects of limited space are perceived by the individuals exposed to them.[17] To Stokols, feeling crowded may be the consequence of population density mixed with personal characteristics such as; lifestyle, past experience with spacial limitations, all in interaction. In other words, whether an individual feels crowded depends on the level of population concentration combined with his personality and socialization. Stokols also suggests that crowding can be a motivational state, where under its influence an individual is directed toward easing the disparity between the preferred and actual environmental situation he inhabits.

Freedman,[18] however, explains that crowding can be conceived in either physical terms with lack of space being the only crucial element or in psychological terms with crowding conceptualized as an internal emotional state as defined by Stokols. Freedman points out that the

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[16]Daniel Stokols, "A Social-Psychological Model of Human Crowding Phenomena", The American Institute of Planners Journal (March 1972): p. 75.

[17]Daniel Stokols, "On the Distinction Between Density and Crowding: Some Implications for Future Research", Psychological Review (Vol. 79, No. 3, 1972): 275-277.

[18]Jonathan L. Freedman, Crowding and Behavior (San Francisco: W.H. Freeman and Company, 1975), pp. 10-15.

sensation of feeling crowded (or of experiencing crowding) is related to, but distinct from, the physical state of having little space. The sensation of feeling crowded does not always follow from, or coincide with, the physical situations. To Freedman, "the physical state has no inherent value one way or the other. It is neither good nor bad in itself. In contrast, the sensation of being crowded is almost by definition a negative one."[19] The crowding referent which Freedman emphasizes is the individual's response to the physical state which seems to parallel Desor's definition of crowding.

In summary, the major problem encountered when using the term crowding is to select the appropriate referent which is relevant to the situation under discussion. A general discussion such as this must therefore recognize crowding as both a physical state of lacking space and a psychological state resulting from lack of space.

C. PERCEPTIONS OF DENSITY

The perception of density is an essential aspect of any discussion of crowding and is viewed from two main perspectives, as described by Amos Rapoport.

1. Social Perceived Density

This is defined by Rapoport as follows:

> "...in terms of social interaction; here, perceived density involves various sensory modalities; or mechaisms for controlling interaction levels - spacing, physical elements, territorial boundaries, hierarchy, the size and nature of the group, its homogeneity, rules for behaviour

[19] Freedman, p. 10.

and how facilities available are used."[20]

In other words, social perceived density could be described as a subjective feeling of lack of space due to a high uncomfortable level of social interactions within that space. Perceived social density is closely related to notions of crowding, or the levels of interaction within an environment, and therefore will not be pursued further here, but rather later in this section.

2. Physical Perceived Density

Rapoport defined this aspect as follows:

> "...in spacial terms; where perceived density reflects one's impressions of the built environment - the height, spacing or juxtaposition of buildings. Here, perceived density results from high levels of such qualities as; a high degree of enclosure, intricacy of spaces, high levels of activity, many uses of space."[21]

One's perception of physical density can be influenced by the number of people in an area. More importantly, it is affected by the available land, space and the organization of built form on that land surface.

In his book, Design Guidelines for Creating Defensible Space,[22] Oscar Newman graphically displays a variety of housing forms at various

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[20]Amos Rapoport, "Toward a Redefinition of Density", Crowding in Real Environments, ed. Susan Saegert. (Beverly Hills: Sage Publications 1976), p. 8.

[21]Rapoport, p. 8.

[22]Figure III diagrams taken from Oscar Newman, Design Guidelines for Creating Defensible Space (Washington, D.C.: U.S. Government Printing Office, April 1976), pp. 61-64.

densities. These drawings have been reproduced in Figure III as a means of illustrating how one's perception of physical density can be influenced by the built form.

Newman has designed several popular housing forms on a one acre site to simplify comparisons. The density ranges from six units per acre in Figure 2.25 (single family detached) to one hundred three units per acre in Figure 2.36 (high-rise apartment) as shown in Figure I.

Many important considerations such as site coverage, height of buildings, ground orientation, views, building set backs, open space and sunlight have an effect upon how dense one perceives an environment or individual residential buildings to be. Perceived physical density is also influenced by one's understanding and belief of what is low and high density. It is further influenced by one's ability to visualize.

D. THE DENSITY-CROWDING RELATIONSHIP

Most informed researchers in the field of human behavior now take great care to distinguish between density and crowding. For example, Amos Rapoport differentiates the two terms as follows:

> "a) Density can be seen as a site measure, and crowding as a measure of density within a dwelling.
>
> b) Or density can be seen as a measure of people per unit area and crowding as a negative perception of excessive density - a subjective experience of sensory overload."[23] (Rapoport also shows confusion of

[23]Amos Rapoport, "Toward a Redefinition of Density", Crowding in Real Environments, ed. Susan Saegert. (London: Sage Publications Inc. 1975), pp. 7-8.

FIGURE III - PERCEPTIONS OF DENSITY

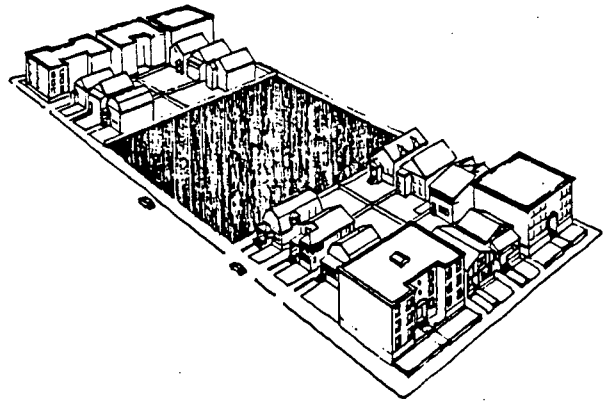


Figure 2.24: Typical city block, 200' X 600' showing a one-acre (218' X 200') vacant site in the center. Figures 2.25 through 2.36 show how the site could be developed in densities ranging from six to 103 dwelling units to the acre.

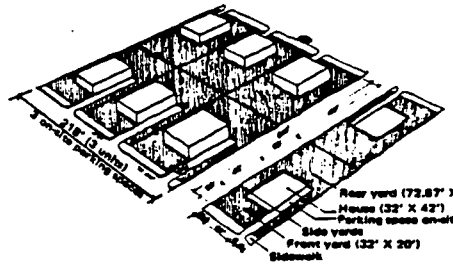


Figure 2.25: Detached houses, one story. Six units per acre.
- Detached houses on 1-acre site
- Site dimensions: 218' X 200' = 43,600 sq. ft.
- 3 units per side = 6 units per acre
- Typical interior unit dimension 30' X 40' = 1,200 sq. ft.
- 1,200 sq. ft. = 3-bedroom unit
- Parking: 6 on-site spaces

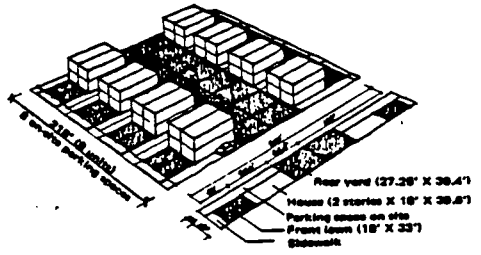


Figure 2.26: Two-story semidetached houses, 16 units per acre.
- Semidetached on 1-acre site
- Site dimensions: 218' X 200' = 43,600 sq. ft.
- 8 units per side = 16 units per acre
- Typical interior unit dimension: 17' X 37.6' X 2 stories = 1280 sq. ft.
- 1200 sq. ft. = 3-bedroom unit, + 40 sq. ft. of stairs per floor
- Parking: 16 on-site spaces

Figure 2.27: Two-story row houses, 18 units per acre.
- Row houses on 1-acre site
- Site dimensions: 217' X 200' = 43,400 sq. ft.
- 9 units per side = 18 units per acre
- Typical interior unit dimension: 23' X 26' X 2 stories = 1288 sq. ft.
- 1,200 sq. ft. = 3-bedroom unit, + 40 sq. ft. of stairs per floor
- Parking: 22 on street parking spaces

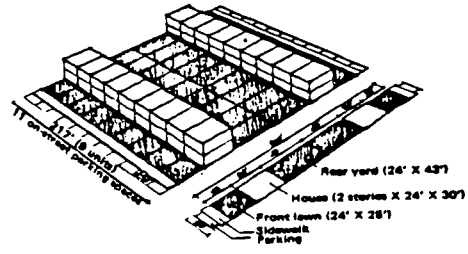


Figure 2.28: Two-story row houses, 24 units per acre.
- Row houses on 1-acre site
- Site dimensions: 217' X 200' = 43,400 sq. ft.
- 12 units per side = 24 units per acre
- Typical interior unit dimensions: 17' X 37.6' X 2 stories = 1280 sq. ft.
- 1200 sq. ft. = 3-bedroom unit, + 40 sq. ft. of stairs per floor
- Parking: 22 on-street parking spaces

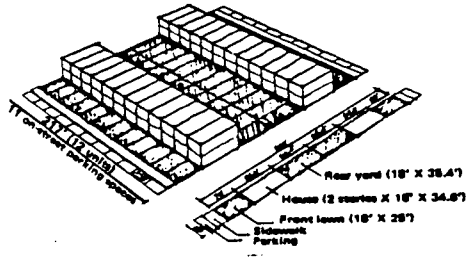


Figure 2.29: Three-story row houses on modified city block, 38 units per acre.
- Row houses on 1-acre site
- Site dimensions: 267' X 163' = 43,321 sq. ft.
- 19 units per side = 38 units per acre
- Typical interior unit dimensions: 13' X 34' X 3 stories = 1326 sq. ft.
- 1200 sq. ft. = 3-bedroom unit, + 40 sq. ft. of stairs per floor
- Parking: 13 spaces per side (on street), total = 26 spaces

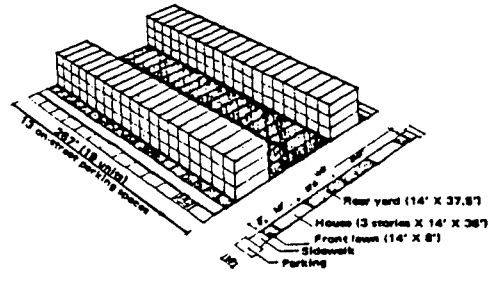


Figure 2.30: Garden apartments, 36 units per acre.
- Garden apartments on 1-acre site, 6 units per entry
- Site dimensions: 218' X 200' = 43,600 sq. ft.
- 18 units per side = 36 units per acre
- Typical interior unit dimensions: 29' X 41.4' = 1,202 sq. ft.
- 1,200 sq. ft. = 3-bedroom unit
- Parking: 10 spaces each side street = 20 spaces, + 16 spaces on interior of site, total = 36 spaces

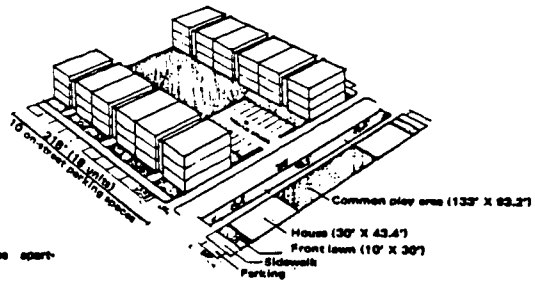


Figure 2.31: Medium high-rise apartments, 36 units per acre.
- Apartments on 1-acre site
- Site dimensions: 218' X 200' = 43,600 sq. ft.
- Six stories, six apartments per floor = 36-36 units per acre
- Typical interior unit areas (per floor): 2 apartments @ 1,200 sq. ft.; 4 apartments @ 1,280 sq. ft.
- 1,200 sq. ft. = 3-bedroom unit
- Parking: 44 on-site spaces

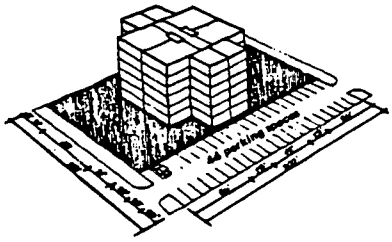
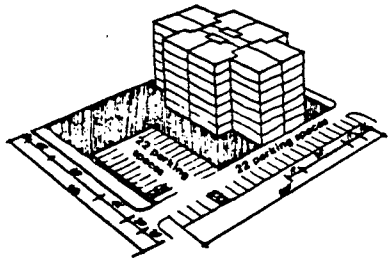


Figure 2.33: European walk-up, 56 units per acre.
- Walk-up apartments on 1-acre site
- Site dimensions: 218' X 200' = 43,600 sq. ft.
- 28 units per side = 56 units per acre
- Typical interior unit dimensions: 27.7' X 43.4' = 1,202 sq. ft.
- Typical interior unit dimensions, duplex: 13.35' X 46.0' X 2 stories = 1,282 sq. ft.
- 1,200 sq. ft. = 3-bedroom unit, + 40 sq. ft. stairs per floor for duplex
- Parking: 22 spaces per side (on street), total = 44 spaces



ments, 56 units per acre.
- Apartments on 1-acre site
- Site dimensions: 218' X 200' = 43,600 sq. ft.
- Seven stories, eight apartments per floor = 56-56 units per acre
- Typical interior unit areas (per floor): 4 apartments @ 1,202 sq. ft.; 4 apartments @ 1,227 sq. ft.
- 1,200 sq. ft. = 3-bedroom unit
- Parking: 44 on-site spaces

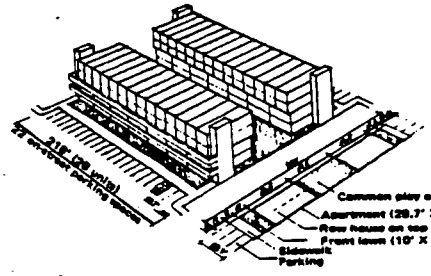


Figure 2.34: High-density walk-up, 72 units per acre.
- Walk-up apartments on 1-acre site
- Site dimensions: 218' X 200' = 43,600 sq. ft.
- 36 units per side = 72 units per acre
- Typical interior unit dimensions: 29' X 41.4' = 1,201 sq. ft.
- Typical interior unit dimensions, duplex: 29' X 22.2' X 2 stories = 1,288 sq. ft.
- 1,200 = 3-bedroom unit, + 40 sq. ft. stairs per floor
- Parking: 30 spaces on site + 20 spaces on street, total = 50 spaces

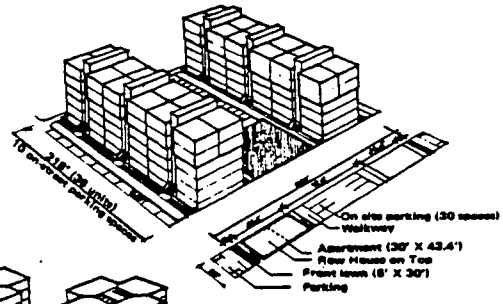


Figure 2.30: Twin-tower apartments, 94 units per acre.
- High-rise apartments on 1-acre site, two 12-story buildings
- Site dimensions: 218' X 200' = 43,600 sq. ft.
- 47 units per tower = 94 units per acre, 4 units per floor
- Typical interior unit dimensions: approx. 40' X 32' (unit actually 1194 sq. ft.)
- 1,200 sq. ft. = 3-bedroom unit
- Parking: 20 on-site spaces per side, total 40 spaces

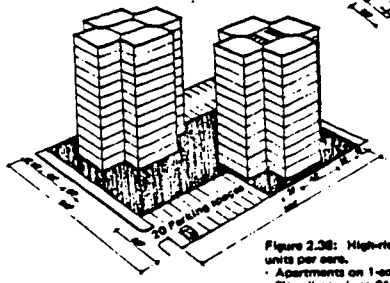
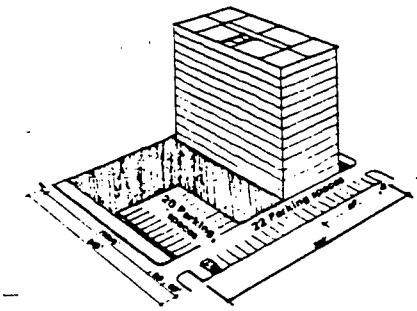


Figure 2.36: High-rise apartments, 103 units per acre.
- Apartments on 1-acre site
- Site dimensions 218' X 200' = 43,600
- 13 stories, 8 apartments per floor = 103 units per acre
- Typical interior unit dimensions: 4 apartments @ 33' X 36' = 1,188 sq. ft.; 2 apartments @ 25.5' X 47.3' = 1,211 sq. ft.; 2 apartments @ 31.5' X 38' = 1,197 sq. ft.
- 1,200 sq. ft. = 3-bedroom unit
- Parking: 42 on-site spaces



terms. In (a) where he improperly uses the term crowding he is actually refering to excessive internal density, (b) is therefore a more meaningful definition.

