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Learning from Suburbia: Residential Street Pattern Design

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Learning from Suburbia :

Residential street pattern design

Prepared for

Fanis Grammenos

Canada Mortgage and Housing Corporation

Submitted by

Julie Tasker-Brown

Sevag Pogharian

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Executive Summary

This investigation of suburban street patterns was prompted by the current debate on the state of suburban development, including its forms and the impact of street patterns on the quality of life in suburbs.

Street patterns contribute significantly to the quality and character of a community. When placed in their proper historic context, street patterns become meaningful by revealing their functions, and may then help address contemporary planning issues. The study identifies some of these issues, examines the evolution of suburban street patterns and, by synthesizing those attributes of street patterns that best respond to the contemporary suburban context, suggests the following design strategies:

- Rationalize conventional suburban street patterns while maintaining their essential characteristics;
- Restructure the private and public realms based on the current technological, economic and social context;
- Establish a structured framework of stable and alterable design elements to accommodate physical change; and
- Establish regular but diverse cells to manage growth.

Street Pattern Rationalization

Rationalizing street patterns maximizes those attributes which people expect to find in suburbs, such as quiet, safety, openness and nature. The idea is to create a grid structure, made up of residential cells or "quadrants", that regulates the level of traffic permeability. At the community scale, the street system is permeable to vehicular traffic, thus improving traffic flow and efficiency. At the neighbourhood scale, the street system becomes impermeable to vehicular traffic, thereby creating residential areas with sought-after suburban qualities. In contrast, the same smaller-scale residential cells, the dimensions of which are based on convenient walking distances, are entirely transparent to pedestrians and offer frequent opportunities for social contact and reprieve.

Restructuring Private and Public Realms

Contemporary means of commuting, communication and exchange provide the basis for the restructuring of the private and public realms. The guiding idea is to ensure that public spaces are accessible to residents while preserving suburban virtues such as quiet, privacy and safety in residential areas.

Accommodating Change

To reap the benefits of inevitable change, the proposed street pattern anticipates it and establishes a land-use pattern that channels it. The idea is that the public realm, which changes most regularly and

drastically, is given its own domain that is accessible to residents by car, transit and foot, and permits change while minimizing its adverse effects on residential life. The public realm containing commerce, services, and recreation and institutional facilities is located within a grid pattern of divided arterials (bi-ways). These biways, of which the median is a regular 350 -foot city block are predominantly devoted to institutional commercial and recreational uses.

Managing Growth

In order to preserve the attractive qualities of suburban areas, growth is managed by using repeatable, but not identical, residential quadrants that encompass desirable elements such as cul-de-sacs, open space, optimum residential density and pedestrian accessibility.

These strategies have been combined to produce a set of alternative suburban street patterns. At the community scale, the proposed designs incorporate the flexibility and adaptability of the traditional grid while minimizing its limitations. At the neighbourhood scale, the designs incorporate two mainstays of conventional suburbs—the cul-de-sac and loop—with an interconnected pedestrian network to produce a quiet, safe and green residential environment providing access to transit, shops, services and other amenities.

Furthermore, the proposed approach to street pattern design attempts to limit the amount of land required for streets so that more land may be devoted to housing and public green space.

Within an overall street organization that permits permanence and change, the proposed neighbourhood design solutions offer a considerable variety of street patterns. These patterns, together with a variety of building types and designs, and a well thought-out distribution of open space, can create residential environments that are both livable and viable. To the extent that these patterns conserve land, they are ecologically appropriate; to the extent that they may assist in increasing residential densities, they would support the goal of reducing housing costs.

Résumé

La présente étude sur les plans de rue prend source dans les discussions actuelles sur l'aménagement des banlieues, notamment sur les différentes formes d'aménagement et sur les répercussions des plans de rue sur la qualité de vie dans les banlieues.

Les plans de rue influencent considérablement la qualité de vie et le caractère d'une collectivité. Lorsqu'on les replace dans leur contexte historique, les plans de rue reprennent un sens, leur fonction devenant évidente. Ils peuvent alors permettre de résoudre certains problèmes contemporains de planification. Les auteurs de l'étude révèlent certains de ces problèmes, examinent l'évolution des plans de rue dans les banlieues et, en faisant un résumé des caractéristiques des plans qui ont le plus de succès dans les banlieues actuelles, proposent les stratégies d'aménagement suivantes :

- Rationalisation des plans de rue conventionnels avec maintien des caractéristiques essentielles;
- Restructuration des espaces publics et privés en fonction du contexte technologique, économique et social actuel;
- Adaptation aux changements physiques par l'établissement d'un cadre structuré d'éléments de conception stables et modifiables;
- Gestion de la croissance par la création de cellules régulières mais diversifiées.

Rationalisation des plans de rue

La rationalisation des plans de rue permet de maximiser les caractéristiques qu'on s'attend à trouver dans la banlieue, comme la tranquillité, la sécurité, les espaces ouverts et la nature. Le but est de créer une structure en grille, formée de cellules ou de quadrants résidentiels, qui permet de contrôler le flot de la circulation. À l'échelle de la collectivité, le réseau routier peut supporter la

circulation automobile, ce qui en améliore le débit et l'efficience. Par contre, à l'échelle du quartier, ce réseau devient imperméable à la circulation automobile, créant ainsi des zones résidentielles qui présentent les qualités recherchées dans une banlieue. De plus, ces mêmes cellules résidentielles à petite échelle, dont les dimensions sont établies en fonction de distances de marche, facilitent la circulation des piétons et offrent de plus grandes possibilités de contact social et de détente.

Restructuration des espaces publics et privés

Les moyens actuels de transport, de communication et d'échange permettent la restructuration des espaces publics et privés. En restructurant ces deux types d'espaces, on s'assure de rendre les endroits publics accessibles aux résidents tout en conservant les qualités de la banlieue, soit la tranquillité, la protection de la vie privée et la sécurité des espaces résidentiels.

Adaptation aux changements

Pour tirer parti des inévitables changements, les plans de rues proposés les prévoient : ils sont fondés sur un modèle d'utilisation des terrains qui tient compte de cette réalité. L'espace public, qui est celui qui change le plus souvent et le plus radicalement, doit être concentré dans un endroit accessible aux résidents par automobile, en transport en commun et à pied. Cet espace doit pouvoir être modifié avec un minimum d'inconvénients pour les résidents. Les commerces, les services, les installations récréatives et les établissements institutionnels se retrouvent dans une grille d'artères à chaussée séparée. Ces artères, dont la médiane est l'habituel îlot urbain de 350 pi, servent surtout à des fins institutionnelles, commerciales et récréatives.

Gestion de la croissance

Afin de préserver les qualités qui attirent les gens vers la banlieue, il faut gérer la croissance, c'est-à-dire adopter des quadrants résidentiels reproduisibles, mais non identiques, qui comprennent des éléments souhaitables comme des culs-de-sac, des espaces ouverts, une densité résidentielle optimale et des accès pour les piétons.

Ces stratégies combinées ont permis de produire une série de plans de rue pour les banlieues. À l'échelle de la collectivité, les modèles proposés intègrent la souplesse et l'adaptabilité de la grille traditionnelle tout en minimisant ses limites. À l'échelle du quartier, les modèles incorporent deux éléments de base de la banlieue classique, le cul-de-sac et la boucle, auxquels s'ajoute un réseau de sentiers pédestres afin de produire un environnement résidentiel tranquille, sûr et vert qui prévoit l'accès aux transports en commun, aux commerces, aux services et à d'autres installations.

Qui plus est, la démarche proposée pour l'aménagement des plans de rue vise à limiter la superficie requise pour les rues de sorte à pourvoir en consacrer davantage au logement et aux espaces verts publics.

Combiné à un réseau routier global qui assure la permanence et le changement, les modèles de quartier proposés offrent une grande diversité de plans de rue. Ces plans, lorsqu'on y incorpore différents types d'immeubles et différentes architectures ainsi que des espaces verts soigneusement disposés, peuvent créer des espaces résidentiels durables, où il fait bon vivre. Dans la mesure où ces modèles préservent les terres, ils respectent l'environnement; dans la mesure où ils peuvent aider à accroître la densité résidentielle, ils soutiennent la réduction du coût du logement.

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National Office
700 Montreal Road
Ottawa ON K1A 0P7
Telephone: (613) 748-2000

Bureau national
700 chemin de Montréal
Ottawa ON K1A 0P7
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1. Introduction

—"*A city is essentially a meeting of minds, a convention of interests, and though we live in the age where these minds can telecommute, the street is the most visible face of public interaction.*" Jukes,P., *Ashout in the Street: the Modern City, 1990*

—"*Streets and roads mold a community's character. They enliven daily life or deaden it. They foster human contact or frustrate it. They broaden people's choices or limit them to a narrow range of experiences.*" Langdon, Philip, *A Better Place to Live, Reshaping the American Suburb*, *1994*

From the smallest village to the largest metropolis, streets are a means of communication. They connect the private and the public domains. They connect different parts of a community. As connectors they are indispensable in that they support the most essential function of a community: interaction.

Streets are also spaces. They are common spaces that are typically appropriated for particular functions. For example, they can be used for the disposal of sewage and garbage from abutting houses, the sale and exchange of goods, celebrations, meeting friends, children's play, seeing and being seen and so on. Each of these functions takes place in a particular historical, cultural and physical context. In each of these contexts, some functions are undesirable but necessary (e.g., open sewage disposal), others are desirable but incompatible (e.g., street play and vehicular traffic), and still others are both desirable and feasible (e.g., sidewalk cafés on an urban street). The type and variety of functions that streets can accommodate depends on the *cultural-technological context* and the *pattern* of the street system. A function served generations ago (e.g., street as workplace) may no longer be possible today. A pattern suitable in one context may malfunction in another (e.g., an organic irregular street network poorly suited to wheeled transportation).

A street, no matter how thoughtfully planned, may nevertheless fail to respond to all of these requirements. This is so because some of the requirements may be contradictory or simply incompatible. In addition, a street can only function in relationship to the larger pattern of streets that form a neighbourhood, a community, a town or a city. Many streets malfunction precisely because they fail to relate well to a larger pattern.

Ideally, a street pattern is laid out according to a set of design principles rooted in the contemporary cultural-technological context. These principles give the pattern coherence and functionality — but only in that context. The transposition of any pattern, however coherent that pattern may be, to a different context may cause it to malfunction. Conversely, a malfunctioning pattern provides evidence of its misapplication or poor adaptation to a particular context. That is, a particular street pattern may have been designed to meet one set of criteria at the expense of others, or according to planning approaches borrowed from the past without considering their original historical context.

It is the observation of the mismatch of pattern and context in new urbanist developments that motivates this investigation.

New urbanism rejects the contemporary suburb, which has laid claim to the physical and emotional landscape of postwar North America, on the grounds that it is an undesirable and even socially and environmentally unhealthy development pattern, a pattern that has left a legacy of sprawl, undue dependence on the automobile, social fragmentation and a highly resource-consumptive lifestyle.