Rapoport agrees that density is clearly related to crowding, but in indirect ways. "Density" should be used to describe a physical condition without behavioral connotations. Crowding, on the other hand, is a much more complex term which refers to a subjective psychological response to a combination of weighted factors.[24] When an individual is exposed to limited space, the restrictive aspects of that limitation on his unique needs are perceived as feeling crowded.

Stokols identifies density as a necessary antecedent, rather than a sufficient condition for the experience of crowding. To Stokols, high density is not a sufficient condition for the arousal of crowding stress. He has found that for crowding to occur there must be a disruption in the individual's social relation with others he interacts with.[25]

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[24]This interpretation is endorsed by several writers; See William Michelson, Man and His Urban Environment (Don Mills: Addison-Wesley Publishing Company, 1976), pp. 152-156; Stan Zlutnick and Irwin Altman "Crowding and Human Behavior", Environment and Social Sciences, ed. Joachim Wohlwill (Washington, D.C.: American Psychological Association, 1972), pp. 72-87; Robert Mitchell, "Some Sociological Implications of High Density Housing", American Sociological Review, 36 (December 1971): 18-27.

[25]Daniel Stokols, "On the Distinction Between Density and Crowding: Some Implications for Future Research", Psychological Review (Vol. 79, No. 3, 1972): 275-277.

Proshansky et al.[26] concluded that an individual may feel crowded by others, which in turn restricts his freedom of choice. Clare Cooper expands this theme by noting that an instance of spatial limitation involves potential inconveniences such as the restriction of movement or the preclusion of privacy.[27] Desor found that when an individual perceives crowding he is "receiving excessive stimulation from social sources."[28]

All of the before-mentioned researchers have directed their attention to determining conditions under which density will affect human behavior and those factors which control the direction of that effect. For example, Schiffenbaur et al. suggest that, "density affects behavior only when the distribution of individuals in the environment interferes with the attainment of some valued goal."[29]

Density and crowding, individually and combined have a variety of complex variables and implications. An important explanation of the relationship between these two concepts was articulated by Day and

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[26]H.M. Proshansky, W.H. Ittelson and L.G. Rivlin, Environmental Psychology: Man and His Physical Setting (New York: Holt, Rinehart & Winston, 1970).

[27]Clare Cooper, "The House as Symbol", Design and Environment (Vol. 3, 1972): 30-37.

[28]Desor, pp. 79-83.

[29]Allen Schiffenbaur, Janet Brown, Pamela Perry, Louise Shulack and Alice Zanzola, "The Relationship Between Density and Crowding: Some Architectural Modifiers", Environmental and Behavior, Vol. 9, No. 1 (March 1977): 4-14.

Day.[30] Their findings recognize that there are different types of density and that each may have different effects on different people and on their behavior. This in turn influences the individual's perception of either physical or psychological crowding.

More research on the relationship between density and crowding will be required before the knowledge can be operationalized. This research should focus directly on human behavior and should avoid surrogate experimentation. An example of recent micro-level crowding research which might be applied by the planner was reported by Biderman et al.[31] In this study, crowding was determined to occur when an individual had less than ten square feet of living space per person. Although not in a fully developed state, this type of tested observation promises valuable new approaches which may be used to improve the planning and design of high density housing environments.

However, before such advances can be realized, those wishing to apply density and crowding knowledge must take a step backward from this type of micro-level discussion. The inconsistencies, contradictions and misinformation about the human consequences of density, or crowding, and their interrelationship necessitate a macro-level examination to clarify and focus current knowledge on these two important concepts. Such an updating of density and crowding knowledge should precede any attempt to

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[30] A.T. Day and L.M. Day, "Crossnational Comparisons of Population Density", Science, Vol. 181 (November 1973): 1016-1023.

[31] Historical Incidents of Extreme Overcrowding (Washington, D.C., 1963), cited by Douglas Porteous, Environment and Behavior (Don Mills: Addison-Wesley Publishing Company, 1977), p. 178.

operationalize this information in practical or micro-level terms.

It can be concluded from the previous discussion that the interrelationship between density and crowding is mainly described on a conceptual or intellectual level which may be confusing. Nevertheless it is possible to draw some practical inferences from this literature. In summary, the term density is most often used to refer to a site measurement or a physical space condition. To paraphrase the acknowledged authorities (Rapoport, Stokols), the individual must perceive* either the state of this density level as excessive because of lack of space and enclosed building design (physical perceived density) or the state of space inadequate because of excessive social interactions (social perceived density) for crowding to occur. However, these two conditions, although necessary,** alone are not sufficient to create crowding.

Other factors, or sufficient conditions*** must also be present; these factors result mainly from the impact of either the social or physical perceived density on the individual's human needs. Authorities

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*Perception is the process through which an individual becomes aware of his environment by organizing and interpreting the evidence of his senses in response to environmental stimulation. Imposed stimulation tends to create more reaction in the individual than stimulation which is sought. (Jerome Kagan and Ernest Havemann, Psychology, An Introduction, 4th ed. (New York: Harcourt Brace Jovanovich, Inc., 1980), p. 579).

**Necessary condition - a state of affairs that must prevail if another is to occur; prerequisite (Webster, p. 767).

***Sufficient condition - a state of affairs whose existence assures the existence of another state of affairs; requisite or desirable (Webster, p. 1164).

have identified that these disruptions, if sufficient, cause stress.* This tension, from either a physical state of excessive density or an emotional state of feeling lack of space, is the main reason individuals experience crowding. Therefore, a high density living environment does not necessarily lead to crowding unless there is a disruption of certain human needs creating stress, termed crowding-stress. In other words under a low density situation, if an individual experiences social or sensory disruption he would not necessarily perceive a feeling of crowding. There needs to be a situation of high density (necessary condition) for crowding to be experienced, but crowding will not occur in every high density situation unless there is disruption to the individual which creates stress (sufficient condition).

To further validate this analysis, Maslow's hierarchy of human needs (see page 74) indicates how human behavior can be affected by his environment. He suggests that the level in which these needs are met in turn influence the quality of life (see page 11) in that environment. Therefore in a high density environment, if various human needs are adequately met, the individual as a consequence is less likely to experience crowding and more likely to experience a satisfactory quality of life. Also Sundstroms' Interpersonal Model of Crowding (see Figure V) further validates such interrelationships between density and crowding.

The following Figure IV depicts these interrelationships as

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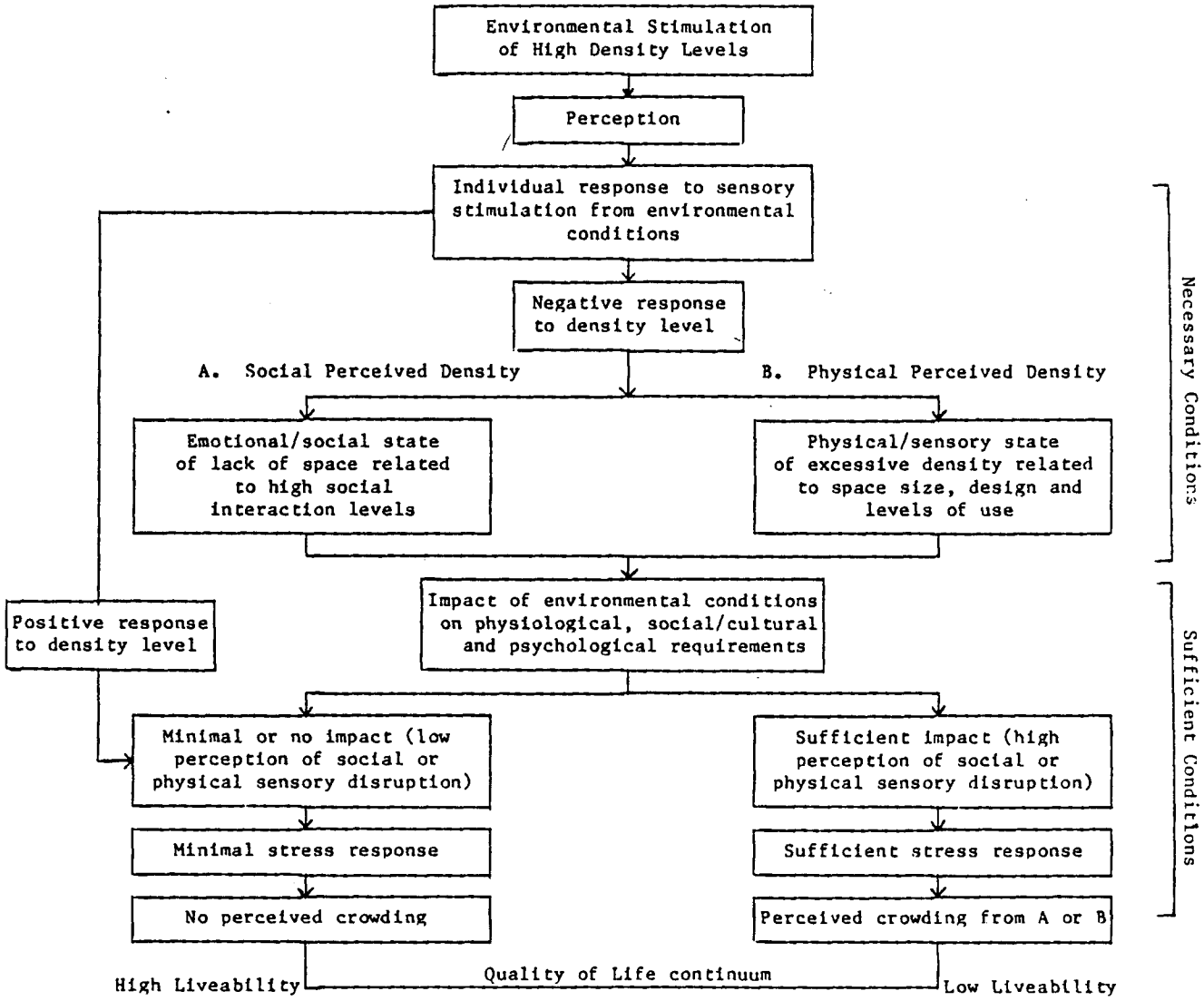
*Stress is the body's reaction to anything that threatens to damage the organism; the physiological wear and tear caused by attempting to adjust to events that cause emotional and other forms of reaction (Kagan and Havemann, pp. 411-412)

FIGURE IV: RELATING DENSITY AND CROWDING



discussed here, further clarifying their distinctions.

There are indications that human needs and stress response best explain the chain of events which interrelate density and crowding. As will be described further in this chapter, there are three main groupings of crowding considerations (physiological, psychological, social/cultural) each with unique requirements that, if adequately met, may reduce the individuals' negative reaction to high density environments. In examining these areas, the concept of crowding-related stress reoccurred; stress from excessive noise, lack of privacy, lack of open space, excessive physical density to list but a few. If a high density environment alone cannot create crowding, then perhaps it is the individuals negative stress response to the impact of this environment on his physiological, psychological and social/cultural requirements that is sufficient to create the experience of crowding.

In looking at the potential crowding-stress resulting from a disruption in physiological requirements, the literature indicates that certain environmental conditions have the greatest impact or influence - such things as noise, visual intrusion, size or occupancy level of rooms are examples of conditions which impact the physiological response and perhaps lead to crowding-stress. In looking at what environmental conditions might determine a psychologial-based crowding response, it was found that the duration of exposure, the individual's desire for social contact, and whether the dwelling is where a person spends a great deal of time are important conditions which might lead to crowding-stress. The impact of social/cultural factors on crowding stress is determined by such conditions as proximity of facilities/

services, ground orientation, private open space, noise levels as well as individual characteristics such as age, culture, education level, personal taste and past experience. In examining the three aspects of crowding considerations, it can be said that both the environmental conditions and its impact on human needs influence how the individual perceives his quality of life in a high density housing environment. Some of these factors would minimize the disruption and stress to the individual, while others would contribute to this crowding-stress. In any event, the level of crowding-stress seems to be a strong indicator of the level or range of liveability in a high density environment as depicted by the continuum in Figure IV.

From this analysis, it appears that the human needs, the stress response, and liveability are all key concepts when speaking of the density-crowding relationship. The degree to which individual requirements are disrupted by the social or physical perceived density is a factor in influencing perceptions of crowding. Ultimately the liveability of the particular environment seems determined by the outcome of this complex process as well. These conclusions have been developed here drawing on relevant literature in this field.

In conclusion, it is evident that density and crowding, though two distinct terms are intimately interrelated. It seems essential to also discuss crowding issues whenever one refers to density, particularly high density because of its potential for creating a perception of crowding. This discussion may further validate the need to pursue more indepth research on human crowding as well as to

formulate a method by which crowding considerations may more readily be incorporated with density controls so that environmental housing conditions which reduce this potential for crowding can be promoted. Ultimately this course of action promises to enhance the level of liveability in high density housing.