In response to these concerns, new urbanism advocates, a "new" approach to designing communities. New urbanism in all its variations — neotraditionalism, pedestrian pockets, transit communities — has tried to recapture the values and atmosphere of small-town America by, in effect, recreating the small town. Ingredients are borrowed from the past — a grid street pattern, town squares, a mixture of land uses, architectural details, front porches and picket fences — in order to achieve what is presumed lacking in conventional suburbs.

For example, a tight grid pattern from nineteenth-century streetcar suburbs and railway towns is reintroduced for its connectivity and potential traffic diffusion. Gridded street networks, it is argued, accommodate vehicular traffic better than curvilinear suburban street layouts. However, historic and current evidence contradicts this thesis.

Clearly, the grid creates more through streets. This gives motorists more route options and may reduce congestion on arterials, but, inevitably, increases traffic on residential streets, an undesirable side effect. The increased options are in fact not all feasible since left turns exacerbate congestion.

Historically, the grid was developed for settlements in which the only connective devices were streets and feet. For streets to provide access to destinations for pedestrians, paths had to be made as direct as possible. With the availability of many new means of transport and communication, daily destinations became multiple and dispersed, often beyond walking range . Consequently local connectivity, though still desirable, becomes less important. In contrast, the diffusion of vehicular traffic enabled by a grid, in a predominantly pedestrian world, is what incites central city dwellers to demand street closures or seek refuge in suburbs.

The mismatch of pattern and context becomes evident when there is a gap between a perceived problem (traffic congestion) and the presumed cause (hierarchical street layout), and between a proposed remedy (the grid) and its actual impact (unsafe and noisy residential streets). By transplanting a design approach from the past into the contemporary cultural-technological context without adequately considering the original historical forces behind the design, opportunities are missed to more appropriately match street design to the desired street functions.

Furthermore, the experience of the last century and half, in which the green, safe and peaceful haven of the conventional suburb emerged and established itself as the residential ideal, suggests that new urbanism misses the opportunity to apply workable and valuable design elements, such as a street hierarchy, the cul-de-sac and loop, in a fresh way.

This study explores the possibility of combining positive features of conventional suburban street design with those of new urbanist proposals, developing, as a result, a contemporary community form that is livable and viable.

2 Scope and Objectives

Street patterns contribute significantly to the quality and character of a community.[1] Given the primacy of streets as a design element at the neighbourhood and community scale, the goal of this investigation is to propose an alternative street pattern which synthesizes the positive elements of new urbanism and of conventional suburban street design. The design challenge then, is to identify ways of reintroducing into a residential neighbourhood the strong sense of physical interconnectedness associated with a grid, without relinquishing the positive attributes of privacy, safety and quiet that are typical of contemporary suburban street patterns. Specifically, the proposed street patterns would seek to:

- Establish a balance between the closed and discontinuous conventional suburban street pattern and the open, interconnected new urbanist street pattern (i.e., privacy and safety versus access and interaction);
- Establish a balance between a hierarchical street layout comprising arterials, collectors and local roads and a non-hierarchical grid layout (i.e., channeling traffic versus providing multiple route options);
- Achieve a greater degree of pedestrian accessibility than found in the typical conventional suburb; (separation without isolation) and
- Achieve land use efficiency equal or better than the neotraditional and the conventional suburban models. (for environmental sustainability and for reducing housing costs.)

In line with these objectives the analysis focuses not so much on individual streets but on their combination in forming a pattern. Similarly, though regional issues, such as transportation and land uses, impact on street patterns they will be examined from the perspective of residential district configuration.Furthermore, the focus is mainly on residential uses, although the discussion will necessarily touch on types of land uses, such as retail and open space, as they relate to the overall street layout of urban areas that include residential districts.

The general aim in developing alternatives is to assist planners, design professionals and developers in the design and development of "greenfield" communities by providing a conceptual diagram that incorporates lessons from the evolving metropolis and in particular its recent past.

3 Research Method

This research project was carried out in the following steps:

- **Review of literature on street design**
  A review was carried out to identify the key issues with respect to street design and the views, perspectives and theories underlying proposed solutions. This review was supplemented by the subsequent step of setting previous and current solutions in a historical context.

- **Identification of design precedents and influences**
  The objective of this review was not simply to record the form of suburban street patterns but also the cultural, technological and economic factors that gave impetus and sustained the creation of suburbs. Their morphology is to be placed in the context of socio-cultural forces and, to the extent possible, explained by them. Where necessary, ideas or factors were to be traced back to their origins. This review also includes the *adaptations* to the changing economic and technological context.
  This part was to trace the influences on the development of the contemporary suburb, dating from its origins in the early 19th century.

- **Identification of the design components of conventional suburban and new urbanism street design.**

  This analysis would derive attributes that are considered essential to each of the corresponding approaches in subdivision design and draw out the distinguishing features for the purpose of evaluating their effectiveness with respect to a given set of criteria.

- **Establishment of design objectives for alternative suburban street designs.**

- **Development of alternative suburban street designs.**
  This follows a process both conscious and intuitive of extracting the essential attributes of suburban street patterns and reassembling them into repeatable units.

- **Development of evaluative criteria for assessing solutions.**
  This task relies almost exclusively on the pioneering work by Michael Southworth and Eran Ben-Joseph that drew new links between the geometry of street patterns and their qualities as living environments.

- **Overlaying the proposed pattern on a plan of an existing community in order to compare quantitative and qualitative aspects between the two layouts.**

4 Literature Review

> ".. Clarence Stein...... proposed a 'radical revision of relation of houses, roads, paths, gardens, parks, blocks and local neighbourhoods' Stein's call for change has remained practically unanswered, and designers and planners are still searching for modifications to subdivision layouts" - **M. Southworth & Eran Ben-Joseph**, 1996

In attempting to lay the foundations for a new approach to street pattern design, the literature review aimed to identify existing theories and practices and their implications. In examining these views, the goals were to establish the relative importance of each, to identify likely shortcomings and , where feasible, to resolve contradictory assertions.

The literature on street design, though not extensive, carries a wide variety of themes and perspectives. These can be divided into two large categories based on scale: a) examining the street in detail at the scale of the city block and b) examining the street as a component of a pattern at the neighbourhood, community or district scale.

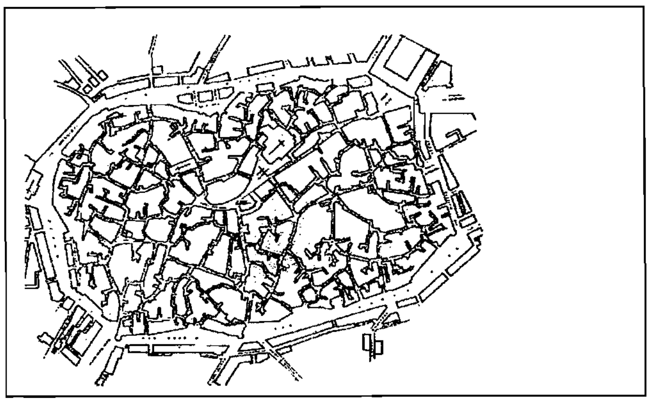


Figure 4- 1 The Organic (and contained) City

Though the city blocks are irregular and non-directional, most of the flow is directed toward the centre and to and from the gates. Goods come in from the gates and are exchanged at the centre. All civic communication happens in person, also at the centre. The centric nature of the plan was idealized in start shaped plans of the renaissance. Athens, Rome, Paris, London, Vienna, are well-known examples of organic cities.

Source: Simon Eisner et all, The Urban Pattern

In reviewing street patterns in various periods and cultures Spiro Kostof (1991) divides them into "organic", which evolved spontaneously and slowly by accretion, and "planned" which resulted from a preconceived notion of the "good" city.

Both types, now a fixed part of present day urban environments, form the backdrop for the views that planners hold about designing streets. The most dominant view is that of the street as an aesthetic experience, the source of pleasurable feelings. (CMHC 1954, G. Cullen 1971, Duanny 1992).

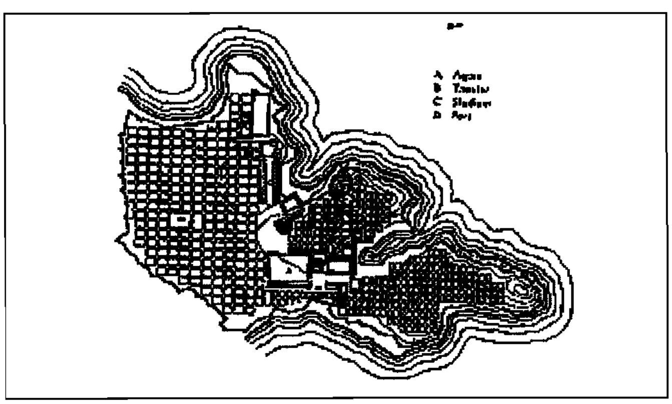


Figure 4-2. The Planned City

Miletus: Unlike the "organic" mother city, Athens, Miletus was fully planned in advance of its construction as a colony. The grid, which differs in size in two areas of the city, is perfectly square, the ideal in pedestrian connectivity. New York, Philadelphia, Los Angeles, Savannah, Toronto, Montreal and most cities of the New World were planned in advance, using the grid.

Source: Simon Eisner et all, The Urban Pattern

Another view perceives it as a functional element that connects pedestrians or vehicular traffic to their destinations (AASHO 1984). Traffic movement in particular has stimulated the production of numerous design standards and guides (ASCE 1990) for traffic flow and control. The value of a street as a social space where interaction occurs and community is cultivated forms a separate stream of investigations (Jacobs 1961, Appleyard 1981, Newman 1980). Another stream looks at the street's adaptation to climatic conditions, the features that moderate their extremes (Rudofsky 1969) and how they accommodate the pedestrian. Finally, the current concern with man's measurable impact on the natural environment places yet another filter in the view of streets: their use of resources. Overlayed on all these views is the inevitable change that urban environments undergo in response to technological, economic and cultural developments. All these perspectives intersect around the physical attributes of a street.

The discussion on streets as patterns is inevitably interwoven with that of city growth of which the suburbs are its most recent and visible expression. They are also the places where most experimentation happened and new ideas were implemented. The literature on suburbs is extensive, widely varied thematically and often polemic. Southworth and Owens (1992, 1997) trace the evolution of their street forms while Palen (1995) follows their emergence and growth in the social context of urbanization. A frequently expressed view of suburbs sees them as the cause of the city decline and social dysfunctions (Calthrope 1986, 1993, Kelbough 1989, Kunstler 1993) . "Sprawl" is used as a descriptor of formless growth that lacks coherence. Subscribing to the concept of environmentally sustainable development, many writers view the suburbs as the antithesis of urban sustainability citing commute frequency, loss of agricultural land, high land absorption rates and loss of natural areas as evidence of unsustainable growth (Calthrope 1993 and 1996). Conversely, advocates of suburban living cite consumer surveys which indicate a persistent and overwhelming preference for the suburban milieu. They view suburbs as the outcome of an expression of peoples choices and a reflection of market economics. Given these preferences and the economics of development, most cities, projecting on actual trends, chart their future growth as occurring mostly at the periphery in low density residential districts.