E. A METHOD OF ORGANIZING QUALITATIVE CROWDING CONSIDERATIONS

The following classification of antecedents of human crowding within the physiological, psychological and social/cultural categories are by necessity arbitrary. For example, stress which results from crowding is as much a social or psychological condition as it is physiological. The following overview is intended to highlight the key aspects and effects of crowding in housing environments.

1. Physiological Requirements

Extensive research on the impact housing environments can have on the physical health of humans has centered on notions of crowding. Documentation of the relationship between living conditions and human health, although far from complete, is sufficient to construct general "cause and effect" conclusions about crowding in housing environments. By building on principles of preventative medicine as developed in the health sciences,[32] urban designers and planners may achieve major advances toward improving high density housing.

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[32]See for example; Hendrik L. Blum, Planning For Health: Development and Application of Social Change Theory (New York: Human Sciences Press, 1974).

Several recent works describe the physiological effects of crowding found in housing environments.[33] These sources review related experimentation and report a wide range of findings. The following summary is based on the information found in these studies.

Human illness most often follows a long chain of social and physiological events. Human crowding has been linked to various types of ill-health such as communicable diseases, cholesterol level, infectious diseases and stress diseases. The strongest evidence indicates that human crowding contributes to a variety of stress diseases and overall health problems.

Given that one accepts a link between crowding and stress disease, the following stress related health disorders have been reported in adults. Stress which can result from several dimensions of crowding (neighbourhood or dwelling) can influence:

> "elevated blood pressure, urinary tract disorders, increased levels of thyroxine, cholesterol and hypertension. Psycho-social stress can influence the course of such illnesses as: tuberculosis, asthma and upper respiratory infections, hay fever, acne, peptic ulers, irritable colon, ulcerative colitis, stroke and aneurysm, rheumatoid arthritis. Infectious diseases may also result from stress due to anti-inflammatory adrenal steroids being secreted which permit the spread of infection in the body. Stress may also result in uterine dysfunction which can cause suppressed menstrational cycles, unusually painful periods and in extreme cases

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[33]Alan Booth, Urban Crowding and Its Consequences (New York: Praeger Publishers, 1976), pp. 44-72; Andrew Baum and Takov Epstein, Human Responses To Crowding (Hillsdale, N.J.: Lawrence Erlbaum Associates, 1978).

spontaneous abortions."[34]

It has also been suggested that crowded living conditions increase one's chance of contacting a variety of communicable disease. This is due to the high number of human contacts experienced in high density living conditions.

What are the physical environmental conditions which influence human physiological responses to crowding?

"i) Spatial Density in Rooms:
The size of rooms and the number of people in the room strongly influence levels of stress and perceptions of crowding. High spatial density produces discomfort and at least mild levels of stress at brief exposure.

ii) Noise and Heat:
Both have been identified as aversive, arousal-producing stimuli. Both may produce stress or intensify stress or intensify stress produced by other aversive conditions. Noise generated on a neighbourhood level from traffic, construction, industry or children play areas was found to influence stress levels at the same rate as noise which originated from within a building or dwelling unit. Prolonged exposure to a variety of noise sources can also impair hearing and sleep patterns. Clean air and ventilation are necessary controls for heat related stress levels.

iii) Visual Intrusion and Loss of Privacy:
Human health is closely related to one's sense of privacy and security. When one's internal or external living space is intruded on by others, a variety of physiological responses may occur such as increased levels of stress. Intrusion on one's personal space may also take the form of smells and odors which including obvious physiological health effects can increase stress.

iv) Lightness Versus Darkness:
Well lit or light coloured rooms tend to be perceived as larger than dark rooms. Thus poorly lit, dark coloured rooms can increase stress levels. Proper building orientation and view

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[34]Booth, pp. 44-47.

preservation aid in protecting natural light sources.

v) Complexity of Physical Surroundings:
Based on an "overload model", complicated and disorderly settings produce stress by creating demands on an individuals capacity to assimilate information; such settings produce greater stress levels than simple, orderly ones.

vi) Variations in Architecture:
Individual perceptions of crowding and stress levels are strongly influenced by building design. For example, higher stress levels were reported in people living in buildings with double-loaded corridors when compared to those living in buildings with entrance of two or three units arranged around common space or those with separate entrances.

vii) Partitions Within Rooms:
Partitioning of rooms enables a larger number of individuals to be comfortable by reducing the amount of social stimulation recieved by each individual which reduces stress by controlling demands on their capacities to process information and stimulation."[35]

2. Psychological Requirements

A continuing theme of crowding as a state of psychological stress which sometimes accompanies high population density links a vast amount of research produced by environmental psychologists.[36] This concept which was refined by writers like Irwin Altman[37] clearly accepts the principle of psychological mediation and the importance of the interplay of both personal and environmental variables in crowding

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[35]Eric Sundstrom, "Crowding as a Sequential Process: Review of Research on the Effects of Population Density on Humans", Human Response to Crowding, ed. Andrew Baum (Hillsdale, NJ.: Lawrence Erlbaum Associates, 1978), pp. 38-46.

[36]Here, environmental psychologists refers to a diverse group representing many different disciplines and theoretical perspectives.

[37]Irwin Altman, "Environmental Psychology and Social Psychology," Personality and Social Psychology Bulletin No. 2 (September 1976): 96-113.

research. This further validates the notion of necessary and sufficient conditions to crowding as depicted earlier in Figure IV.

Lazarus and Cohen[38] summarize this type of crowding research and point out that the new psychological approach to crowding is characteristic of a general shift in modern psychology which recognizes the importance of personality determinants of reaction and cognitive mediation. Briefly they found;

> "It has become clear that crowding is a psychological variable that has often been confused with a physical variable, high population density; this confusion is parallel to the concept of stress often used by sociologists, who have treated social strain, automatically as if it were experienced by the individual as psychological stress. Second, as research and theory on crowding has expanded, the analytical concepts employed have increasingly involved social, psychological and physiological mediation and mechanisms. Third, the outcome measures of crowding research have included the entire spectrum of stress - response measures at all levels of analysis including for example, social disorganization, short-term physiological changes, precursors of disease, disease of adaptation and mortality."[39]

Other authors have applied the knowledge of psychology to the study of crowding on human environments. For example, Perin investigated how concepts from behavioral sciences can bring a central concern for human behavior and development to environmental design and planning.[40] Amos Rapoport also has produced a comprehensive overview

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[38]Richard Lazarus and Judith Cohen, "Environmental Stress," in Human Behavior and Environment, eds. Irwin Altman and Joachim Wohlwill (New York: Plenus Press, 1976), pp. 89-119.

[39]Ibid., p. 116.

[40]Constance Perin, An Interdisciplinary Prospectus For Environmental Design (Cambridge, Massachusetts: The MIT Press, 1970).

of man-environment studies which as well organizes and applies a vast range of behavioral knowledge to planning and design.[41]

Psychological implications of crowding are far too complex and broad in scope to allow complete coverage here. However, with the aid of a model developed by Eric Sundstrom,[42] a basic understanding of the psychological underpinnings of crowding in human environments can be achieved.

The following model depicts crowding as a sequential process and serves as a means of organizing the findings of psychological crowding research. Sundstrom based this model on several assumptions:

"i) The various types of high density (i.e. the number of structures per acre, the number of dwellings per structure, the number of rooms per dwelling, the number of persons per room) do not necessarily produce aversive conditions that result in crowding.

ii) Effects of high density on individual experience are mediated by conditions that either accompany high density or are produced by it. In other words high density only indirectly produces stress.

iii) Psychological events that accompany crowding may include changes in attitudes toward other people (i.e., decreased attraction and changes in perception of others).

iv) Under some conditions, cognitive or perceptual processes of adaptation may diminish crowding. People may reduce crowding through coping or alteration of conditions through interpersonal behavior, task performance, or physical environment.

v) Negative after effects and cumulative effects of crowding may result from (a) stress, (b) the effort expended during coping, or (c)

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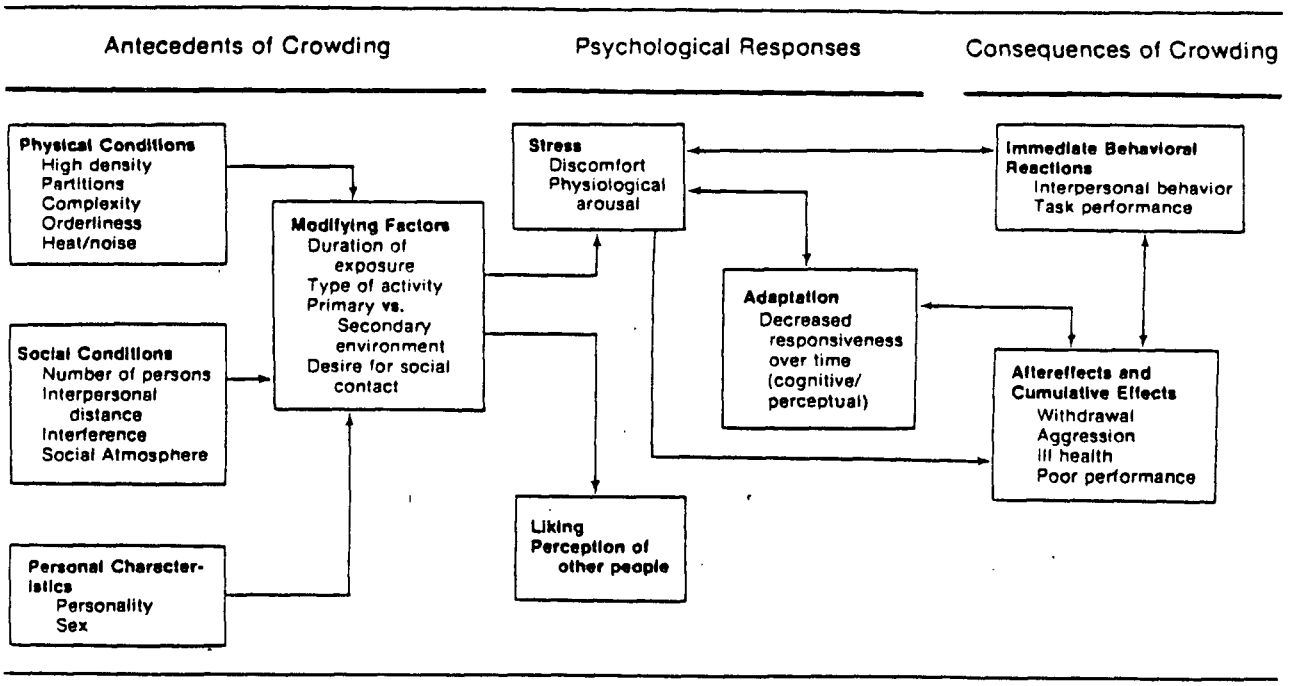
[41]See, Amos Rapoport, Human Aspects of Urban Form (New Yorks Pergamon Press, 1977).

[42]Eric Sundstrom, "Toward An Interpersonal Model of Crowding," Sociological Symposium No. 14 (1975): 129-144. Figure V on page 97 of this research comes from this source.

the effort spent in adaptation."[43]

FIGURE V - PSYCHOLOGICAL RESPONSE TO CROWDING



Sundstrom's model is divided three categories; (1) Antecedents of Crowding, which lists physical conditions such as size of room, noise and complexity of setting; social conditions such as the number of persons, interpersonal distance and social atmosphere; and personal characteristics such as sex, age and personality preferences or experience with crowded surroundings. In the model, these antecedents feed into modifying factors such as duration of exposure and primary versus secondary environment. Controlling for these modifiers the model lists; (2) Psychological Responses to Crowding such as stress,

[43]Sundstrom, 1978, p. 35.

adaptation and altered attitudes toward other people. The model recognizes other behavioral responses such as changes in task performance and interpersonal behavior and reduced interpersonal interaction.

Perhaps the greatest contribution Sundstrom's model makes is in the area of the final category; (3) Consequences of Crowding. Here he distinguishes three levels of psychological reaction to crowding, immediate behavioral reaction, cumulative effects and after effects, all of which may include changes in health or performance levels that arise after exposure to crowded conditions. Sundstrom's article applies this model while categorizing and reviewing relevant source material which need not be reproduced here.

A continuing problem one faces when attempting to define crowding is the, "specification of conditions that lead to stress in high density living conditions."[44] Although not intended to imply that crowding stress always occurs at high density, the following list of psychological factors are presented to outline the kind information planners should be aware of when planning for high density.

What are the environmental conditions which impact the human psychological responses to crowding?

"i) Duration of Exposure:
An individual may tolerate a brief exposure to conditions of high density such as a ride on a crowded bus, but prolonged exposure may increase the likelihood of crowding. Crowding is also influenced by an individual's advance knowledge of the duration of exposure. Even prolonged high density conditions can be tolerable if a person knows how

[44]Sundstrom, 1978, p. 33.

long they will continue.

ii) Predictability:
Research on stress suggests that aversive conditions are more stressful when they are unpredictable.

iii) Current desire for social stimulation:
A person sometimes needs solitude and at other times desires intense social interaction, depending on recent experience and personality characteristics that derive from past experience. A person who has recently been isolated may have a temporarily elevated threshold for crowding. Someone raised in a crowded household may establish a high adaptation level for social stimulation and may prefer relatively crowded quarters.

iv) Primary versus secondary environment:
Primary environments are places where a person spends large amounts of time, related to others on a personal basis, and performs personally important activities (i.e., homes, apartments and places of work). When overload or thwarting occurs in these settings, they pose a greater threat to "psychological security" than in other settings. Therefore, crowding in primary environments is expected to be more intense and difficult to resolve than in secondary environments where a person spends little time and relates to others on an impersonal basis. By this reasoning, crowding in dwellings is more difficult to resolve than crowding produced by high neighborhood density.

v) Perceived origin of interpersonal events:
If interference and thwarting by other people is personal (eminating from a single person, deliberate, and personally directed), crowding is experienced as being more intense than in response to neutral thwarting. Similarly, a violation of norms of interpersonal distance may be more stressful if it appears intentional and not due to the physical constraints present in a situation."[45]

3. Social/Cultural Requirements

Human behavior is strongly influenced by society, social institution and social relationships. The individual's personal history and culture also affect how one reacts to one's surroundings. To examine the human consequences of crowding in a relevant manner, a combination of social and cultural factors which influence behavior must be weighed.

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[45]Sundstrom, 1978, pp. 33-34.

This section deals briefly with the study of how social systems and culture have been applied from crowding research. Although social and cultural factors could each warrant separate investigation, their parallel use here and in sociological literature minimizes the duplication of available sources, thus permitting a more concise reporting of their importance to the study of human environments.