As existing areas of cities strive to adapt to the new realities of commuting, communication and commerce, the quest for a pattern of growth that responds fully to these realities and , at the same time, to the identified weaknesses of current patterns, continues. A more detailed look at the above views and perspectives follows:

A Street as a visual experience

The aesthetic view asserts that streets can evoke pleasurable feelings through the composition of their physical elements (Cullen 1961, Bacon 1974). Essential attributes to that end are said to be "enclosure"

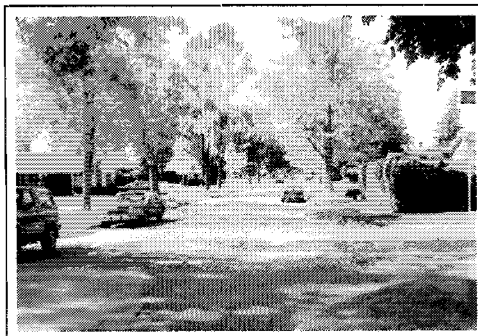


Figure 4-3. The Suburban Straight Street

A mature suburban street planned in the 50s, that is presumed to be uninteresting and unpleasant because it is straight, has an open horizon and has a low ratio of width-to-building height. In contrast to theory, this example evokes a pleasant feeling of openness, tranquility and natural beauty.

Source: Author

which is defined as the sensation of an imaginary "room" composed of the "walls" on either side of the street and affected by the ratio of the street width to the height of the flanking buildings. The continuity of the "wall" is judged to be a critical ingredient for achieving the sense of enclosure; buildings must be closely spaced to create that perception. As for the ratio, proponents of that view agree that an "ideal" ratio seems to emerge from observation, but they differ on what this ratio is: it varies from 1:1 to 1:6 (Ewing, 199..) The preference for enclosure and the pleasure derived from it are attributed to an assumed innate human propensity to seek enclosure (CMHC 1954). On these grounds, authors argue that straight streets are uninteresting and unpleasant and recommend that streets be made curvilinear or, alternatively, in linear segments that change direction slightly about every 1000 feet (CMHC1954, Duanny 1992).

Figure 4-4 . The Straight Street

"The spec-builders layout produces a never ending prospect suggesting "I am a bird of a passage" G.Cullen 1971.

Drawings such as this depict bland, sterile, treeless straight streets to portray their unpleasantness. However, few real streets are as featureless and unvaried as that. See straight street photo on previous page.

Source : Cullen, 1971

While "enclosure" as an attribute may contribute to the quality of the impression a street makes on pedestrians using it, numerous other factors affect the composite mental image of it. A. Jacobs (1994, 1996) in studying streets to determine what makes them "great", found the following attributes to confer a favourable impression: maintenance, cleanliness, trees, ***visual complexity***, smoothness, road geometry, class distinction, comfort (micro-climate), safety, one-to-four proportion, transparency, stopping places, density, activities (living and working). Jacobs states that many of these attributes are operational (e.g. maintenance) or cultural-historical (e.g. visual complexity) or incidental (e.g. activities) or regulatory (e.g. density zoning) and cannot be "designed" into the street. He also speculates that these "may be more important than the physical, designable qualities" but maintains that design can make a significant contribution to ennobling street experience (A. Jacobs in Moudon and W. Attoe 1995)

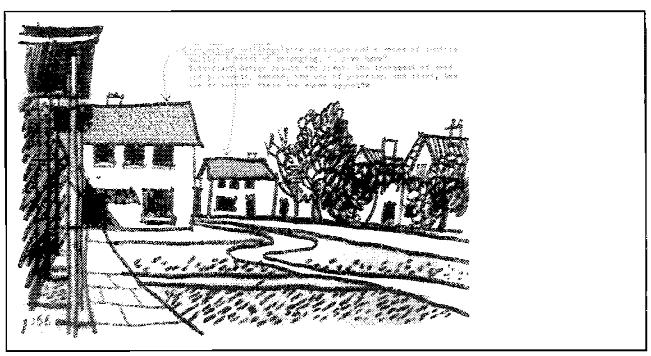


Figure 4-5. The Non-linear Street

"Projecting buildings give enclosure and a sense of individuality; a sense of belonging. 'I live here". Subsidiary design points are first, the treatment of road, second, the use of planting and third the use of colour". G.Cullen, 1971

Source : Cullen, 1971

While there is enough justification to insist on folowing aesthetic guidelines, the aesthetic view of the "good" street looses some of its importance when put through the filter of history. Many straight streets of grided cities, for example, are well known and frequented inspite of the presumed "unpleasant" open horizon. Similarly, streets that retained all their "ideal" physical characteristics have, through other influences, become unappealing and, conversely, certain streets maintained their attraction even though

their characteristics have changed over time (Jacobs A 1994). Moreover, the condition that physical attributes must remain static in order for a street to maintain its presumed positive impression can hardly be satisfied by streets of evolving cities.
The obvious preponderance of non-physical factors in the experienced quality of a street and the unrealistic expectation of fixity in an evolving context should moderate the emphasis placed on prescriptive design and the expected impacts of it.

A Street as a kinesthetic experience
An extension of the aesthetic view, the kinesthetic or serial experience, emphasizes the effect that a carefully orchestrated *sequence of visual experiences* (or serial vision) can have on the observer rather than simply the physical elements of a street itself (Cullen 1971, Bacon 1974).

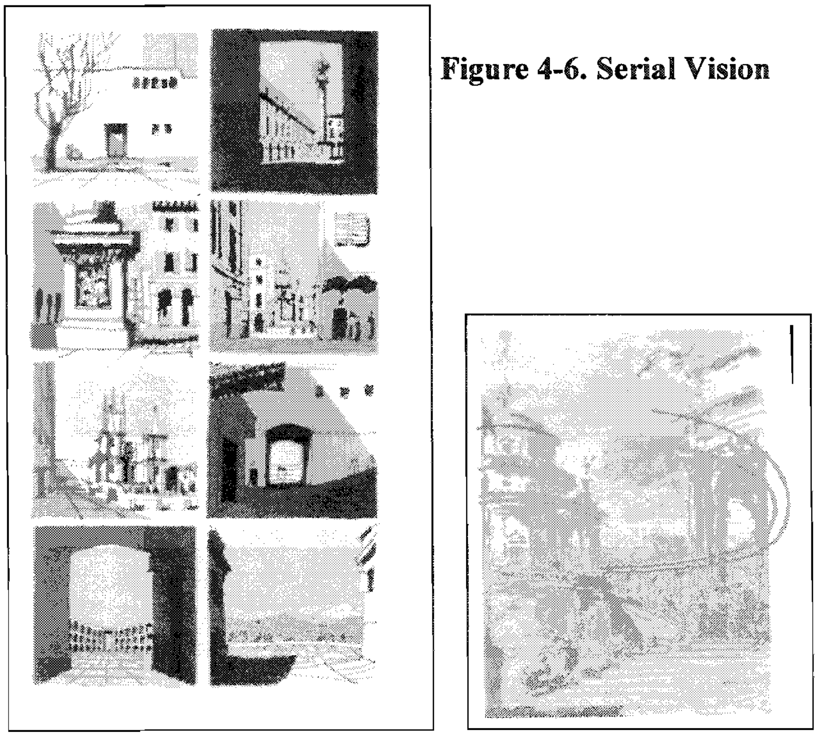


Figure 4-6. Serial Vision

"If therefore, we design our towns from the point of view of the moving person, (pedestrian or car-borne) it easy to see how the whole city becomes a plastic experience, a journey through pressures and vacuums, a sequence of exposures and enclosures, of constraint and relief" G. Cullen 1971.

Sources : Cullen, 1971 and Bacon, 1974

Not one but a set of connected streets, it is argued, should be designed to act as a total composition that evokes a range of feelings such as anticipation, surprise, enclosure, exposure and fulfillment. When summed up, the total experience is perceived as meaningful and gratifying.

This analysis and the resulting approach to street design are based entirely on subjective observations and speculative theories about the nature of the experience of built space. Moreover, they largely rest on exploring "organic" cities: the observed kinesthetic effects are incidental to a city's existing form and can be more easily explained as projections of the viewers mental constructs rather than formal intentions of the physical setting. As such, they pose the question of whether subjective interpretations of incidental forms of the past could hold useful lessons for guiding contemporary street design. Even if they did, in a prioritized list of street design considerations, they are unlikely to occupy a high position, when placed alongside critical functional considerations (discussed in subsequent sections.)

A Street as a social space

The most analyzed and discussed subject is the role of the street as a social space. (J Jacobs 1961, Aplleyard 1981, Duanny 1992, A Jacobs 1994). Naming it "public realm" or "urban living room", observers point out that the street frequently functions as a space where social bonds flourish, a feeling of community is created and a sense of belonging is cultivated through interaction. "Street life" is seen as evidence of a well functioning community. Jane Jacobs assigns great importance to the street life for street security, neighbourly contact and assimilation of children into adult society (J. Jacobs 1961).

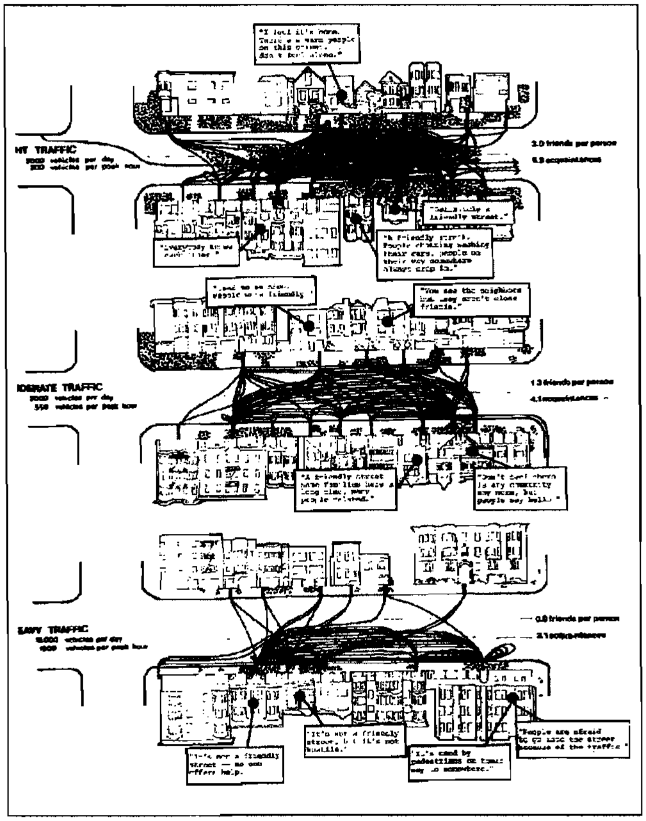


Figure 4-7. The Social Fabric of a Street

One of five diagrams that compare the perceptions and activities of residents on three streets in San Francisco with differing traffic volumes.

This diagram registers Neighbouring and Visiting differences from the low traffic street at the top to the high traffic street at the bottom.
From D. Appleyard, *Livable Streets* 1981.

Appleyard dedicated his book to : "children whose lives are threatened by traffic and to all those who suffer from noise, vibration, fumes dirt, ugliness, loneliness, alienation and other impoverishments due to its presence...."