As pointed out by Susan Saegert, the significance of these two factors in understanding human environments reflect a general claim by sociologists, "that the nature of society itself and the bonds amongst its members are pervasively affected by the density of its population concentration."[46]

a. Social Factors:

Sociological literature reveals many factors which are important to crowding phenomena. From a sociological perspective, the individual's response to crowding is strongly influenced by age, sex and lifestyle. Other factors such as personal resources, personality type or position in the social structure are examples of further possible factors. Social units such as the family or neighborhood come into play in one's response to crowding. Considerations such as homogeneity[47] of a population have also been noted to influence perception of crowding.

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[46]Susan Saegert, "High Density Environments: Their Personals and Social Consequences," in Human Responses to Crowding, ed. Andrew Baum and Yakov Epstein (Hillsdale, N.J.: Lawrence Erlbaum Associates, 1978), pp. 257-281.

[47]"Homogeneity" refers to the degree to which an individual is similar to those around him in terms of ethnicity, race, life style, or other characteristics.

In short, sociology has presented broad evidence of factors associated with the relationship of selected aspects of the physical environment to particular social characteristics and activities of people. The volume of this material rules out a comprehensive survey here. In its place however, one can utilize secondary sources which have condensed and applied such research in an endeavor to draw conclusions about social behavior in living environments, for example, a collection of essays on social ecology by Moos and Insel.[48] Also, books by Baum and Epstein,[49], Freedman,[50] and Douglas Porteous[51] can serve as additional information sources. However, the source most applicable for the purposes of this study is William Michelson's 1976 edition of Man and His Urban Environment: A Sociological Approach.[52] Backed by his depth of sociological knowledge, Michelson has listed tentative conclusions about the social environment which are relevent to this discussion and will be reproduced here.

What are the physical environmental conditions which can

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[48]Rudolf H. Moos and Paul M. Insel, ed. Issues In Social Ecology: Human Milrius (Palo Alto, Calif.: National Press Books, 1974).

[49]Baum and Epstein, 1978.

[50]Freedman, 1975.

[51]Douglas J. Porteous, Environment and Behavior: Planning and Everyday Urban Life (Don Mills: Addison-Wesley Publishing Company, 1977).

[52]William Michelson, Man and His Urban Environment: A Sociological Approach, 2nd ed. (Don Mills: Addison-Wesley Publishing Company, 1976).

influence human social responses to crowding?

"1. Intense, frequent association with a wide range of relatives thrives in areas in which many people have easy physical access to each other, while the same people find that this style of life diminishes involuntarily in areas of low density.

2. An emphasis on the nuclear family and its joint activities is most congruent with the access of people to each other and to various activities now provided by the typical housing, open space, and land use patterns of the suburbs.

3. Active, traditionally masculine pastimes are part of home life only when the environment is structured so as to minimize the impingement of neighbors on each other.

4. Specialized interests which require co-enthusiasts are difficult to satisfy in low density areas. Adaptive behavior, often expressed in terms of kaffee klatching or organizational participation, is essential for those whose lives have previously included other people and activity but who are suddenly relatively isolated.

5. People with "cosmopolitan" life styles desire more physical separation from neighbors and place less emphasis on proximity to facilities and services than do people whose interests are "local".

6. Direct access to the outside maximizes control in child raising under conventional parent-child relationships.

7. Self-contained housing units minimize parent fostering of children's inhibitions.

8. Adults, before and after raising children (as well as those who are childless) frequently rate centrality (i.e., access to consumer goods and services) more highly than do families with growing children.

9. The aged find greatest satisfaction in a concentration of like-aged people, particularly when they have "local" life styles and previously lived in noncohesive neighborhoods.

10. Accessibility to lively activity is also beneficial for older people.

11. The percentage of income that people will spend on good quality housing varies primarily according to their education.

12. People in different socio-economic classes have different conceptions of housing adequacy.

13. Completely random placement of working class residents among middle class neighbors results in the isolation of the former rather than in any intended, positive result.

14. Although current usages and images of the city are restricted by personal resources, no significant differences in the preferred form of homes, neighborhoods, and cities have been shown related to social class differences.

15. National and cultural values frequently transform the type and the use of urban spaces in any place.

16. People who highly value convenience are likely to prefer more mixed land uses and small lot sizes. People who highly value individualism prefer larger lot sizes.

17. People evaluate housing with different yardsticks, according to the type of housing.

18. People associate private open space with active family pursuits regardless of the size of the space.

19. Housing condition leads directly to social and physical pathologies only when it is desperately inadequate. Marginal improvements in housing condition have been found markedly related to few expected benefits, the most pronounced of which is a shorter duration for children's illnesses.

20. High neighborhood densities seem more related to social pathologies than crowding within dwelling units, but its effect is mediated by personal and cultural factors.

21. High noise levels are related to the incidence of diseases that involve tension.

22. Lack of ability to meet people in a place where contact can become meaningful (such as can now be found in certain types of apartment buildings) is related to an increased incidence of reported medical problems, possibly reflecting induced introversion.

23. A forced change of residence induces a psychiatric syndrome more direct than most other behavior responses to environment. This is particularly acute among people whose cultural or occupational traits (or both) are different from middle class norms.

24. Spatial proximity, often based on the position and outlook of doors, may determine interaction patterns, but it normally occurs only under conditions of real or perceived homogeneity in the population and where there is a need for mutual aid, which is in many instances caused by population turnover in situation where residents themselves cope with repairs and like problems."[53]

b. Cultural Factors:

The influence one's cultural background has on the individual's use of space and physical environments was first proposed by E.T. Hall in the widely cited book The Hidden Dimension[54]. Building on his earlier observations Hall later developed a proxemics framework[55] which will be described here as a model to describe how culture influences behavior and response to crowding in living environments. Hall defines proxemics as, "the interrelated observations and theories of man's use of space as a specialized elaboration of culture."[56] Hall's work has two separate focuses, (1) hypotheses about spatial zones used in social interactions and (2) observations and hypotheses concerning space usage in different cultures. This discussion addresses the second focus.

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[53]Michelson, pp. 193-195.

[54]Edward T. Hall, The Hidden Dimension (New York: Doubleday & Company, Inc., 1966).

[55]Edward T. Hall, Handbook Of Proxemics Research (Washington, D.C.: Society for the Anthropology of Visual Communication, 1974).

The task of condensing Hall's extensive research has been undertaken by Altman and Vinsel.[57] Hall's findings might be best described by an example taken from this source. Briefly, Hall takes an anthropological approach of observation to determine cultural norms and values which are reflected in the use of space and reaction to environments. The deduction is made that furniture arrangements, home design, distance and orientation between people vary with cultural values. Altman and Vinsel cite the example of differences in contact and non-contact cultures:

> "Hall portrayed Arabic societies as highly sensory, with people interacting at very close quarters: nose to nose, breathing in one another's face, touching and the like. Such immediacy contrasts with practices in so called non-contact cultures, for example, northern Europeans, who presumably are more reserved in their communications."[58]

A limited amount of research now exists on the spatial behavior and requirements of ethnic groups from which the planner can begin to select data to aid in incorporating cultural considerations into high density planning. Altman and Vinsel's article supplies on extensive bibliography which documents some of these sources.

Although several lines of research have outlined specific ethnic or cultural factors of spatial behavior, these findings in their present state, are insufficient to provide general planning direction. For example, studies have focused on Arabic, Northern European, Latin American and ethnic groups in the United States (blacks and whites) but

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[57]Irwin Altman and Anne M. Vinsel, "Personal Space: An Analysis of E.T. Hall's Proxemics Framework" in Human Behavior and Environment, ed. Irwin Altman and Joachim Wohlwill (New York: Plenum Press, 1978): 181-259.

[58]Ibid, p. 241.

are not refined sufficiently and do not include a large enough sample of ethnic groups to enable the planner to apply this knowledge toward physical planning in the multi-cultural context of Canadian society.

However, Hall's theorizing on cultural differences in spatial behavior and response to crowding promises to focus future research to provide the cultural data necessary for worthwhile application to planning for high density environments. Present knowledge does, however, validate Hall's observation that culture is a key factor in human responses to environments. Cultural differences and responses to crowding are important factors to consider in the planning of high density environments.

F. SUMMARY OF CHAPTER IV

The intent of this chapter has been to present an overview of the current status of crowding knowledge as it relates to planning for high density housing. The focus was to clearly define and describe the qualitative component which relates to crowding, its causes and its effects on humans. The qualitative component was divided into three classifications of human crowding conditions; 1) the physiological, 2) the psychological, and 3) the social/cultural. As indicated in the following chapter, these categories combined with the three quantitative components of density measures comprise the major considerations of the proposed conceptual framework.

The close interrelationship between density and crowding is evident from this chapter, and further illustrates the need for the systematic incorporation of the density-crowding relationship in planning approaches for the regulation of high density housing environments.

CHAPTER V

THE INCORPORATION OF CROWDING CONSIDERATIONS AND DENSITY MEASURES

A. INTRODUCTION AND BACKGROUND

The objective of this chapter is to combine knowledge from the preceding chapters in order to develop a conceptual framework which depicts the density-crowding relationship in a planning context. This framework might assist the planner to more systmatically incorporate crowding considerations into his decision-making in conjunction with technical density measures. The framework as proposed here outlines a process through which the density-crowding relationship might be used to suggest planning implications for high density housing.

The strategy of developing such a guide for density-crowding controls is valuable for another, more academic, reason; that of serving as a necessary link between theory and practise, knowledge and actions. If one assumes that an awareness of current theory is useful in that it expands one's viewpoint and increases one's ability to interpret or problem-solve, then the question becomes, how can theory be made useful and practical to planning? This research hopes to answer this challenge by suggesting a conceptual framework that may both narrow the gap between theory and practise and serve as a guide towards more sensitive high density housing environments.

Other objectives for developing a conceptual framework are that; it may provide consistency in applying the theory involved, it may provide an informed basis for decision-making and it may clarify the

interrelationships involved. In addition a conceptual framework can be adaptable to the evolution of knowledge regarding density and crowding. Therefore, it may prove a useful tool to provide continuity in advancing more sensitive high residential density planning by offering a theoretical basis for the planner's interpretations and actions.

The proposed conceptual framework is designed to be adaptable so that it may complement current density control mechanisms or serve as criteria for developing new density-crowding controls. It would be an impossible task to describe criteria for all possible planning situations, nor would this be a desireable goal. Rather, the framework which is designed to be adaptable might apply to a range of situations. Also its particular focus on the residents' quality of life in high density environments is timely. The conceptual framework can serve as a basis to organize knowledge from recent and future theoretical advances in density and crowding research.

A matrix is used because it is flexible, and may be applied in a variety of complex planning situations. This approach may be more responsive to innovative high density designs than a rigid code of quantitative density measures. Again it must be emphasized that this framework is not meant to replace current density controls, but rather to serve as a guide in the application of both density and crowding theory in the design and control of high density developments.

A case can be made for putting the current crowding knowledge into a matrix format from an urban planning perspective. A conceptual framework which may help the planner to interpret, refine, or supplement

current, mainly quantitative density measures, with crowding considerations may be an effective planning approach, and may provide a system which can better deal with the many high density planning concerns on a more individual basis. For example, ensuring quality of life cannot be left to chance through the current use of quantitative density measures such as floor space ratios. The inclusion of human requirements into density controls may be more systematic if planning is provided with a useable framework which represents both the technical measures of density and human aspects of crowding. As well, the framework may be utilized to critique or evaluate the effectiveness of current density measures and controls in addressing crowding considerations.

B. A CONCEPTUAL FRAMEWORK FOR INCORPORATING DENSITY MEASURES WITH CROWDING CONSIDERATIONS

1. Development of the Framework

The conceptual framework in itself is not the end product of this study. Rather, it is the density-crowding knowledge collected in the previous chapters which is the important consideration. The framework is nothing more than a concise means of organizing and operationalizing this vast amount of knowledge. It should be noted that the density and crowding chapters were both organized to correspond with the format of the framework. In particular, the three components of density measures and the three components of crowding considerations

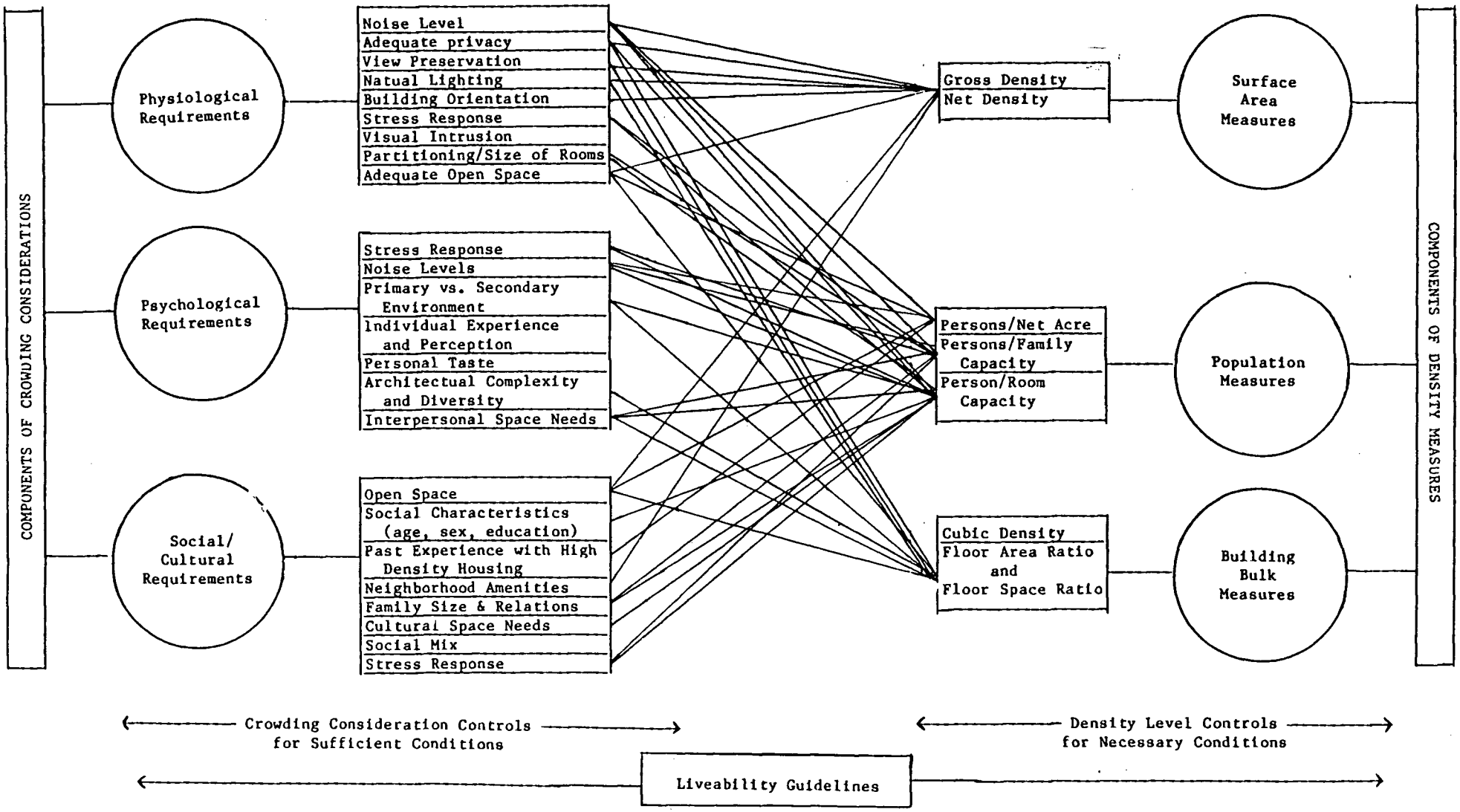
comprise the major matrix headings. The following discussion and figures suggest how one might "fill-in" the nine boxes which appear in the conceptual framework in order to hypothesize possible planning implications of the density-crowding relationship.