Source : Appleyard, 1981

This social function of the street is often believed to be mediated by its physical geometry or architectural elements of the flanking buildings such as porches or both (Duanny 1992). While the connection to geometry and architecture remains tenuous and speculative, stronger linkages have been made to other factors that enhance or inhibit social interaction (Appleyard 1981, Newman 1980). These factors are non physical or at least do not relate to the street's own physical characteristics. Among those that enhance interaction are residential density and social homogeneity. The most prominent among those that inhibit interaction is the nature, volume and destination of traffic on a street. Empirical studies show that sociability decreases as the volume of traffic increases and conversely, when traffic is reduced by street closures, neighbourliness and interaction rises (Appleyard 1981, Newman 1992). In this case, satisfaction with the street, is conclusively and most strongly correlated to the degree of social cohesion of the street residents.

One of the most frequent occasions for informal exchange is when children are at play. The safety of children and their ability to use the street or nearby spaces for play are a serious concern for parents and a constant challenge for contemporary planners. Researchers found increased children activity in streets where through traffic is excluded and recommend discontinuous street patterns for enhancing children participation in outdoor play (Wheway and Millward 1995). Both socializing and satisfaction with a street appear to be closely linked with the sense of safety that are associated with a low volume of traffic and to the feeling of security that grows out of familiarity with neighbours. Thus curbing traffic emerges as the undisputed objective of street pattern design, when sociability is sought.

A Street as a traffic conveyer

Attention to motorized traffic as a detracting element and a destabilizing factor for social activity is relatively recent; it traces the increase in car ownership and the reliance on it for most of regular daily activities. Unlike today, streets were populated mainly by pedestrians for most of the 40-century urban history. A Paladio design for street construction shows a central 8-foot lane for pedestrians and smaller 4-foot sand-and-gravel lanes on either side of it for carriages and cattle (Southworth & Ben-Joseph 1996). This priority is now reversed in favour of mechanized traffic.

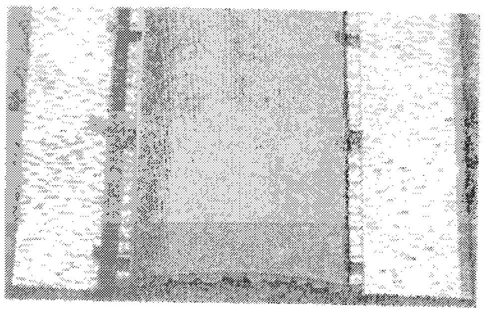


Figure 4-8. Traffic Priorities

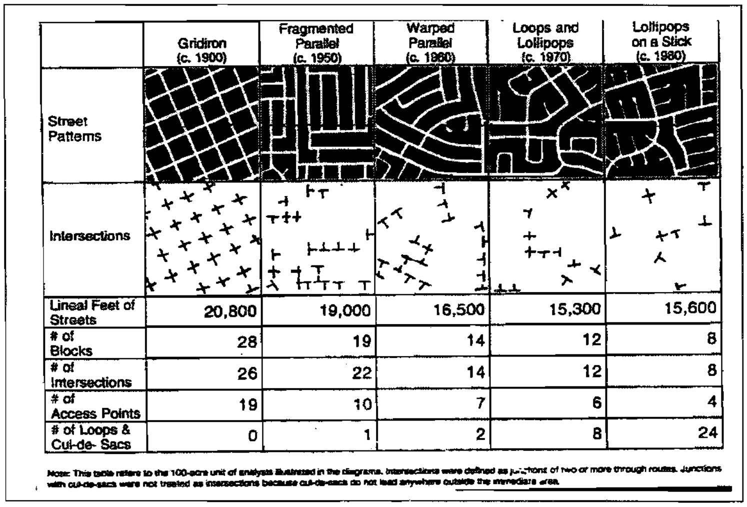
Roman street pavement design by Paladio:
Priority is given to pedestrians.
Quoted in *Streets and the Shaping of Towns and Cities*, by Southworth and Ben-Joseph 1997

Source : Southworth and Ben-Joseph 1997

As pedestrians become drivers and visa versa their use and perception of streets shift dramatically and, correspondingly, their satisfaction from it. This dual perspective adds a new dimension to the conventional street design which assumed walking as its main criterion. Interestingly, "walkability" now becomes an <u>added</u> requirement for old and new streets and gains renewed importance in the face of vehicular predominance. At the same time, "flow" or speed is also expected to be an essential property of a street. The incompatibility of these two attributes has been the source of constant tension and the driver of ideas for its resolution.

A gradually evolving response to this duality of use is apparent when examining planned expansions of contemporary cities. Southworth and Owens(1992) trace the evolution of street patterns of these expansions, name them, identify their characteristics and quantify their performance with respect to meeting the needs of the amphi-mobile user (fig. 4-9). From the common gridiron of the 1900s to the "Fragmented Parallel" of the 1950s, to the "Warped Parallel" of the 1960s, to the "Loops and Lollipops" of the 1970s and to the "Lollipops on a Stick" of the 1980s. In general, the above street patterns display a progressive reduction in the number of paved linear feet; the number of city blocks defined by streets; the number of street intersections (particularly four-way) and the number of access points to a larger district (often called "community" or "subdvision" or "development"). These decreases correlate well with a corresponding increase in Lollipops on a Stick (cul-de-sacs).

Translated in terms of meeting the needs of street users, these reductions mean " ... that our pets and kids are safer when there is no-outlet street; you feel kidnapping is less likely - there is more of a sense of neighbourhood".(resident quoted in Southworth & Ben-Joseph 1997,). The safety benefits of these discontinuous patterns have been confirmed through traffic statistics (Ben-Joseph 1995) and conclusively reaffirmed by user preference studies (Perks 1996).



	Gridiron (c. 1900)	Fragmented Parallel (c. 1950)	Warped Parallel (c. 1960)	Loops and Lollipops (c. 1970)	Lollipops on a Stick (c. 1980)
Street Patterns					
Intersections					
Lineal Feet of Streets	20,800	19,000	16,500	15,300	15,600
# of Blocks	28	19	14	12	8
# of Intersections	26	22	14	12	8
# of Access Points	19	10	7	6	4
# of Loops & Cul-de- Sacs	0	1	2	8	24

Note: This table refers to the 100-acre unit of analysis illustrated in the diagrams. Intersections were defined as junctions of two or more through routes. Junctions with cul-de-sacs were not treated as intersections because cul-de-sacs do not lead anywhere outside the immediate area.

Fig 4- 9. The evolution of street patterns

The comparative analysis of the evolving street patterns, the first of its kind, dissects their attributes with respect to movement, geometry, connectivity and the implied attributes of safety and quiet.

Source : Southworth and Owen, 1993

The benefits of traffic management through street pattern design to residents are also commonly associated with the disbenefits of " decreased pedestrian accessibility and disconnected social enclaves".(Calthrope, 1997) Additional observed disbenefits are traffic congestion on local collectors and arterials at peak hours, and the undesirability of these streets as places to live or walk on as well as the risk associated with crossing them. These disbenefits seem to be acceptable tradeoffs for most people for the perceived and proven benefits of the cul-de-sac pattern (A Downs 1999). Moreover, "problems associated with cul-de-sac neighbourhoods may stem more from land use issues than the street pattern itself" (Southwotrth 1997). Traffic flow at the local street level has gradually given priority to safety and sociability.

Traffic and circulation

Conveyance of traffic also has its counterpart - congestion. Congestion, coupled with annoyance and risk, outcomes of increasing traffic, first reached crisis proportions in established cities following the emergence of mechanized transportation. Efforts continue to adapt the older parts of cities, which were conceived mainly for pedestrians, to motorized traffic, now the dominant transportation mode. All these efforts are founded on the realization that traffic, irrespective of its mode, is the bloodstream of a city.

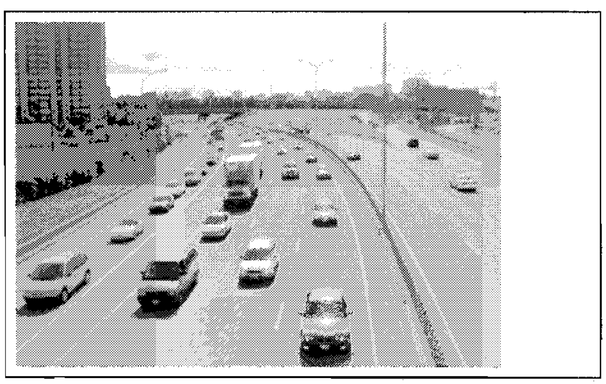


Figure 4-10. Traffic : the Bloodstream of a City

Going home at the end of the day. Traffic peaking at 5 PM bringing people to the suburbs of a wide metropolitan region, 10 times the size of the original founded city. The prosperity of the city and its residents depend on easy access to destinations of work, commerce, learning and governing: traffic and all forms of exchange are virtually synonymous.

Source : Author

Cities grew and flourished at the crossings of transportation routes. Though the word "traffic" has now mostly negative connotations, it still retains some of its original meaning in expressions such as "store

traffic" or "trafficking"; its Arabic root means "to seek profit"(Weekley E 1967). The many adaptations that have been developed to counteract the deficiencies of the pedestrian grid fall essentially in two large categories: a) those that improve flow and access and b) those that reduce annoyance and risk.
With regard to flow, two adaptations stand out as crucial: automated traffic signals and one way streets. Lights regulate flow with mechanical precision and prevent accidents. One way streets increase flow and solve the left turn problem of congestion and risk (Kelbough in Moudon and Attoe 1995, Alexander 1977)*. With regard to reducing the negative impact of traffic in central areas of cities, the prevailing solution is the gradual internalization of functions away from the street (fig. 4-11), either on ground or below/above ground. Large buildings, often occupying entire city blocks, now frequently incorporate open or enclosed courts, atria and streets that are secluded and buffered from traffic.

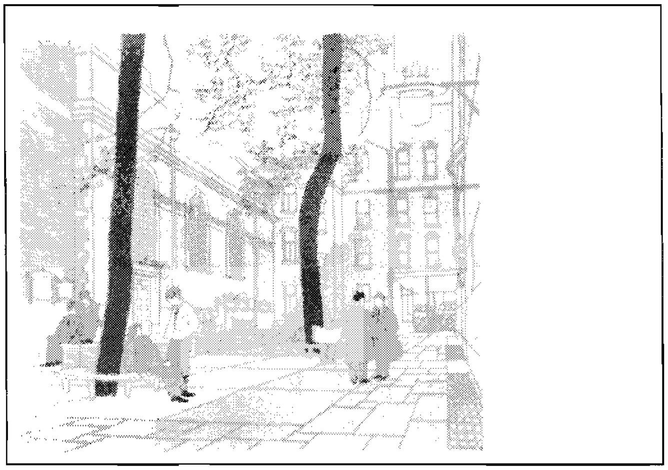


Figure 4-11. Adaptations to traffic

The open court device:
One of many adaptations to the presence of mechanized traffic including: Courts, lanes, mews, enclosed shopping malls, restricted traffic areas, level 15 paths, and underground pedestrian networks with shopping. These either exclude or avoid traffic and thus create safe, quiet and protected pedestrian realms.