The framework is intended as a broad guide for the organization of the density-crowding relationship knowledge from this research. Its purpose is to outline a process by which the planner might comprehend and apply this knowledge in a more meaningful way. No new knowledge is generated by the development of this conceptual framework, rather the discussion in this chapter is intended to serve as a "road map" which may show how to combine density-crowding knowledge as well as identify some of the resultant planning implications.

Prior to presenting the framework, it may be useful to first draw some correlations between the three general crowding components as outlined in Chapter IV with the three types of density measures described in Chapter III. As based on this research, a description is suggested of the potential connecting elements between density and crowding and how they relate to the density-crowding relationship as shown by Figure VI.

The purpose of Figure VI is to graphically identify some of the apparent connecting elements or the linkages between the factors related to the sufficient conditions of crowding as shown on the left and the measures of the necessary conditions of crowding as shown on the right side. Organizing a large amount of information, the headings of the chart correspond with sections of the text of this study. Through a

FIGURE VI - POTENTIAL CONNECTING ELEMENTS OF THE DENSITY-CROWDING RELATIONSHIP



process of referring back to the appropriate section of the text, one can reach some conclusions as to whether or not a relationship between a specific crowding consideration and a specific density measurment can be suggested. Although the correlations between specific crowding concerns and density measures are not large, there is nevertheless enough inferrable information to permit some generalization which produce the connecting lines in this figure. It does not mean that the crowding consideration will adequately be prevented if the connecting density measures are adopted. Rather, by using the particular density measure, which seem more promising, such as the population measures, the connecting crowding considerations might better be systematically ensured in the housing environment though the development control process.

To understand further how the figure relates to the density-crowding relationship, a brief explanation is necessary. Crowding was created by the existence of both necessary and sufficient conditions. The high density level is the necessary condition for crowding. The density measures on the right of the figure serve to quantify this necessary condition. It is apparent from this figure that the population measures have the most potential connecting elements. If implemented as density controls however, these measures can only indirectly have positive impact. For example by setting up the necessary environmental condition in a way more conducive to human needs, disruption of those needs might be avoided and ultimately this prevents the existence of the sufficient condition to crowding.

The sufficient conditions are represented by the human crowding requirements on the left of the figure. In addition to density measures which have an indirect impact on these, separate controls might be necessary to ensure their consideration to a degree which prevents crowding-stress. Therefore as the figure depicts, it may be necessary to have two sets of high density controls. The set related to the measurement of high density could be termed density level controls and would be used primarily to control the necessary environmental conditions that influence crowding. The second set, called crowding consideration controls, would be necessary to control the environmental conditions that are sufficient to disrupt human needs and result in crowding. Since both conditions are needed for crowding to occur, it would follow that some type of planning mechanism is necessary to control both conditions adequately. Also since the presence or absence of crowding is an indicator of the liveability of the environment, both sets of controls would constitute comprehensive guidelines for liveability.

Two problems arise from connecting density measures with crowding considerations as in Figure VI. Firstly, the diagram reveals that no linkages can be found from several of the crowding considerations and the various density measures. Secondly, the linkages which have been identified have mainly been inferred from the literature so that they may not be as reliable and consistent as desired. Therefore, even if one chose to use the population measures as development control this would not be adequate to prevent both the sufficient and the necessary conditions to crowding. From this analysis

it would appear there is a need for controls directly aimed at human needs because density measures, at best, can only be applied as indirect controls. The sufficient environmental conditions must be controlled along with the necessary conditions if crowding is to be prevented. As the figure shows some density measures can indirectly control some of the environmental conditions that could negatively impact human needs. However there seem to be other environmental conditions that can not be addressed by density measures at all. These conditions must also be controlled because they can also have sufficient negative impacts on human needs to result in crowding, thus the need for two sets of high density housing controls.

Figure VI can serve as an outline to apply the density-crowding knowledge documented by this study. The information indicated by this figure is further refined and presented in Figures VII-IX which follow. These figures are developed as a way of explaining some of the planning implications which result from the density-crowding relationship at a more specific level. Each figure outlines the planning implications which become evident when one compares a particular crowding component with the various density measures.

2. Planning Implications of the Density-Crowding Relationship

Figure VI raises two important questions: (1) How can the most promising density measures be implemented to be more sensitive to human needs? and (2) What kind of controls are needed to address both the necessary and sufficient conditions to crowding?

With these questions in mind, the following Figures VII-IX have been developed to outline some of the planning implications which arise. An assessment is made on how a specific density measure fits into the density-crowding relationship. For example, does it influence the environment either negatively or positively, and does it cause or reduce a crowding-stress response? If the density measurement is not determined to significantly influence crowding considerations, then the planning process must center on the sufficient conditions to crowding which involves focusing on the human requirements at high density.

The purpose of these charts is to outline which crowding considerations, if any, can be influenced directly or indirectly by the measures of the three density types. Again, some of the measures can not be directly linked to specific crowding considerations for several reasons. First, their basic nature is such that no meaningful association can be made. Also the measurement may not be defined in theory well enough to base a sound judgement. These are inferred relationships only, but they are useful to suggest possible directions for the application on the density-crowding relationships in the planning field.

3. Description of the Conceptual Framework

Figures VII - IX have given some specific planning implications of the density-crowding relationship. Sensitive use of the various density measures might reduce some of the environment conditions that negatively impact the various human needs. It was also suggested

FIGURE VII: INCORPORATION OF DENSITY MEASURES WITH PHYSIOLOGICAL CROWDING CONSIDERATIONS

Types of Density Measures	Planning Implications
A. Surface Area Components	
1. Gross Density of a Neighborhood	Noise control, adequate privacy, view preservation, natural lighting and building orientation are the key considerations here; limiting gross density may indirectly control for each and thus meet these needs. As gross density also included neighborhood amenities, it has more flexibility than net in decreasing crowding perceptions and stress levels from the external environment.
2. Net Density of a Neighborhood	Generally same as above, except that neighborhood considerations are excluded. Manipulating net density may possibly address the key considerations as identified above.
B. Population Components	
1. Persons per net acre	Again, noise control, and adequate privacy are key considerations. By limiting neighbourhood density through this measure, many physiological crowding responses can be reduced. Potentially a highly effective measure for controlling a limited range of crowding concerns.
2. Person/Family Capacity	The size of rooms and the number of people in the rooms influences levels of stress and perceptions of crowding. Both have been identified as influencing physiological crowding. Visual intrusion, loss of privacy and partitioning of rooms are key points.
3. Persons/Room Capacity	Internal living space, noise control, and privacy can all be controlled indirectly by this measure. It appears that this measure can directly affect physical perceived density.
C. Building Bulk Components	
1. Cubic Density	This measure has not yet been described and tested in enough detail to operationalize its use here.
2. Floor Area Ratio (FAR) Floor Space Ratio (FSR)	View preservation, open space, privacy, sun light are key considerations. This measure directly influences all of these and therefore can be said to directly address physiological crowding considerations. Most importantly, this measure determines variations in architecture--a key factor of perceptions in crowding.

FIGURE VIII: INCORPORATION OF DENSITY MEASURES WITH PSYCHOLOGICAL CROWDING CONSIDERATIONS

Types of Density Measures	Planning Implications
A. Surface Area Components	
1. Gross Density of a Neighborhood	The key considerations here are the individual's past experience with high density, his adaptation process, and personal stress response. It is difficult to draw direct relationships between gross density and the level of crowding experienced as the person adapts to densities to a level he personally finds tolerable.
2. Net Density of a Neighborhood	The same as above in general terms. No readily apparent methods of controlling for psychological crowding through this measure have been drawn from this study.
B. Population Components	
1. Persons Per Net Acre	The key considerations are the individual adaptation process and interpersonal behavior. Personal characteristics of age, sex become mediating factors. This measure affects secondary environments and therefore can be used to resolve crowding concerns which result from high neighbourhood density levels.
2. Person/Family Capacity	Group behavior patterns tend to obscure the application of this measure. Psychological crowding considerations do not clearly relate to this type of density measure.
3. Persons/Room Capacity	This measure influences primary environments - places where a person spends large amounts of time. Psychological crowding in this type of environment poses major concerns in terms of the human quality of life and requires some form of control. Internal living environments are closely associated with key psychological crowding considerations.
C. Building Bulk Components	
1. Cubic Density	This measure has not yet been developed and applied in enough detail to allow meaningful appraisal here.
2. Floor Area Ratio (FAR) Floor Space Ratio (FSR)	This measure can not be easily related to influencing key psychological crowding considerations in its present state. Key psychological crowding considerations are; architectural complexity, interpersonal distance, primary vs. secondary environment. Human adaptation process greatly influence this form of crowding.

FIGURE IX: INCORPORATION OF DENSITY MEASURES WITH SOCIAL/CULTURAL CROWDING CONSIDERATIONS

Types of Density Measures	Planning Implications
A. Surface Area Components	
1. Gross Density of a Neighborhood	Ethnic groupings, the family, neighbourhood identity, and the need for open space are the key crowding considerations here. These concerns should be considered when measuring gross density in development controls.
2. Net Density of a Neighborhood	The differences in land area from the above density measure causes this measure to be less effective in controlling for social/cultural crowding considerations than is gross neighborhood density.
B. Population Components	
1. Persons Per Net Acre	Personal history of age, sex, past experience with high residential density, socialization, and family relations are key social crowding considerations. Additional cultural crowding factors combine with the social considerations to increase resident perceptions of crowding at high residential density. High residential density development controls could be improved by incorporating social/cultural crowding controls.
2. Person/Family Capacity	This density measure's effectiveness as a high density development control, might be improved when used in conjunction to social/cultural crowding considerations.
3. Persons/Room Capacity	This density measure, when enforced, directly controls several social/cultural crowding considerations at high residential density, such as personal space needs.
C. Building Bulk Components	
1. Cubic Density	This density measure has not yet been described in planning theory and tested sufficiently to make an informed judgement at this time.
2. Floor Area Ratio (FAR) Floor Space Ratio (FSR)	These measures' relationship to social/cultural crowding considerations are difficult to define, given present knowledge. When these measures are the only development controls implemented to regulate high residential density, it is questionable that these measures impact social/cultural crowding considerations.

that additional mechanisms which more directly influence the human response to the density level might be necessary as well. In this end, a conceptual framework is proposed to indicate how greater liveability could be acheived at high density.

It is now appropriate to present the conceptual framework which depicts, in the form of a matrix, the density and crowding taxonomies. This matrix appears in Figure X and has been "inspired" by the matrix of density measures used by Maurice Kilbridge et al. in a density study entitled Urban Analysis.[1] His matrix however generated too many indices for useful application by the planner. Perhaps this is the reason it has not been developed in greater detail by other scholars. (See Appendix II)

The two axes of the conceptual framework in Figure X consist of three components of density measures and the three crowding components as described in Chapter III and IV. The crowding considerations, as described in Chapter IV, includes: psychological; social/cultural; and physiological requirements. The density measurements, as described in Chapter III, consists of : the surface area; the population; and the building bulk measures. These six sub-components provide the matrix framework. It would be useful at this point to review the density-crowding relationship and relate it more closely to the framework. The high density level, as represented by its measurement, is the necessary condition to crowding. Depending on how the individual perceives this condition he may respond positively or negatively. A

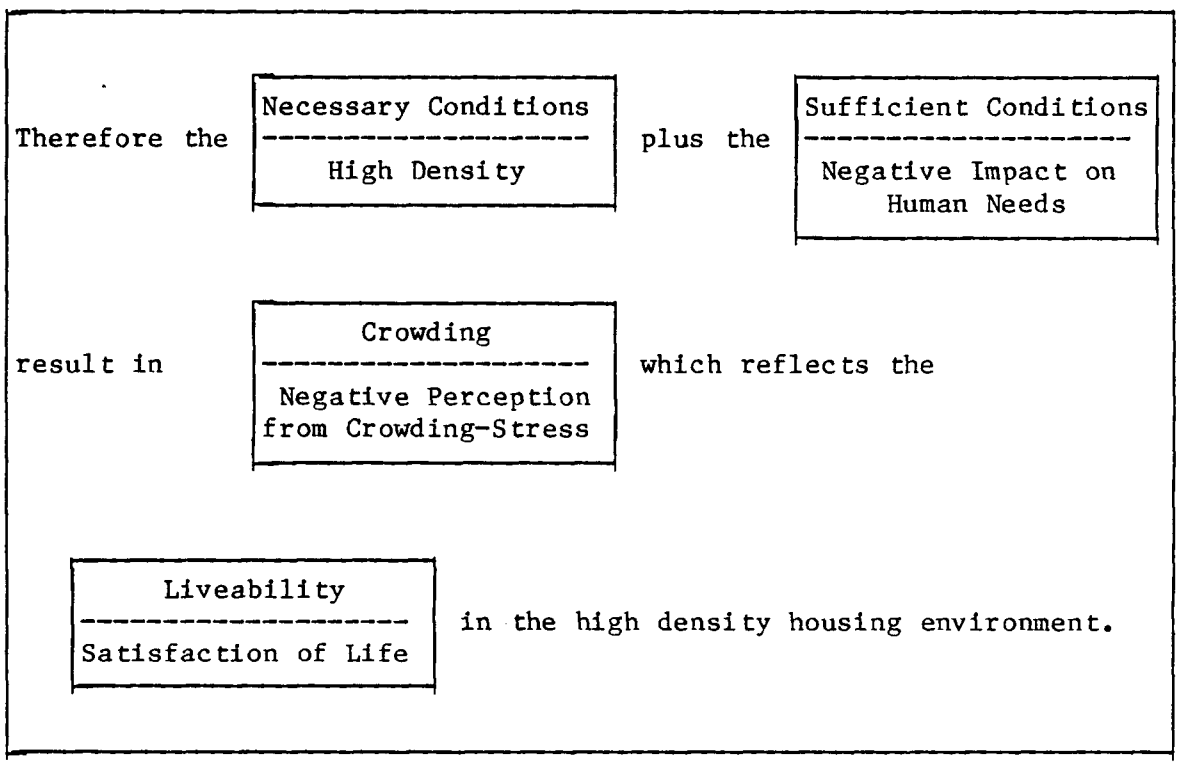
[1]Maurice D. Kilberidge, Robert P. O'Block and Paul V. Teplitz, Urban Analysis (Boston, Mass.: Harvard University Press, 1970), p. 47.

negative response usually is a result of two conditions: one of excessive social interactions (social perceived density) and one of excessive uses of available space (physical perceived density). If these necessary conditions in turn disrupt the three aspects of human needs to a large enough degree, a sufficient condition to crowding can occur. In this instance the individual would experience stress from his need disruption which would culminate in an overall negative perception of the high density environment. The combination of both the necessary conditions and the sufficient conditions concludes into a crowding experience.