Source : Cullen, 1971

Also closures of streets and traffic diversions, such as the Berkeley experiment (Appleyard 1981) are the common solutions to excluding traffic in residential districts.
An improved sense of order and quality in contemporary cities result largely from these adaptations which recognize the value of traffic, accommodate it and design out its negative impacts.

Walkability, destinations and residential density

Traffic also means pedestrian movement. While central areas of cities are gradually being transformed to accommodate car traffic and the suburbs have mostly fully adapted to automobility, critics say these adaptations resulted in neither of them being walkable: The central city is not walkable (or at least

Figure 4-12. Urban, Suburban

<u>Urban street 1920:</u>
33 by 100 feet lots-
10 units per acre

<u>Suburban street 1950:</u>
70 by 100 feet lots -
4 units per acre.
Source : Author

uninviting to walk) because of an unfriendly, chaotic and sometimes dangerous environment, and the suburbs, because of the big distances to destinations, exacerbated by meandering and confusing curvilinear streets.

The renewed call for reinforcing walkability is driven mainly by the perceived need to conserve oil (a CO_2 generator) but also by an association of walkability with an increased sense of community (the resource issue is discussed separately below). To conserve resources, walkability is linked to the use of public transit as a preferred and convenient mode of commuting and, to enhance community, walkability is linked with the need for interconnectedness between various parts of a community.

Figure 4-13. Personal Adaptations For Mobility

CO_2 and other noxious byproducts of the internal combustion engine put human health and the planets climate at risk. People adapt with personal measures, but strategies that metropolises can adopt remain elusive. Inspite of systematic efforts to entice travelers to public means of transport, personal travel by car continues to increase steadily; so does car ownership and the size of cars.

Source : Photo by National Geographic

Both are associated with several essential street and community features such as: a) at the street scale, continuous sidewalks, safe crossings, buffering from traffic, street oriented buildings, comfortable and safe places to wait, shade trees and others and b) at the community scale, medium-to-high densities, mix of land uses, moderate size blocks, transit routes every half mile and others (Ewing 1999). Starting with the transit station, the question of pedestrian destinations is considered central to achieving meaningful walkabiltiy.

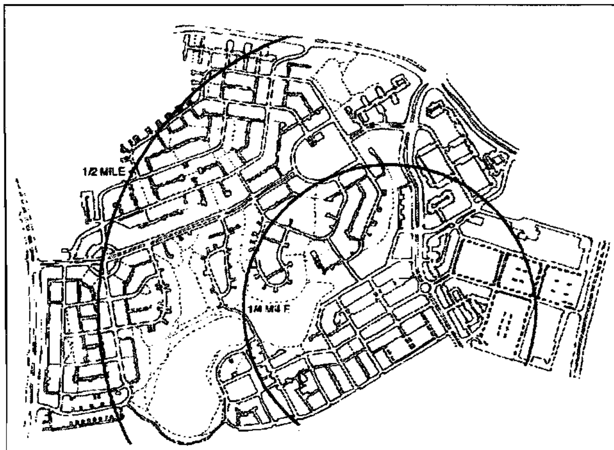


Figure 4-14. The quest for density
Kentlands in Gaithersburg, Maryland a Traditional Neighborhood Development (TND) designed by Andres Duany and Elizabeth Plater-Zyberk.
***"..Although this can reach very high densities in localized areas, inclusive housing averages out about eight units per acre. A lesser gross density is probable, as open spaces and commercial and civic buildings in a New Urbanist community can consume a substantial area..."* A. Duany in *Architecture,* December 1998.**

Source: M. Southworth and E. Ben-Joseph (1997) showing the 5 and 10-minute walk radiuses.

While it is generally agreed that for good transit service it is essential to have an average density of at least 15 units/acre or higher, few contemporary proposals or built subdivisions actually achieve it: Kentlands (5-7) and Laguna west (4-6) two of the most well known subdivisions conceived to be walkable and transit-oriented fall short of the mark. A streetcar suburb of the 1900s, Elmwood, (10-12) has double the conventional suburb density, but still barely meets the threshold. (Southworth 1997).

The residential density requirement of 15 units per acre also holds true for viable neighbourhood businesses and active street life (Ewing 1999).

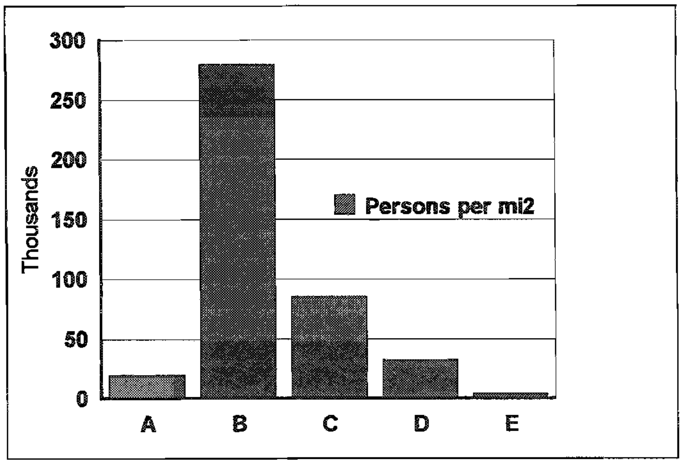


Figure 4-15. Density Through History

Chart adopted from *The Urban Oasis*: *guidelines and greenways.*

A - Roman times until early 19th Century
B - Paris, Manhattan, Prague in late 19th Century
C - Manhattan in 1970
D - Brooklyn, Bronx, Queens and Hudson (NY)
E - Dallas Forth Worth or East. Connecticut, 1970

Source : Warren, Roxanne 1998

Thus a street pattern that follows the half-mile rule for transit line spacing will have only one of the two necessary ingredients that enhance transit use; the second ingredient, residential density, cannot be influenced by the street pattern alone, if at all. The history of urban density points to other factors being critical.

Similarly, since the presence of commerce and services also depends predominantly on residential density (Ewing 1999), the half mile rule can only assist in making potential destinations proximate not engender them.

While a street pattern should aim to enable easy access to transit stops and other destinations, it could not be expected to induce increased walking without the presence of destinations and anticipated levels of service; these depend primarily on the residential density of the development. The emphasis on street patterns for reforming travel behaviour seems disproportional and misplaced.

Streets as consumers of resources - land

In the context of growing evidence of man's impact on the natural environment, attention has turned to the issue of resources consumed by streets. Streets use land and materials, reduce soil water absorption and contaminate waterways with polluted runoff. These impacts are proportional to the area taken by the street's right of way (ROW) and its paved area. Also, the greater the land portion used for street the less land remains for housing and other uses. This ratio affects housing costs directly through the cost of land and, indirectly, through the required maintenance of streets. Though housing cost is not a natural resource issue, it enters the discussion because of its social significance.

Studies compare the land area used by different street patterns to assess their relative efficiency in using land.(CMHC 1995, IBI 1995). Two approaches in measuring efficiency are taken: The first identifies the land used by streets as a ratio of he total developable land and the second measures land used for streets per unit of housing. The second method requires that a housing density be associated with a given street pattern. But since housing density is not determined or affected by a street pattern, that association is not a necessary one. Therefore, the second method is not useful when comparing street patterns.

Another complicating factor in measuring street area is the assumed or actual ROW and pavement width. These vary widely historically and among contemporary cities. To enable a reliable comparison one must assume that these remain constant in all cases, recognizing that a rationally derived set of widths can be used for any street pattern.

	older communities			new communities	
	Beach	Cedarv.	Leaside	Miss. V.	Mead.
Gross land area	447	404	426	405	655
% P. op. space	2.8	5.6	2.1	16.5	10.7
% in Schools	2.8	3	2.4	4.3	5.3
%in Roads	30.2	26.2	34.9	30.1	25.2
Develop. area	286.9	263.2	258.3	198	385.2

Figure 4-17. Land Use Efficiency

Five Toronto neighbourhoods and the distribution of some of their land uses: public open space, schools and roads. Newer subdivisions dedicate more land to open space and schools and, in general less space in roads.

Source : IBI 1995

A study of five Greater Toronto area existing neighborhoods (IBI 1995) found ratios of road areas to vary from 25.2% to 34.9 % of the total gross land area. The former represents a discontinuous curvilinear pattern while the latter a rectilinear grid pattern. This difference represents a 40% increase of area dedicated to roads. A study comparing the costs of infrastructure for two types of street patterns, conventional (existing) and neotraditional (hypothetical), found a 10% difference in the proportion of area taken up by streets and a 22% increase in the length of streets (see layouts in chapter 4).

	compared to Armadale		compared to Mintleaf	
	%	cost	%	cost
More roads	35.6	822,200	37.2	883,100
Lanes	64.4	1,490,400	62.8	1,490,400
Total add. cost	100	2,312,600	100	2,373,500

Figure 4-18. Road Area percentages.

A planned Neotraditional community is compared to two existing conventional suburbs to determine the reason for the extra cost: More roads and the addition of lanes are found to account for it.

Source : CMHC , "Changing Values...", 1997

Similarly, an infrastructure cost study (Hygeia 1997, MMM 1994) compared two existing suburban communities with a planned one (neotraditional grid-based) and found that the grid-based community was from 16 to 24% more expensive than the conventional discontinuous-pattern communities(fig.4-18).

These studies show that streets affect the efficiency with which land is used in two ways a) by the frequency of their occurrence and b) by their width. Their frequency depends on the choice of street pattern and the depth of the buildable lots: the tighter the weave of the pattern the lower the efficiency and the shallower the depth of the lots also the lower the efficiency. Curvilinearity, a frequent attribute of discontinuous street systems, stems from an aesthetic preference and has no bearing on the efficiency of land use.
When considering land efficiency, evidently, discontinuous street patterns emerge as the obvious choice.

Streets as consumers of resources - Oil consumption and CO_2

Though the discontinuous street patterns of the conventional suburbs have been shown to use land efficiently, many authors criticize them on the grounds that they are resource inefficient with respect to a) urban travel and b) using the renewable, nonpolluting energy from the sun.

This criticism involves a third way of looking at resource use by street patterns: Their indirect influence on energy use by people and structures. The first involves comparing the travel habits of people residing in different areas and determining the relation between the street patterns of the area to the amount of car travel. At issue is the consumption of oil, a nonrenewable resource, and the emission of CO_2, a greenhouse gas. The second, assessing the consumption of fuel for heating houses under different orientations.

Travel influence

It has been observed that suburban residents generally travel by car more frequently (Kelbough 1997). This fact is often attributed to the street paterns which are said to lengthen distances and make pedestrian access difficult.

Most authors agree that the discontinuous patterns reduce connectivity and discourage walking (Southworth 1997). However, it is also generally accepted that people will walk only if there are meaningful destinations within a quarter mile radius (Ewing 1997). At current suburban population densities, destinations such as convenience stores, are not viable at that distance because they draw on an insufficient, thinly spread out customer base. Public transit also depends for its viability on population density. Connectivity without destinations will not induce walking and destinations will not emerge without sufficient residential *density*. When destination emerge, however, connectivity is indispensible for their viability.