To summarize: the necessary conditions related to high density (existence of social or physical perceived density) plus the sufficient conditions (sufficient impact of the environment on human requirements) result in crowding (negative perception from crowding-stress) which reflects the liveability (satisfaction of life) of the high density housing environment.

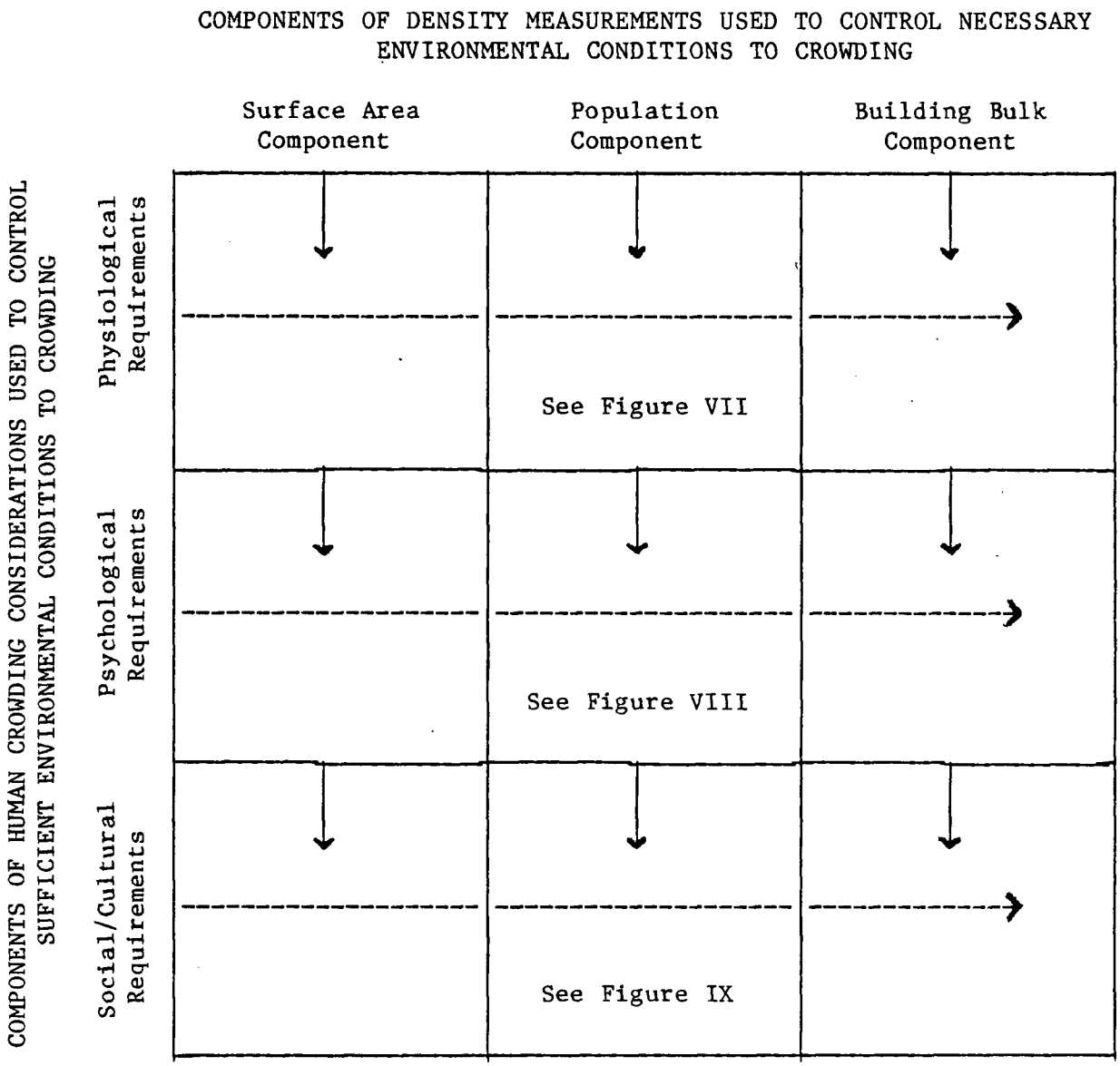
One can conclude from this process that in order to prevent crowding in a comprehensive approach, both the necessary conditions and the sufficient conditions should be considered. Planning intervention directed only at controlling the density level is inadequate. It is the disruption of human needs that ultimately determines if crowding will occur, and those planning interventions which address human crowding consideration are also necessary. Although the density measures have some impact on liveability as evidenced by the connecting elements in Figure VI, they alone appear insufficient to ensure that both the

necessary and sufficient environmental conditions which create crowding-stress are prevented, and that the environmental conditions which positively fulfill human requirements at high density are encouraged. The purpose of this framework is to reflect this process so that the knowledge and planning intervention required to positively intervene in it can be conceptualized. The text of this thesis and the planning implications suggested earlier are what operationalize this framework. It does not provide the answers, rather it suggests the direction to take in finding the answers. It is proposed as a tool to up-date planning thought on the issue of high density housing.



In looking at Figure X there are two main ways one may approach the framework. One might start by considering a particular density

FIGURE X: A CONCEPTUAL FRAMEWORK FOR INCORPORATING DENSITY MEASURES WITH CROWDING CONSIDERATIONS



measure in one of the density components (i.e. FSR in the building bulk component). The first step would be to understand completely what FSR means and how it works to measure density and control the related necessary environment condition. The second step would be to move down the column and carefully consider how FSR might impact each of the three groups of crowding considerations. For example, one could question whether the FSR measurement can be used to control any environmental condition that would have a negative impact on human needs. As the earlier linkage chart demonstrate there appears to be few linkages that can be made with any success. So then one has to take a third, yet crucial, step and consider each of the three crowding components in the context of the density measure in question. In this step one must determine what additional approaches are necessary to control the environment so that it positively addresses the human requirements which make a high density environment liveable. In the case of using FSR, it directly can be used to control the density qualities of an environment, but it indirectly has little influence on ensuring that many of the human needs are not negatively impacted. To better ensure that these sufficient conditions to crowding are also controlled, one must incorporate into the planning process consideration for environmental conditions that relate to each of the three crowding components. To continue with the FSR example, it indirectly addresses view preservation and open space, but it does little to address noise control and interpersonal space needs. Because these are also important environmental conditions that prevent crowding, some additional crowding

controls to the FSR density control may be necessary. In this way, both the necessary and sufficient condition to crowding are addressed in the planning process.

The other main approach one may take to apply the framework is to first choose one of the crowding components, get a good grasp of all the human requirements related to it, and then look across at all three types of density measures to see which ones are most appropriate. To make this determination one would decide how each density component might control environmental conditions that could negatively impact the human requirements in question. One might decide that use of more than one density measure is best to prevent necessary conditions to crowding in relation to the crowding component in question. Although one would still need to also consider more direct crowding controls to prevent sufficient crowding conditions this process would at least set the stage by first controlling the necessary conditions as much as possible. If nothing else, this process might serve as a cross-reference to ensure all considerations of the environment have been taken into account.

To further acheive understanding of how the framework can be used as a planning guide, a scenario regarding noise control has been developed. This description appears in Appendix I. Noise control was chosen as it is one of the most crucial considerations in preventing crowding-stress. It is hoped this scenario might illustrate the problem-solving process necessary to acheive an environment more sensitive to human needs.

Regardless of which approach is taken to the framework, the

underlying principle is the same. By addressing density as well as crowding controls, both the necessary and sufficient conditions to crowding can better be prevented. The desired outcome of application of this framework is more systematic consideration for liveability in high density housing.

In conclusion, it might be suggested that the conceptual framework in this study, given further development, will prove viable for use in problem analysis, research design, policy-making and conceptual organization of existing density and crowding knowledge. These four tasks may be readily implemented through the use of this framework, and prove to be a useful addition to the field of high density planning.

C. SUMMARY OF CHAPTER V

Chapter I of this study identified two main problems regarding current high density planning - lack of understanding of what density means and how it related to crowding; and lack of a human element in density controls necessary to make such housing more liveable. This chapter has attempted to apply the knowledge that addressed these two concerns in Chapter III and IV.

This chapter presented possible planning implications for density controls that takes into consideration the density-crowding relationship. It suggested the need for two sets of high density housing controls. One set would be primarily density controls that prevented the necessary environmental conditions to crowding. The other

set would be crowding controls that would prevent the sufficient environmental conditions to crowding. The first would prevent as much as possible the states of either social percieved or physical perceived density in the individual. The second would prevent a negative impact of that environment on specific human requirements so that crowding-stress would not result. Both sets of controls, though interrelated somewhat, are necessary to provide a comprehensive approach for ensuring greater liveability in high density housing. To this end a conceptual framework was proposed.

This chapter offers the challenge of applying the density-crowding relationship in the field of planning. As only a few of the planning implications of this framework can be described in the scope of this study, it provides a general guide of how to apply density and crowding knowledge. The framework would be best utilized when one has a specific high density housing development in mind. The context in which one applies knowledge to the framework will be a large determinant of its success.

CHAPTER VI

SUMMARY AND CONCLUSIONS

A. SUMMARY OF RESEARCH FINDINGS

The scope of this research covers many perspectives regarding density, crowding, their unique relationship, and the resultant planning implications. To achieve this end an overall goal with specific related objectives was identified in Chapter I. By way of summary it may be useful to reproduce the purpose of this research here and briefly address how each objective was achieved. Also some general implications to the field of planning will be presented in the following section of this chapter.

Chapter I indicated that the purpose was to organize density and crowding knowledge in the form of a conceptual framework from which a more sensitive approach to high density housing planning could be drawn. This framework was proposed in Chapter V but not before considerable preparatory research was completed in the preceding chapters. For example Chapter II explored the history of density thought so that an understanding of planning theorists might put current density thought (including that of this research) into some perspective. Particular attention was given to the contributions of Le Corbusier and Jane Jacobs.

Chapter III was devoted to the study of density - what it means and how it is measured. The taxonomy of density measures with three main types was presented so that it may serve as a common language and

understanding of their role in high density planning.

Chapter IV concerned itself with describing what crowding meant. It also organized a taxonomy of three aspects of human requirements in high density environments. As well the interrelationship between crowding and density was explored so that a better understanding of its implication to high density housing planning might be gained. It was found that the level of liveability achieved in high density housing is largely dependent on how the density level impacts human needs. If the individual feels his needs are disrupted by a high density environment he will likely feel more stressed and likely attribute it to negative perception of crowding. These were important findings in understanding the density-crowding relationship and its potential use as an indicator of the liveability of a given high density housing environment.

Chapter V subsequently operationalized into planning implications the density-crowding relationship. It proposed a conceptual framework which might assist the planner to more systematically incorporate crowding considerations into high density controls in conjunction with technical density measures. Some planning implications for more sensitive development controls were offered. The ultimate goal of this framework was to provide a process, not a rigid formula, for the planning of more liveable high density housing in our modern cities.

This study recognizes that the proposed framework is not fully developed, nor could it be fully operationalized within the scope of

this research. However, the framework has proven to be sufficiently refined to indicate the possible application of density measures and crowding considerations in high density development control situations. Appendix I describes a short case example regarding environmental noise experienced at high density and indicates how the density and crowding knowledge might be applied to real life planning problems experienced at high density.

In summary, this research addressed three problems relating to density usage (1) it provided a definition of density and an exploration of its various measures; (2) it clarified the difference and interrelationship between density and crowding; and (3) it explored a system for addressing human needs in high density housing planning with more sensitivity to quality of life criteria.

B. PLANNING IMPLICATIONS OF THE RESEARCH

This research has uncovered several main findings that might influence the planning of high density housing, particularly in three areas: the implications regarding density usage, regarding crowding considerations, and regarding their interrelationship. Some of these planning implications are listed below followed by a brief discussion of the apparent strengths and weaknesses of the Conceptual Framework for Incorporating Crowding Considerations with Density Measures.

1. The Density Implications

(a) It is futile to use density measures alone to attempt to regulate crowding concerns; they seem to be inadequate for the task of improving liveability.

(b) Of the three components of density measures, the population measures indicate the most potential in addressing some of the physiological, psychological, and social/cultural crowding considerations.

(c) The density measures related to the surface area and building bulk components seem to have some, but less potential than population measures, in controlling the impact of a high density environment on human needs which subsequently influences crowding perceptions.

(d) It is necessary to first obtain a common language and understanding of density and its measures; this alone may correct some of the current problems related to density usage; also it is essential to distinguish between density and crowding when planning high density housing environments.

(e) High density is more satisfactory when it provides diversity of building form, lifestyle, amenities and services which ensure freedom of choice.

(f) High density does not necessarily lead to crowding; other factors must be present.

(g) Control of internal densities (people within a dwelling) is more important in preventing crowding than external densities (dwellings on the land).

(h) Though inadequate alone, arbitrary numbers and measures are needed to serve as "rules of thumb" in controlling

pre-conditions in a high density environment. For example:

a population measure of less than 1.5 persons/room will prevent conditions related to crowding; another source cites 7.50 m^2 per person as an ideal habitable space.

- FSR measures can effectively ensure efficient land use, view preservation and ground orientation.

(i) Acceptable density levels is a function of personal taste to the individual as well as public acceptance which varies over time.

2. The Crowding Implications

(a) Crowding is an essential concept in high density housing planning; not all high density environments create crowding. Only when the individual feels stress from a disruption of his needs does he experience crowding at high density. It is crucial that planners clearly understand how crowding differs from density. Knowledge about the human stress response and adaptation will assist in this task.

(b) The liveability of high density housing seems to be a function of the crowding response. Less crowding, and a higher level of of liveability, occurs when specific human requirements are satisfactorily maintained in high density environments.

(c) These human requirements are made up of three components: social/cultural, physiological, and psychological. More literature exists on the latter component, but all three should be considered for comprehensive sensitive planning to reduce the impact of high density on its residents.

(d) Poverty and poor quality construction seem to be important factors in creating crowding. There appears to be a correlation between the cost/quality of construction and the success of high density housing. Also families with small children are not suitable for high density in most cases.

(e) Individuals with previous positive exposure to high density have greater adaptation abilities and less stress response. Those that have had a negative experience tend to adapt less readily to future high density situations.

(f) Specific aspects of human needs that seems to greatly prevent crowding are: 1) noise control, 2) privacy, 3) open space/sunlight both on the ground (i.e. parks) and in each dwelling (i.e. large garden patios) and 4) adequate internal space. There are indications that these considerations have the most impact in reducing crowding-stress and ultimately improving liveability in high density housing environments. Good building design and quality of construction are also very important. Ideas such as large balconies, concrete construction,

single-loaded corridors, diverse but not overly complex design, well-lighted and light colored rooms and preservation of views to the outdoors might be useful.

3. **The Density-Crowding Relationship Implications**

(a) There seems to be a need for two related but distinct sets of high density planning controls. Just as density and crowding are distinct but related terms, so it follows about the planning implications associated with each. A high density environment, which is a necessary antecedent to crowding, can be somewhat controlled with arbitary physical density measures. However, just as high density alone cannot cause crowding; density measures alone cannot control for crowding. Therefore one must also clearly focus on the sufficient antecedents to crowding - that is the environmental conditions that impact the human needs to a level that it causes crowding-stress. These must also be addressed so that crowding is prevented. In order to prevent crowding and improve the liveability of high density housing, one must address both its necessary and its sufficient antecedents. Two sets of planning controls - one addressing density levels through density measures, and one addressing the impact of the density levels on human crowding considerations - are necessary to truly improve the liveability of high density housing. Therefore

all high density housing controls might be called liveability guidelines consisting of both density level controls and crowding consideration controls.

(b) There are suggestions that the density level of an environment is less an issue than how the individual feels impacted by that environment. As this perception is an integral part of crowding-stress, it follows that controlling for crowding considerations may be the key factor in planning liveable high density housing. The main issue seems to be how to plan, design and construct the development so that it adequately meets conditions that reduce how crowded "it feels".

(c) It is crucial to both understand and acknowledge the role of the density-crowding relationship in high density planning if it is to have an impact on creating sensitive high density housing compatible with human needs.

(d) The literature and knowledge in this area is not well organized. It is therefore useful to have a method which condenses this material and suggests the process the planner can go through to incorporate crowding consideration with density measures. The conceptual framework of this research is a beginning step in applying this density and crowding knowledge. Much further research by planners and social scientists is needed.

(e) The framework does not replace the need for planners to first gain much knowledge regarding density and crowding. This knowledge is a pre-requisite to its successful implemention. There are no easy answers or solutions to improving the liveability of high density housing without a strong theoretical and historical basis.

(f) Public education may also be a practical solution to crowding control where existing density measures cannot be determined to control for those concerns. For example, if an individual is made aware of the symptoms of crowding-stress in his environment, he can either take direct action to control the crowding-stress or he can move to a density level which is more compatible with his personal needs and taste. Planners may need to assume a greater advocacy role in ensuring adequate public information levels.

These are some general planning implications to summarize the essence of this study; more specific planning implications can be found in Chapter V.

4. Strengths and Weaknesses of the Framework

There are a number of fairly self-evident planning implications. For example, there is a need to broaden our understanding of density and crowding, there appears to be a need to find better ways of incorporating quality of life considerations into development controls for high residential density, and, finally, planners and local

governments should be more prepared to experiment with well designed high density environments. However, it is useful to examine some of the strengths and weaknesses of the planning application of the density-crowding relationship in a conceptual model.

The strengths may be summarized as:

1. It provides some linkage between density and crowding knowledge and planning practise; it organizes a complex body of knowledge into an easier format. Subsequently it may improve the planner's knowledge of the issues.
2. It suggests the possible incorporation of quantitative density formulae with crowding considerations.
3. It enhances the consideration for quality of life criteria in high density housing environments with more comprehensive application of crowding theory;
4. It provides a tool that is adaptable, flexible and systematic; and yet it may be applied to a variety of circumstances where increased densification is an issue.
5. It provides a possible framework for the critique or refinement of current guidelines/policies and for the development of new density guidelines.
6. It suggests some planning implications of the interrelationship between density and crowding so that more sensitive high density housing may be developed.
7. It may solve the two main problems of inconsistent use of density measures and the inadequate focus on crowding concerns in density planning.

The weaknesses may be summarized as:

1. It would be time-consuming to update density and crowding knowledge in order to implement the framework.
2. It may be difficult to implement some aspects of the framework in planning practise as the knowledge is insufficiently refined in some areas (i.e. the actual impact of the various density measures on human needs).
3. The framework is only a beginning step; as yet there are no easy solutions to a complex problem.
4. The conceptual framework would make the planning process somewhat more controlled and "scientific". Though there is room for some individual interpretation, the planner would have less personal input into what he believed was liveable housing. This would reduce the potential for decentrist bias as mentioned in the history section which likely would outweight this disadvantage.

The planner has historically assumed the role of advocate for the "public good." At its most general level, this overall objective of planning can be equated with a desire to obtain the highest possible quality of life for urban residents given the numerous constraints. In order to carry out this task, the planner will need to become more aware of the qualitative aspect of crowding in order to effectively advocate human considerations in housing form and density. If planners do not become involved in the process of inevitable change regarding high density trends, or remain dogmatically opposed to high density, then the

change will occur without their potentially valuable input; in other words, they will be left out and planning knowledge in this field may be ignored.

Another related implication on the planners' role is that they will need to become more intimately knowledgeable about density and crowding theory so that they may take a stronger role in planning high density environments. Planners can no longer recommend acceptance or rejection of a development proposal merely on its conformity to physical formulae, as is currently a common practise in North American cities. This is in fact a very passive role. Planners need to broaden their assessment criteria, particularly by including a more clearly developed understanding of qualitative crowding factors. Planners may need to assume greater responsibility in this role, for it is too simplistic to look at FSR, for example, as the one criteria for an acceptable high density development. This will require a more active role on the part of the planner with increasing knowledge and abilities in the whole field of high density. In view of the increasing rate of change in our society and cities, a planner cannot possibly be prepared for every situation but must possess greater abilities in problem-solving, interpreting and determining feasible compromises.

This leads to the final effect on the planner's role, that of how he utilizes his time. More time and energy will be spent on controlling for qualitative or human aspects of high density. More attention will be paid to the internal living environment and building design to ensure they possess characteristics that enhance liveability.

Less time will be spent on the external levels of density and judging whether a building meets quantitative formuae. Ultimately, the quality of life will be met primarily through the betterment of the internal environments of high density buildings; this is where the future of high density planning lies.

C. NATURE OF THE LIMITATIONS

After completion of the research and examination of the findings, several possible limitations might be concluded:

1. As much time and research was required to explore the concepts of density and crowding as well as develop the conceptual framework, it was not possible to also test it in a comprehensive manner, such as applying it in an actual density planning situation to determine its feasibility. Therefore, the conceptual framework's potential in connecting theory and practise may not be fully realized without some sort of practical validation. It now stands as mainly a guide for addressing crowding concerns in high density planning.
2. The current crowding literature on the whole has not been scientifically validated. This data, for the purpose of this research, has been assumed to be valid and may at some point be proven incorrect. However, because of the framework's flexibility, specific knowledge regarding the crowding- density relationship may be up-dated and changed

without affecting the overall structure and intent of the framework. Its application to planning would merely adapt to incorporate new knowledge in the field. As density and crowding knowledge evolve, and their unique interrelationship is further defined, ideas about the latter which are believed to be correct today may be disproven in the future.

3. The current density literature is lacking particularly in the area of defining its measures and exploring the implications of these on liveability at high density. Therefore Chapter III on density is not of the same depth as Chapter IV on crowding. Nevertheless the available literature offered suitable insight in order to achieve the objectives of this study.
4. The density-crowding relationship, as described in this study, is based primarily on inferred correlations. As understanding of this relationship seems crucial before exploring its planning implications, more study and refinement of this interrelationship in the literature would have been a great asset to this study.

D. SUGGESTED FURTHER INVESTIGATION

The background and discussion of density and crowding opens many avenues for further research. Through the course of this research it became apparent that several areas warrant further study:

1. A study would be useful which documents and analyzes methods other than quantitative density controls which planners use to decrease the harmful effects of crowding (i.e., informal or indirect methods such as view preservation and ground orientation) in their control of density levels.
2. A comprehensive study to operationalize and fully apply this framework is needed. It could assess the framework's practicality to integrate crowding and density concepts into the planning process as suggested by this research.
3. Given the diverse nature of the topics of density, crowding and their interrelationship, a project-team approach which consists of a planner and experts from the field of Health and/or Behavioral Sciences might be a more creative, reliable approach to fully operationalize this framework, in research which may, for the first time, look at the issue from a planning perspective.
4. Many avenues for further research and useful application lie in the area of planning trade-offs at high density. The limited number of initial current works might be expanded and refined to generate innovative planning strategies.
5. There was some suggestion of a correlation between the increasing cost of various high density buildings forms and their ability to meet adequate quality of life standards. For example, there is some indication that some lowcost housing is not successful in preventing crowding at high

density (i.e. due to inadequate noise control?). This proposition warrants further investigation.

6. More research is needed into the entire density-crowding relationship, for example, examining the validity of using perceptions of crowding as an indicator of the level of liveability in a given high density housing environment. Also, perhaps research should be devoted to defining crowding experiences common to all housing environments, factors which determine why individuals react effectively or ineffectively to these environments and, finally how the planner may intervene appropriately in this process.
7. More study of the centrist and decentrist bias in planning philosophy is needed which could focus on the intellectual impact in current planning practice. One might investigate how a planner's particular philosophy affects his decisions in the development approval process of high density housing. For further historical reference, a more indepth study of Le Corbusier as a utopian is required. Most planning history recognizes Le Corbusier as an architect and perhaps overlooks his major contributions to the planning profession.

It is the hope of this study that the findings serve as a beginning for further development of planning theory related to high density environments. Methods other than the use of a framework might also effectively organize and utilize density and crowding knowledge in

a practical way. However, the matrix format has proven very stimulating and challenging as a methodology. Particularily, it has offered a broad understanding of new areas of knowledge. On a personal note, this study has enabled the author to organize his own beliefs and dispel subjective biases about high density housing environments. It is hoped this research will be of assistance in achieving the goal of planning more liveable high density housing environments.

Reflecting on the framework, its main strength appears to be that of an organizer of density and crowding knowledge, one which requires much more research and refinement; in short it shows promise. It also may be a useful tool to assess liveability concerns as well as apply the density-crowding relationship more systematically in high residential density environments.

The framework, once fully developed, could be applied not only to all aspects of planning research or environmental design, but also to entirely different fields concerned with crowding and density-related issues. Finally, the study suggests that there is much more knowledge to be derived from human behavioral research on the density-crowding relationship. This study offers a practical guide in the form of a conceptual framework through which density-crowding knowledge may be applied more systematically in the planning of liveable high density housing.

EPILOGUE

High density housing seems inevitable in the modern city; crowding is not. The conventional planning process behind high density development, however, is plagued with bias, misinformation and inconsistency. Humanism in such environments is also poorly understood.

In view of this, a study which addresses the liveability of high density housing is fundamental. A common language and framework is necessary for meaningful density debate to occur. If nothing else, this research regarding the planning implications of the density-crowding relationship may serve as an initial discussion paper and a basis for dialogue and research among urban visionaries and social scientists.

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APPENDIX I

Noise Control: A Scenario of The Framework's Application

The purpose of this appendix is to demonstrate how the framework might be used to apply density and crowding knowledge in the one area of noise control. This area was chosen because of its apparent importance in reducing crowding-related stress at high density.

The exercise of building a framework might take many different approaches, however the end product should have several basic attributes regardless of its design. It should address a problem statement; it should be of general application; and it must offer the opportunity for the researcher to apply the framework in different situations. It in essence is a tool which bridges the gap between theoretical concepts and actual situations. One basic goal of density and crowding research in housing is to improve the liveability of the environment. In simplistic terms this can be achieved by identifying actual or perceived negative and positive factors which might serve as a basis to guide the design of better residential environments.

Perhaps at this point it is important to clarify the scope of the term "environment", which in this case refers to the surroundings in which one's home is situated. Environment is influenced by density, internal to the dwelling unit; external encompassing outdoor open space and; the broader spectrum of neighbourhood which might include parks, social service facilities, shopping areas or community centers. The important point being made, is that user needs and thus satisfaction with one's living environment must be studied in both micro and macro density terms.

In any environment, there is constant change taking place. For example, the space needs and thus satisfaction levels of the individual can change over time. A young couple living in a one bedroom apartment, when they have their first child, find their space needs will change quickly as the child grows. An example of external changes in the environment might take the form of urban renewal in a mature neighbourhood. As population density in randomly planned mature neighbourhoods increases, the original residents may be confronted with increased external noise and pollution levels, increased use of inadequate community facilities, all of which will affect how they feel about and respond to the density of their environment.

As residential densities increase, the above changes act as stimuli to the residents. As a process of adaptation to these changes occurs, these stimuli act upon the residents and result in behavior or outcomes on their part as they attempt to adapt or adjust to these stimuli. A major problem presented by the study of density and crowding is that the researcher cannot observe or measure the actual process which takes place between the introduction of a change stimulus and the resulting response on the part of individual residents. This interaction is internal to the individual, and therefore not easily tested. However an avenue of fruitful research might either use techniques of observation or interviews of residents as a method of linking the original stimulus to a resulting behavior or outcome within affected resident groups.

Changes in the environment (influencing perceptions of density and crowding), create stimuli which activate a process internal to the

individual which impact the high density resident needs, real and perceived. As the process of exposure to higher densities or crowding evolves, observable or measureable behavioral outcomes develop from the internal process. These outcomes might take the form of individual attitudes, verbal statements, or real actions related to their response to their housing environments.

Behavioral outcomes from the crowding experience might fall into two different categories. These will be defined as "effective" and "ineffective" outcomes. Classification into each sub-group would depend upon specific criteria, which will be described. An initial criteria might be; does the behavioral outcome maintain the integrity of the individual user (i.e. meet one's physical, emotional or social needs). Here the researcher would identify an effective outcome by questioning whether the outcome resulting from the housing environment meets such needs of the user group as a whole.

Another criteria for determining classification of outcomes might be to determine if the effect of the stimulus on the use group is desirable or not. Take for example the case of environmental noise as a stimulus. A possible outcome would be for a resident to actually leave the neighbourhood because of the noise level created by higher densities. Another outcome might be that the resident states he does not like the noise but has adjusted to it. This latter case is an application of a psychological adaptation model which will be expanded here.