With respect to the comparative travel habits of residents of communities with differing street patterns it was found that the patterns had less influence on the amount of travel than the location of the community within the urban structure. In fact, a grid-pattern community even with a complementary set of attributes such as moderate density, shops schools and work places, if located in the urban periphery will show equal or greater travel (fig. 4-19) per household than the curvilinear, discontinuous patterned ones without these features but located closer to the city centre (CMHC, 1999).

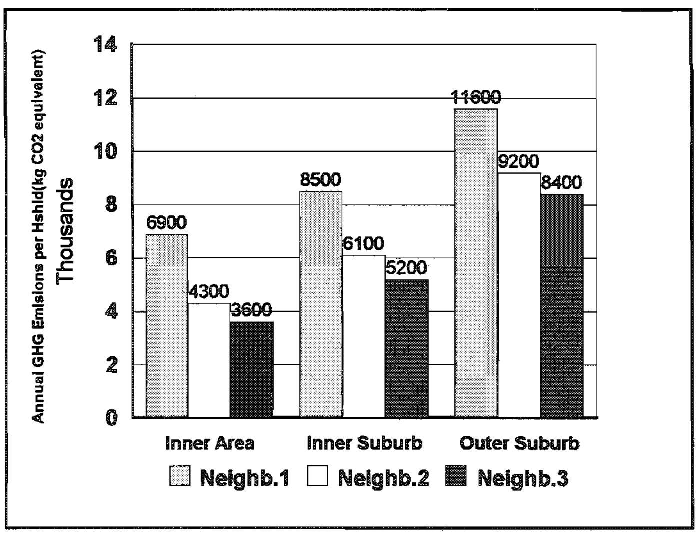


Figure 4-19. Neighborhood Scenarios - Annual GHG Travel Emissions per Household.

After car ownership, the strongest explanatory variable, in the auto VKT model, is the distance from the CBD. As for car ownership, its strongest predictor is the number of adults in the household and the second strongest, the household employment income.
Of the design variables of a neighborhood, none appear to have a decisive influence on VKT: Residential density moderately decreases car ownership and increases transit travel, and curvilinear layouts associate with slightly increased car ownership.

Source : CMHC 1999

The same study concludes that "the "macro" urban structure is more important than the "micro" neighborhood design in reducing GHG emissions from auto and transit weekday travel by residents". Though small, the impact of street pattern design on car travel reduction is discernible. The linkage between street patterns and weekend travel has not been determined; most studies capture only weekday data. Recent statistics indicate that personal travel in general has been increasing steadily tracing the growth in GNP and the corresponding personal affluence.

These studies show that the effect of street patterns on the efficiency of travel with respect to its length and frequency (oil consumption) is either not sufficiently understood or to the extent that it is understood of secondary significance. The primary role with respect to this efficiency is clearly played by the distribution of land uses - the macro or regional scale planning. Street patterns at the local level can support that role by reflecting and complementing regional planning priorities.

A much different view on travel as a factor in resource use focuses on the causes for concern: the use of oil and the resulting CO_2 emissions. This view maintains that it is more cost-effective and quicker to invest in improving the efficiency of car engines that have a life-cycle of 5 to 10 years than in changing the structure of communities that have a minimum 50 year cycle and enormous invested capital. The proponents of this view suggest that, ultimately, the internal combustion engine has to give way to a new nonpolluting one that uses a renewable source. Engine prototypes, such as Hybrid and Fuell Cell based have already been built and are in use. Historically, the expectation for oil displacement is justifiable given that other sources of energy and power such as wood, coal, water, animal were displaced because of intrinsic inefficiencies and limitations; the indisputable negative effects of using oil suggest that the time may have come to displace it.

The analysis of street patterns with respect to their impact on travel and ,by implication, oil consumption suggests that: a) street patterns have a relatively small effect compared to the location of destinations, b) their exact relation to car use cannot be strictly established without separating the contributing factors of residential density and mix of uses, c) regional distribution of uses is far more important than the patterns themselves d) street pattern influence on weekend travel habits is not known and e) that efforts for reducing oil consumption could be far more effective if aimed at improving or replacing the internal combustion engine than at changing street patterns of new or existing communities.

Influence on house heating

The literature shows that houses generally get 10 to 15% of their heating requirements satisfied by solar heat. In cases where houses have been deliberately designed to accept and use solar radiation this percentage can rise to 30% (CMHC 1998). A simple but essential condition for this benefit, and the corresponding reduction in fuel consumption, is an east-west orientation of streets. Such orientation enables houses to have one of their main elevations facing south.

Street patterns of conventional suburban subdivisions pay no attention to orientation. The extensive and persistent use of curvilinear streets, produce random orientations of houses. This randomness reflects their design approach which predates environmental concerns and is focused predominantly on creating an alluring milieu.

The street patterns of Neotraditional developments fare no better. Though in principle based on a rectilinear grid, which provides the opportunity for correct orientation, in practice they do not consider

orientation for passive solar heating. The design emphasis is placed on recapturing the elements of the small American town.
The impact of street orientation in reducing fuel consumption is significant and should reenter the street design considerations; it is also immediate and tangible. The orthogonal geometry is the likely the means by which this consideration can be accommodated.

Conclusions

This brief review of current ideas and issues concerning street pattern design suggests the following thematic lines and directions for new design alternatives:

- Aesthetic considerations can be included in the design criteria set but cannot be given high priority; a street's livability has less to do with its aesthetic quality than other nonphysical attributes.
- The overriding concern in residential street design must be its sociability; it depends on limiting vehicular traffic and enhancing casual, spontaneous pedestrian use, particularly by children.
- Conventional suburban street patterns have adapted to motorized traffic, meet user expectations and can guide further street pattern design development.
- Conventional suburban street patterns are the most efficient in using land.
- Walking should be made easier anticipating supports at the regional level that make it a realistic alternative to driving.
- Street pattern design cannot affect residential density, a necessary condition for walkability
- Street pattern design can make only a modest contribution in reducing car travel. Urban weekday travel depends predominantly on overall city density and the distribution of land uses. Other travel will increase regardless of street patterns or regional adjustments.
- CO_2 emissions can be more rapidly and cost-effectively reduced at the combustion engine level than at the subdivision planning level.
- Passive solar heating can reduce house energy use; it requires an east-west street orientation

1

5 Precedents and Influences of Suburban Street Design

A review of literature on suburban street design led to tracing the changes in its design from the early nineteenth-century British antecedents through to the conventional suburban forms of postwar America, to the new urbanist developments of the last decade.

The historical analysis presented below attempts to:
1) identify the ideas behind some of the important suburban street patterns that evolved in the last century and a half;
2) set them in a historical and technological context;
3) identify the resultant morphology of the built expression of some of these ideas; and
4) assess their advantages and disadvantages for today.

Traditional Streetcar Suburbs: The Gridiron

Streets are laid out in patterns that reflect the transportation mode(s) of the day, and these patterns generate particular types of circulation.

In Britain and North America, in the context of the rapid urbanization and industrialization occurring at the turn of the century, major advances in transportation technology made possible the extension of existing urban areas and the creation of new ones. The streetcar and commuter train expanded boundaries and, along with them, housing choices for people in ways previously unimaginable (Palen 1995).

The new suburban communities were laid out in a gridiron pattern around transit stops, along lines radiating out from city centers. Shops and services developed around the transit stop within walking distance of residential areas. The grid was adopted because it was the simplest and most pedestrian-friendly layout (fig. 5-1) . Its high interconnectedness and transparency made it easy for pedestrians to reach a transit stop and other destinations. The street layout of the "streetcar suburb" was based on a strong transportation logic: efficient long-distance commuting and convenient short-distance access.

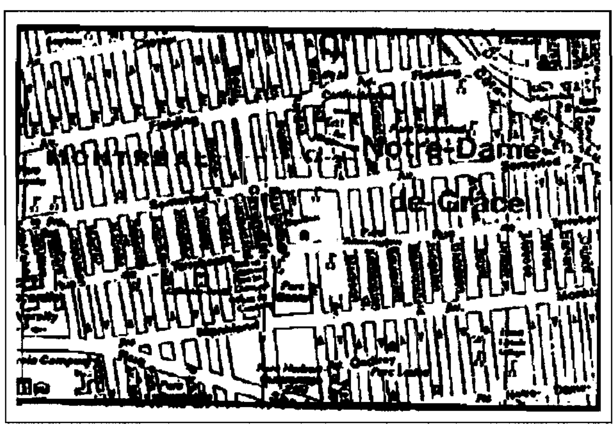


Fig. 5-1. Notre-Dame-de-Grâce, Montreal, a streetcar suburb from the early 1900s.
Though suburbs or out-of-city-estates existed since Rome, it was the streetcar that first made them possible for large numbers of people. Originally only for the upper class, who could afford the fare, eventually became the place of preference for the majority. Earlier suburbs, such as this one, have been overtaken by the continuous city expansion aided by the advancement of means of transportation, public and personal. (Note the one-way arrows, a fairly recent traffic flow management device).
Source: MapArt. Street Atlas of Montreal

Streetcar suburbs emerged about 70 years before the private automobile became commonplace. In this context, the use of the grid, which dates back to Roman times, was a natural choice due to its interconnectedness and expandability. In the era of vehicular traffic, however, the grid loses its functionality for both pedestrian and driver.
When the car is introduced into a gridiron, it creates congestion, danger, noise and pollution into each and every street: the higher the traffic volume, the greater the danger and pollution; the faster the traffic, the higher the noise level and again danger.

Figure 5-2. Traffic Congestion in Chicago, the Loop, ca 1909.

A typical situation in the centre of every large city in history: Athens, Rome, Paris, London, New York all have examples of it. The concentration of people, amenities, functions and events in the core inevitably generates congestion. This is aggravated by the layout of the streets that creates bottlenecks at every intersection: Gridlock.

Source Kostof, Spiro ,1992

The presence of through-traffic can reduce the ability of the street to provide safe pedestrian routes and to function as a space for other activities such as children's play and socializing. Grid neighbourhoods have higher rates of injury accidents than either loop or cul-de-sac neighbourhoods (Ben-Joseph 1995).

With rapid urbanization at the turn of the century and the cumulative centralization of functions, the traditional gridiron with its four-way intersections became dysfunctional for vehicular traffic. This was the case even though until 1920 the primary means of transport for most was the streetcar. The emergence of private cars in the streets further aggravated congestion which became a frequent occurrence in cities (fig. 5-2).

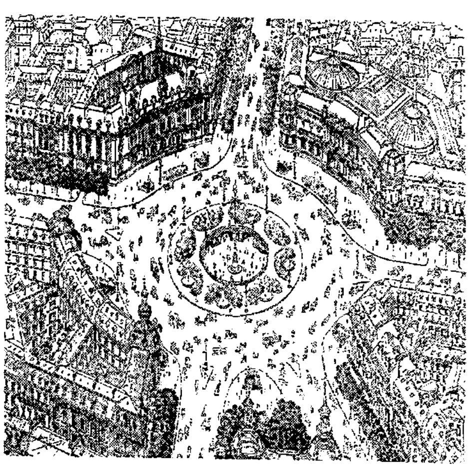


Fig 5-3. Eugène Hénerd's traffic circle responds to the grid's deficiency.

An early attempt to ease traffic flow and prevent congestion by reconfiguring the normal intersection into a traffic circle. (note that the vehicles in the drawing are horse-drawn carriages). This solution was adopted by many cities and worked well until it proved to be insufficient due to the increased volume of motorized traffic. The same idea was reapplied when entire center city districts were turned into one way grid formations: <u>effectively, each city block became a traffic circle.</u>

Source Wolfe, Peter 1968

The root of the problem is the discontinuous flow and multiple directions at intersections. Over time, many measures have been taken to counteract these deficiencies and ease congestion with varying degrees of success, including: Eugène Hénard's traffic circle (1906), (see fig 5-3) wide straight boulevards, many types of signaling systems and finally unidirectional (one-way) streets.

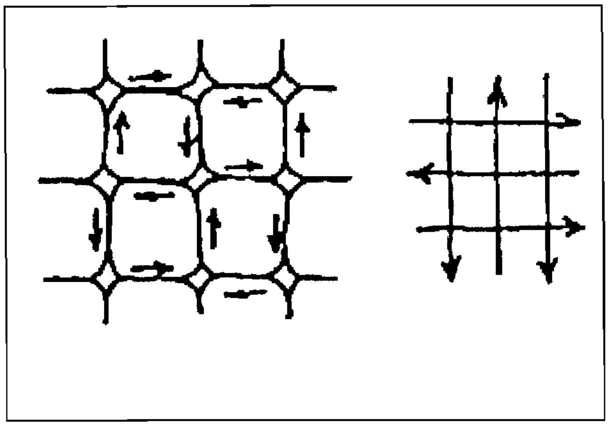


Figure 5-4. Examples of Modified Grids to Improve Traffic Flows. (From K. Lynch 1990)

Off all possible adaptations, that ease traffic flow, the most practical and widely adopted is the simple one-way street system. It eliminates either left or right turns at each intersection thus reducing the number of interlocking paths substantially.

The creation of one-way streets to ease the flow of traffic has been widely applied in most city centers (fig. 5-1), which underlines two important points. First the grid requires a traffic management measure in order to accommodate moderate to high traffic flows.

As illustrated in figure 5-4, Kevin Lynch (1990: 122) presents two ways that grids have been adapted to increase capacities and simplify intersections by creating one-way flows. In fact, these modified grids can be viewed as inhabited traffic circles.

Advantages of the Grid for Today

- For pedestrians, the tight grid provides a variety of route options and increases overall community accessibility, where destinations within walking distance exist.
- For motorists, the grid provides a greater variety of route options and may reduce congestion by spreading traffic over several streets.
- By increasing accessibility, the grid works well in supporting public transit and retail activities, where these are pedestrian dependent.

Disadvantages of the Grid for Today

- The grid makes all streets equally inviting to vehicular traffic, thereby making local streets unsafe for children's play and socializing, and restricting mobility for the young and elderly.
- The grid generates four-way intersections, which are a source of congestion at moderate and high traffic volumes.
- Four-way intersections are more accident-prone than T-intersections.

Radburn, New Jersey: Prototype for the Conventional Suburb

When Clarence Stein and Henry Wright designed Radburn, New Jersey in 1928, automobiles, though still relatively few, had completely changed the functioning and quality of city streets. They brought noise, danger and pollution to city living. Stein and Wright declared the gridiron, which made every street equally inviting to traffic, dysfunctional and obsolete. As early as the 1920s, Clarence Stein, the leader of the American Garden City movement, observed:

> The flood of motors had already made the gridiron street pattern, which had formed the framework for urban real estate for over a century, as obsolete as a fortified town wall . . . The checkerboard pattern made all the streets equally inviting to through traffic. Quiet and peaceful repose disappeared along with safety. Porches faced bedlams of motor throughways with blocked traffic, honking horns, noxious gases. Parked cars, hard gray roads an garages replaced gardens. (cited in Southworth and Ben-Joseh, 1997)

In Radburn, the designers synthesized and integrated design elements used by the American landscape designer, Frederick Law Olmstead, particularly in Berkeley Neighborhood, California (1866) and Riverside, Illinois (1868) Fig 5-11, and, a few decades later, by Raymond Unwin and Barry Parker in English Garden Cities like Hampstead Garden Suburb (1905) Fig 5-7.

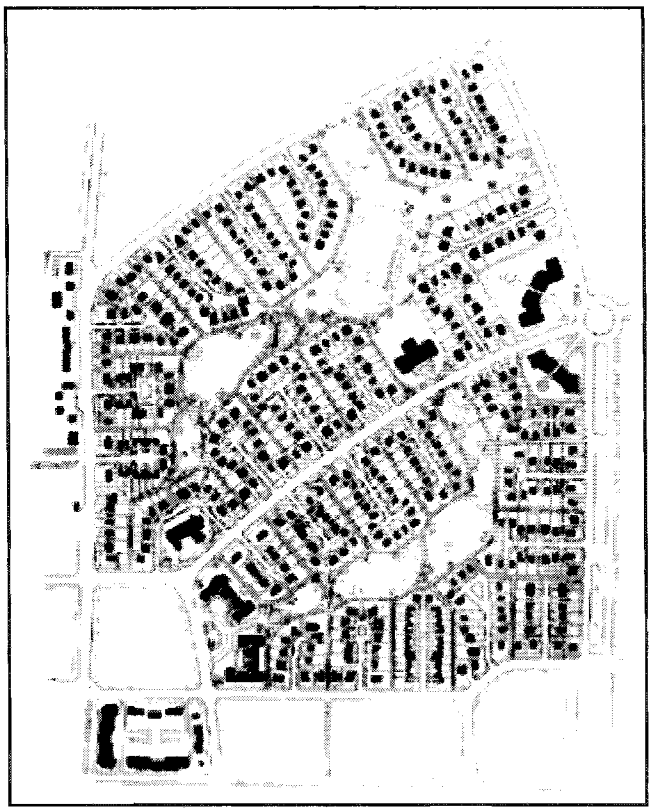


Fig. 5-5. Radburn (1928): Superblocks of Cul-de-sacs.
A radical departure from the traditional concept of the rectilinear plan, this idea was guided by the need to assimilate the automobile in the functioning of residential areas. The conventional city block was abandoned and a larger residential precinct, the superblock, was created. This was accessible but not traversible by car. By contrast, the entire block, the size of 10 to 12 traditional city blocks, was accessible on foot without crossing traffic.

Source: Southworth and Ben-Joseph ,1997

The English Garden City movement itself was a reaction against the "impersonal monotony" of the Bye-law street layout used throughout late nineteenth-century London to improve deteriorating urban living conditions associated with industrialization and rapid urbanization.

Elements from Hampstead (fig. 5-7) and Riverside, such as the cul-de-sac, street hierarchy, a curvilinear street layout, and the separation of pedestrian and vehicular traffic, were reinvented in Radburn to achieve three principle objectives:

a) to create a picturesque non-urban landscape;
b) to create purely residential streets; and
c) to limit the impact of the automobile on residential living.

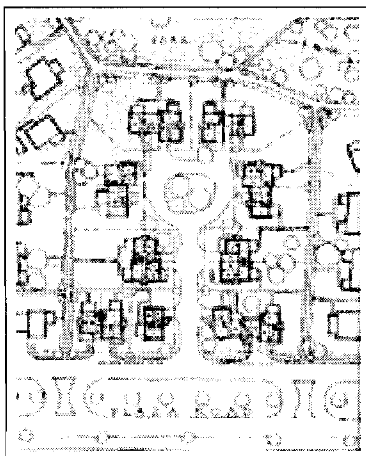
Fig. 5-7. Hampstead Garden Suburb (1905):

Cul-de-sacs, courts and common gardens at medium residential density.

Source: Southworth and Ben-Joseph, 1997

A pastoral setting was evoked through the use of curvilinear pedestrian pathways, tree planting and landscaping, a greenway linking neighbourhoods, and a street layout that respected the natural topography of the site. To create purely residential neighbourhoods, all housing was located in "superblocks" containing cul-de-sacs (fig. 4-5). To limit the impact of cars, Radburn's plan featured a street hierarchy which facilitates vehicular circulation while discouraging through-vehicular traffic on residential streets. In addition, cars and pedestrians are separated; in some cases, completely, by using a pedestrian pathway connected to a greenway; in other cases, partially, by using planting strips to separate sidewalks from roads (fig. 5-8).

This approach to suburban design became the prototype for most contemporary suburbs, and is still being used today. Most new suburban communities follow essentially Radburn's approach to street design in a number of variations, including the replacement or mixing of the cul-de-sac with loops and a relaxation of the strict separation of vehicular and pedestrian traffic.



Figs. 5-8. Radburn (1928): Separation of Vehicles and Pedestrians

Note also the divided arterial and the right-turn-only entry to the cul-de-sac.

Source: Southworth and Ben-Joseph, 1997

Seventy years later in 1990, almost half of the US population makes their home in suburbs that are based on Steins ideas. It is pertinent to note that Radburn's inspiration, Hampstead, incorporates cul-de-sacs and courts in its design but, due to its predominant use of townhouses and semidetached units, has a higher density than found in either conventional suburbs or new urbanist projects (see fig. 5-7).

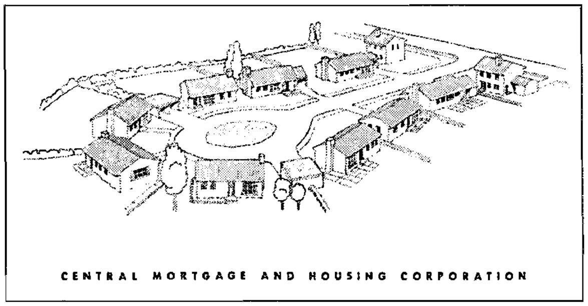


Fig 5-9. Extolling the virtues of the cul-de-sac

A publication on house groupings portrays the cul-de-sac as the ideal residential place justifying it on aesthetic, functional and social grounds. Note the wide lots and the bungalow as the predominant house type. Most Canadian subdivisions, followed this advise and residents were pleased with the results.

Source: CMHC, 1954

Radburn, itself, uses generously semidetached houses and to a lesser extent, townhouses. From these examples, it is evident that cul-de-sacs have and can be built at higher densities and need not be necessarily associated with detached housing on large lots. Partly because of this misapplied association with low density, New Urbanists call for the elimination of this street type, inadvertently discarding its positive attributes.

Figure 5-10. An ideal cul-de-sac

Roslyn place: an example of a densely built cul-de-sac "... Step into Roslyn Place and you are likely to sense, immediately, that you are indeed in a place, a special place, a handsome place, a safe place a welcoming place, a place where you might wish to live. ..... The space can be likened to an outdoor room some 65 feet by 250 feet. ....Narrowness, enclosure and intimacy bring a feeling of safety to Roslyn Place."

Source: Jacobs, A , 1994

Advantages of the Radburn Model for Today

- Cul-de-sacs and loops eliminate through-traffic and create a peaceful and safe common street space.
- Cul-de-sacs generate T-intersections, which are safer than four-way intersections.
- Separate pathways provide safe route options for pedestrians and cyclists.
- Street hierarchy channels traffic away from residential streets and improves traffic circulation.
- The use of cul-de-sacs decreases infrastructure costs.