Many other criteria of this nature could be developed to further define whether the housing resident's behavioral outcome is "effective"

or "ineffective" such as: the cost of these outcomes, the overall benefit to the community, whether it infringes on others rights, etc.. These suggestions are only a cursory look at possible criteria which lends itself to considerable further research and determination.

The application of density and crowding knowledge might best be explained through its application to a field research example. For illustration, a case example of noise levels affecting a mature neighbourhood will be developed to illustrate the potential application of the Conceptual Framework For Incorporating Density Measures With Crowding Considerations proposed in Chapter V.

The environmental structure for this example is a mature single family neighbourhood in which a densification or housing infill process is taking place. Once a quiet area, the residents are now reporting problems of increased noise levels which they believe are resulting from the nearby generated noise of higher density development construction. More people, more traffic and ultimately more noise is present. Also very important in this process is the residents' internal factors which greatly influence what impact the stimuli will actually have. In this example, the residents resented the changes in their neighbourhood, felt they weren't consulted and spent more time in their homes exposed to the noise. Age, sex and ethnicity are also examples of user group personal characteristics. Such factors also influence their perception and therefore response to the noise stimulus as a result of higher densities and changing perceptions of crowding.

The environmental stimulus combined with the internal factors act on user attitudes and actions. Examples of major user needs in this

living environment are a very low internal living unit noise level from internal and external sources, moderate external noise tolerance, and a strong sense of "neighbourhood" with resistance to change. In response to the stimulus and its impact on their needs, some internal adaptation or adjustment may occur, such as activation of the stress response. The individual response to higher noise levels which created stress can further lead to physiological changes, such as disrupted sleep patterns or general deterioration in health. Essentially these are internal human responses which, as previously mentioned, are crowding responses which can occur at high density.

The planner must be sensitive to the behavioral outcomes of the user group as they attempt to adapt or adjust to the noise stimuli and its effect on their needs. Through techniques of observation, site inspection and interviews, the planner can determine what actions some individual users had taken with in their living environment to adapt to the noise problem and encourage these on an area-wide scale to minimize crowding-related problems.

Here, the planner might discover an array of behavioral outcomes. For example, on the macro, or neighbourhood density level external to the user's immediate living environment, the user group may be lobbying the civic administration to incorporate police enforcement or traffic control devices to reduce higher density traffic generated noise in their neighbourhood. This, however, would only partially decrease the overall noise level as human activity increased in their environment. The researcher might find that residents were taking

action more immediate to their living unit by planting trees and vegetation between the noise source and their homes to defuse the noise. Others might be building berms or constructing fences to deflect the noise away from their living environment. Some users might be incorporating noise insulation into affected walls or replacing single with double pane windows. As well, bedrooms might have been moved to the rear of the dwelling farther away from the noise source. Also there might be a higher than usual turnover in neighbourhood residents indicating that users were moving away from the noise. All of these examples are measures residents might take to reduce crowding-related stressors at high density.

Again using the case of noise levels, the planner must first recognize and define the environmental stimulus as being high noise levels or he may do the step in reverse by first observing particular resident behaviors and then assessing their main causative factors or stimuli. Next, the planner must undertake to study the behavioral outcomes of the noise stimulus. This takes the form of the data collection and analysis phase of the planning process. The planner identifies each resulting behavior as "effective" or "ineffective" based on the suggested pre-determined criteria. He then must analyze and link these outcomes to the environmental stimuli causing or reinforcing the resident behavior. For example, is the affected resident actually planting trees or building berms as noise abatement, or is he merely landscaping with no real intention of noise reduction?

Having made the link between the environmental stimulus and the behavioral outcome, the planner must develop a plan implementation to

deal with the high density neighbourhood noise problem. In this instance, the action takes the form of an intervention against the environmental stimulus and is achieved through the manipulation of the noise stimulus.

Generally interventions can be of either a "positive" or "negative" nature. In a case such as a noise problem, for instance, it may not be realistic for the planner to either take-away or reduce the stimulus (a negative approach as it constricts action) through the enforcement or expansion of density controls alone. Further the planner might intervene through implementation of regulations other than density controls which would confine the stimulus, such as reducing operating hours of the major noise-making activities within the neighbourhood. This could serve to alter the impacts of the high density generated noise stimulus through controlling for stressors in the environment. An alternative approach, as an example of a positive approach which promotes action, could offer an opportunity for the planner to focus on maintaining or promoting those resident behaviors which suggest their adaptation to the environment. Also the planner must take into account the possibility of the individual undergoing some level of internal adaptation to the stimulus of high noise levels experienced at higher density, where no action, either positive or negative need be taken.

The final step in the planning process which must be incorporated is some form of evaluation of the intervention schedule which questions the costs, benefits and effectiveness of any actions which are taken. Here the planner must question: was the original

assessment correct?; were the goals realistic?; and was the intervention appropriate or adequate to the situation?.

Flexible use of the Conceptual Framework For Incorporating Density Measures With Crowding Considerations allows the planner to apply relevant knowledge to a specific urban problem, such as noise. The planner can either apply all the variables of the framework in a comprehensive manner, or focus on one component such as done here with the example of noise. The planner must remain aware however, that "crowding" occurs because of different environmental stressors which may be somewhat controlled by the various density measures described in Chapter III. Also the planner must continually determine the original cause of the environmental stimuli (i.e. is the noise from an increased density or from another factor, such as poor building design and construction?). In seeking solutions, the influencing qualitative factors and the personal history of both individuals and groups of individuals should be considered when analyzing the crowding-related stress which results from the environment's disruption of the individual's physiological, social/cultural and psychological needs.

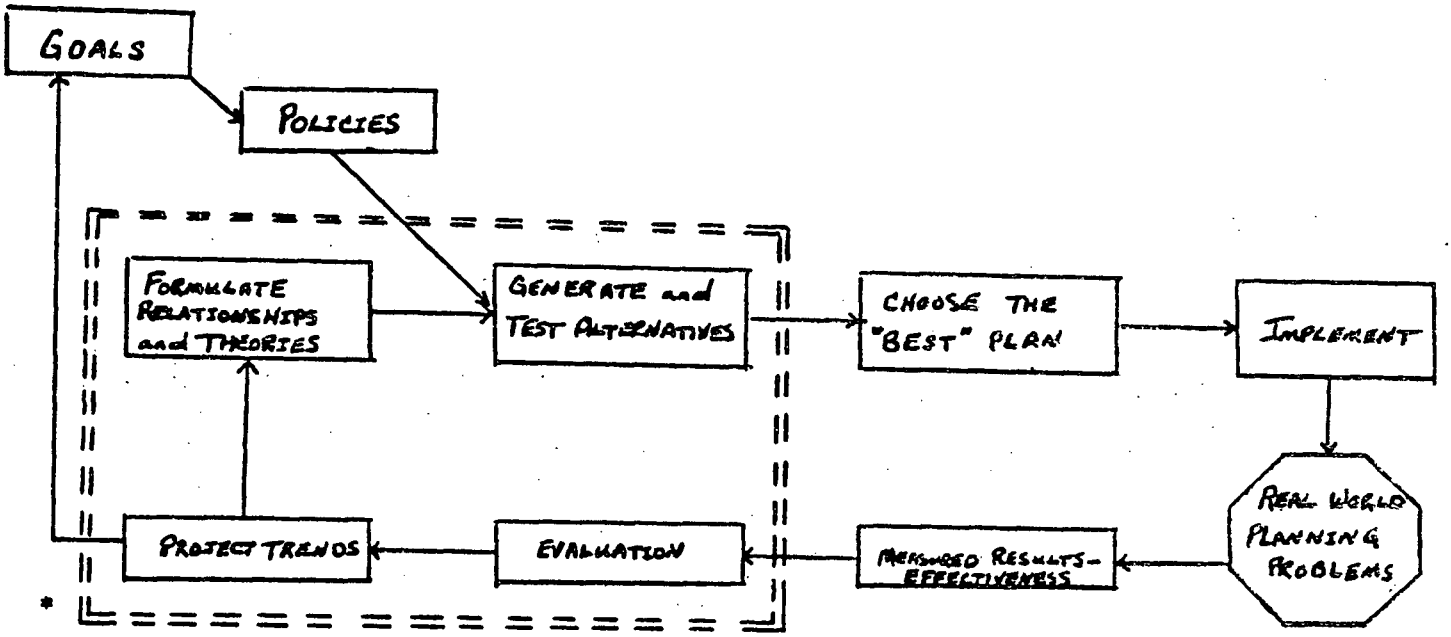
This necessary application of crowding knowledge may best take place at the implementation stage of the planning process. Controls for crowding considerations can take several forms: 1) the planner may implement controls which themselves become environmental stimulus in order to correct some other negative stimulus; 2) new regulations can be applied which change the original stimulus thereby decreasing its effect; 3) regulations can also be designed to encourage or maintain the presence of a positive stimulus; and 4) trade-offs, as described later,

could be implemented in the face of a stimulus that cannot be changed realistically. This latter crowding initiative is perhaps the most important. The identification of trade-offs and their use may effectively influence the resident's perceptions of density and crowding in a positive manner. For example, given that no realistic solution can be found for the increasing noise levels from densification in a maturing neighbourhood, the planner might consider amenities which could be offered to the existing residents which would improve their living environment in some other way. This approach will not actually reduce noise levels but it may modify the resident's response to it so that crowding-stress can be minimized. There are rewards that could be given to the residents to aid in their adaptation to higher densities, such as; decreased property tax levels, subsidized noise insulation measures to reduce stress, public education on density and crowding and how the individual may protect themselves from possible negative effects at higher density. Affected residents may be offered a range of corrective measures as a part of a program to develop and test innovative measures sensitive to human needs in high density residential development. By way of summary, the knowledge generated by this framework promises many new aspects of research which might yield innovative approaches to control crowding considerations at high density. Much more research is required on how existing density and crowding knowledge can be applied in planning development controls for high density housing.

The process as previously described has many implications to planning. It appears that a conceptual framework based on density and

crowding knowledge could become an important tool for the planner's use in the assessment of many aspects of human environments and behavior. The conceptual framework for example might be operationalized through the planning processes shown in Figure XI below, particularly in the steps within the box.

Figure XI: The Framework's Role In The Planning Process



*The greatest potential for the Model's application is represented by the double-dotted (=) box.

The Use of Trade-Offs in the Planning Process

Inherent in the previous discussion are the notions of flexibility and adaptability. This is particularly true when one is

attempting to establish the optimal level of high residential density or building design. Borukhov summarizes this idea succintly when writes:

> "A residential neighborhood has many characteristics. Usually people trade off one characteristic against another. For instance: people can trade off density against cost or accessibility against space. The aim of good planning is to find the combination of characteristics that will give maximum level of satisfaction to the residents of a neighbourhood subject to the limitations of their budgets. Density standards should, therefore, be adapted to the preferences of the potential residents and their preferred compromise between the various attributes of their environment."[1]

Burukhov further contends that people tend to be negatively influenced more by factors other than density such as views, open space and noise, and it is important to analyze and modify these factors to the benefits of its residents. For example, at high densities "ground orientation" may be traded for private open space in the form of a garden patio/balcony. Or the transportation/infrastructure cost savings at high density may be applied to improved internal building conditions such as effective sound-proofing which may dramatically improve the liveability of the dwelling.

On a broader scale, decisions should be made regarding the amount and mix of densities to implement in a given area. Here trade-offs also occur so that at higher densities an increased choice of public and private services can be accessible at a convenient distance. This in turn reduces the noise, air pollution and safety hazards of automobile traffic that are less necessary in a more compact

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[1]E. Borukov, "The Trade-off Between Density and Other Objectives: A Re-examination of Planning Norms", Geojournal Vol. 2.1 (1978): 71.

environment.[2] However in poorly planned high density environments the reverse can be the case.

To aid the planner in identifying the preferences of residents so that satisfactory trade-offs may be made, Borukhov cites three different methods:[3]

1. Analysis of behavior shows preferences based on what people do rather than what they say. This data is collected through the three approaches of on-site observation, analysis of statistical information regarding relocation or crime rates, and multiple regression analysis of house prices.
2. Direct questioning of the residents on their attitudes, how their neighbourhood/dwelling meets their needs, and how residents' satisfactions in different types of densities and designs compares.
3. Trade-off games which develop simulations of actual housing situations in financial constraints and demonstrate neighbourhood and housing trade-offs.

Further discussion of these methods will not be included here, however they have been presented to provide a understanding of appropriate planning approaches. The issue and strategies of trade-offs might be considered when applying the conceptual framework as proposed

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[2]Borukov p. 73.

[3]Ibid, pp. 75-76.

in Chapter V.

It is not the intention to indicate that the use of trade-offs meets every residents' preference or requirement, for this is an impossibility. However, decision-makers are called upon to make such interpretations to the best of their ability. They must therefore prioritize the many factors and decide which trade-off will result in slightly more or slightly less satisfaction and come to the most desirable compromise among the various variables. Planning then centers around the process as well as the end product. It is in this spirit that the conceptual framework of this study has been developed. This framework is not meant to be a concrete formula, but rather a flexible tool that may systematically guide decision-makers in addressing quality of life considerations at high residential density and how they may be best assured.

Much more refinement of the framework is necessary. However, it is suggested by this analysis that it has potential as a planning tool. As can be seen from the noise level case, research findings on "effective" behavioral outcomes might readily be applied to neighbourhood plans which would be implemented to control noise levels. The knowledge outlined by this research might also form the basis of high density control guidelines or other policy which could be applied to either new residential areas or to neighbourhoods soon to be faced with higher residential densities and potential undesirable crowding effects.

In conclusion, it might be suggested that the Conceptual Framework For Incorporating Density Measures With Crowding

further development, will prove viable for use in problem analysis, research design, policy-making and conceptual organization of existing density and crowding knowledge. These four tasks may be readily implemented through the use of this framework, and prove to be a useful addition to the field of high density planning.

APPENDIX II

FIGURE XII - MATRIX OF DENSITY MEASURES

Qualities of Space (denominator)

Qualities of Persons (numerator)			*Land Space*: *Flat, Rolling, Net, Gross, Open, Public, Private, Communal, Town*	*Dwelling Space*: *Ground Level, Elevated, Residential, Living Unit, Room*
	Cultural	Ethnic Background Education Level		
	Economic	Employment Status Income Level Occupation Home Owner Tenant Car Owner		
	Age	Aged School Age Preschool Age		
	Social	Individual Persons Families Female Heads of Households Residents Transients Present Only in Day Present Only at Night Migrants		

Maurice D. Kilberidge, Robert P. O'Block and Paul V. Teplitz, Urban Analysis (Boston, Mass.: Harvard University Press, 1970), p. 47.