Disadvantages of the Radburn Model for Today

- The excessive application of cul-de-sacs and loops, especially in combination with curvilinear roads, may generate isolated enclaves, and elongated pedestrian and vehicular routes.
- Separate pedestrian pathways decrease security and liveliness on streets and increase development costs.
- The excessive application of curvilinear roads is disorientating. A rigid street hierarchy that channels traffic onto collectors and arterials can create peak-hour congestion.

Conventional Postwar Suburban Street Patterns: From the Cul-de-sac to the Strip

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By the 1850s, curving roads set in pastoral landscapes became part of the lexicon of suburban planning. In 1869, Frederick Law Olmstead, and his partner, Calvert Vaux, designed the best-known curvilinear suburb of the nineteenth century, Riverside, Illinois (fig5-11). Olmstead's "rejection of the grid and the adoption of the curvilinear road and single-family house epitomized the suburban ideal of the placid and pastoral in contrast to the efficient and mechanistic order of the urban environment". (Southworth and Ben-Joseph, 1997)

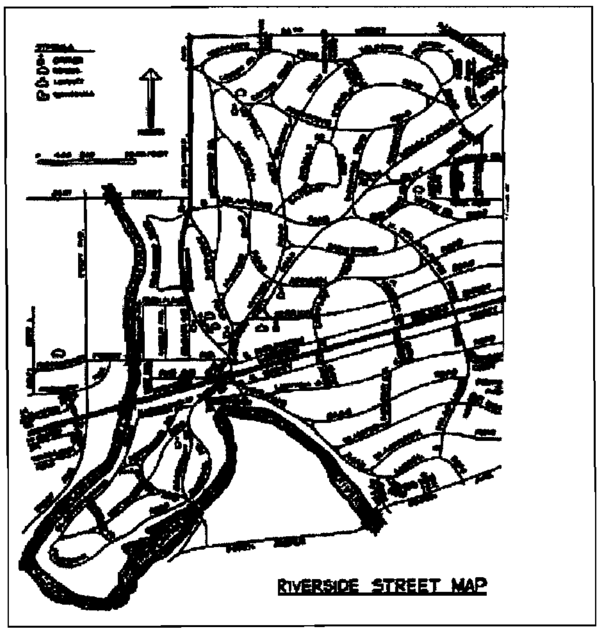


Fig. 5-11. Riverside, Illinois (1868): Curvilinear Street Pattern.

Several decades later, curvilinear suburbs were featured in the depression-era Greenbelt new towns as models of "modern" planning. At about the same time, 1924 the US Federal Housing Administration (FHA) published a series of documents containing technical and planning standards for residential communities that combined Garden City, Radburn and Neighbourhood Unit planning principles (fig. 5-12).

These documents also showed examples of what the FHA considered "good" and "bad" design, such as its promotion of larger lot widths and longer blocks. In part, as a result of the widespread adoption and application of these standards throughout the 1950s, 1960s and 1970s, the conventional suburban model has become the most widely used form of residential development in North America.

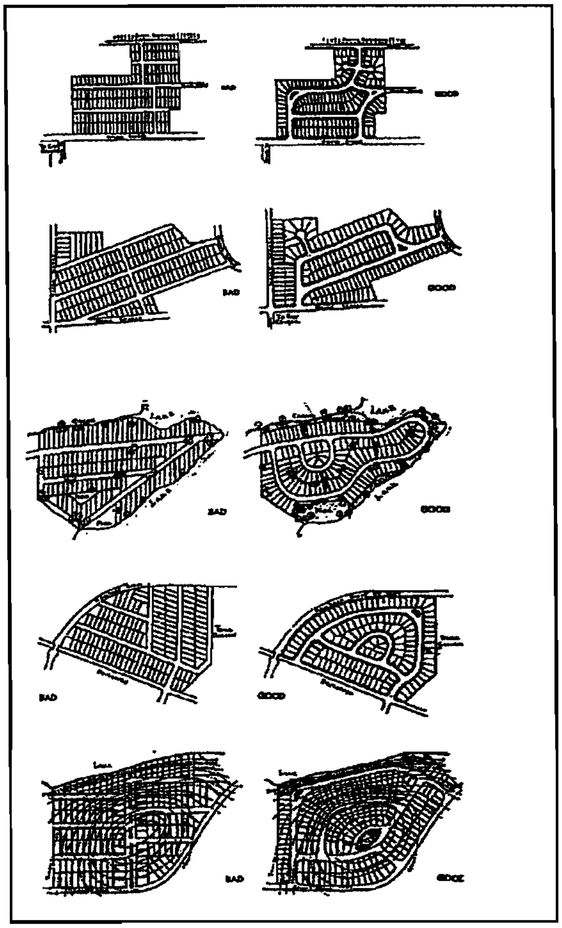
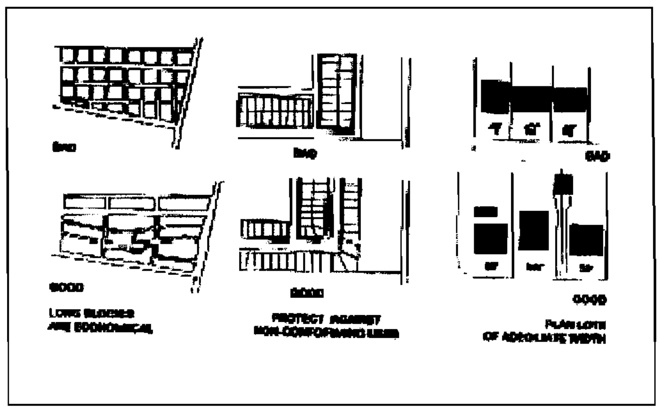


Fig. 5-12. Example of FHA guidelines



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urce: 1. Southworth and Ben-Joseph, 1997 and 2. Easterling 1993

Most conventional suburbs are laid out according to a street hierarchy of arterial, collector and local road, in which each street is designed for a specific purpose, depending on the expected speed, volume and destination.

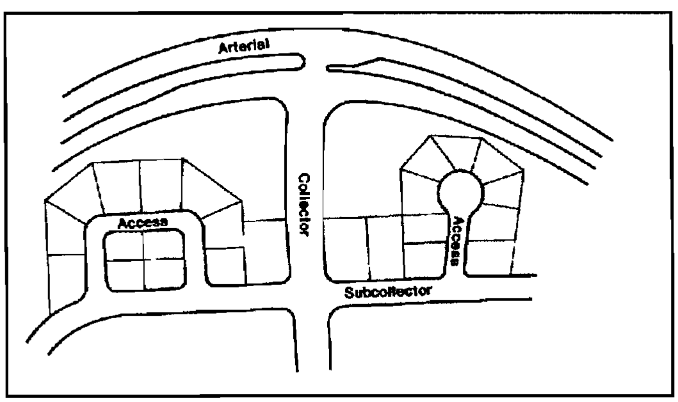


Fig 5-13. Street Hierarchy.

Access, Subcollector, Collector and Arterial comprise the range of road types that make up residential districts.
Ideally, no residential buildings face either an arterial or a collector: these roads become "traffic sewers" unfit for people. In a good layout, most houses will be on an access-type street: loop or cul-de-sac. Subcollectors are an inevitable compromise.

Source: ASCE - Residential Street Design, 1990

Houses — primarily single-family detached — are located, for the most part, on cul-de-sacs and loops. The street pattern is curvilinear and irregular. Even in the early Riverside example, the curvilinear street plan is disorienting and difficult to conceive despite the community's origins as a railway suburb.

The problems commonly associated with conventional suburbs, such as architectural and social homogeneity, disorienting street layouts, and others, lie not with the original design intentions of the early garden suburbs but with their application, particularly in the postwar period. According to Witold Rybczynsky (1995), "compared with contemporary suburban developments, the garden suburbs were paragons of urban design. Instead of confusing layouts of cul-de-sacs, there were carefully planned hierarchies of avenues and streets interspersed with parks and squares. Instead of the ubiquitous bungalow, there was variety: row house terraces, clusters, twins and courts, as well as freestanding cottages and villas."

Why the change? The principal answer is that postwar suburbs were marketed to a large and growing middle class for their affordability, so costs were kept low by eliminating the "extras", such as quality architectural and site design. "By concentrating entirely on making houses affordable," Rybczynsky (1995: 196) notes, "the developers overlooked the chief lesson of the 1920s garden suburb: subdivisions should not be composed solely of private dwellings but also need shared public spaces where citizens can feel they are part of a larger community."

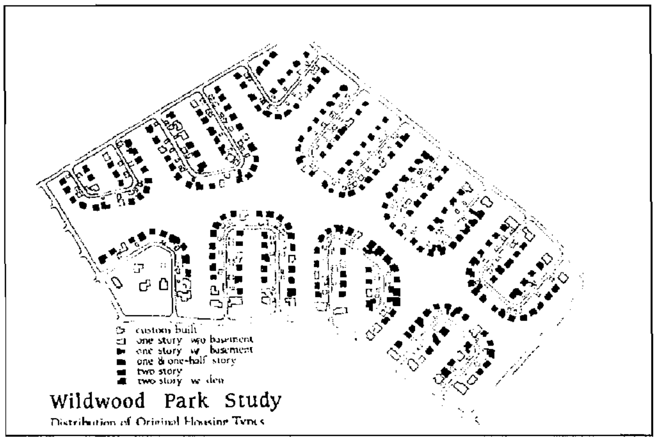


Fig. 5-14. Wildwood Park, Winnipeg, 1947

Patterned intentionally on Radburn, this plan replaces the cul-de-sac with the loop and abandons the strict separation of pedestrians. These two practical adaptations became common in subsequent conventional suburban subdivisions.

Source: CMHC, 1983

A second answer is that, after the late 1920s with the mass production of the relatively affordable automobile, suburban development was freed from geographic constraints of transit stop based growth(Palen 1995); any and all developable land became accessible and consequently affordable. Accordingly, the street patterns adopted for the suburban expansions of the postwar period owe their existence to the private car. They reflect the fact that most destinations are a short drive away and also that car traffic is dangerous and disruptive. The conventional suburban street pattern is discontinuous and frequently curvilinear with many dead-end streets. Using this pattern, most suburban districts create enclaves, with limited access points and connections to other neighbourhoods.

A Canadian example of the prototypical conventional suburb is Wildwood Park in Winnipeg, Manitoba (fig 5-14). Built in 1947, Wildwood Park served as a model for many suburban developments built throughout Canada. Its layout was inspired by Radburn's design, particularly the use of a "superblock" containing several loops (rather than cul-de-sacs), the separation of pedestrians and cars, a road hierarchy, and a park as the backbone of the neighbourhood. While, like most postwar suburban plans, Wildwood Park incorporates many elements from Radburn, it shuns the dense cluster which preserves open space (fig. 5-14)

Not only individual subdivisions such as Wildwood Park, but entire districts were developed using these principles. In response to the rapid population growth, urbanization and economic prosperity of the postwar period, this suburban pattern was employed in expanding urban areas throughout North America. A Canadian example of the use of suburban model at a larger scale is Mill Woods, Edmonton (fig. 5-15).

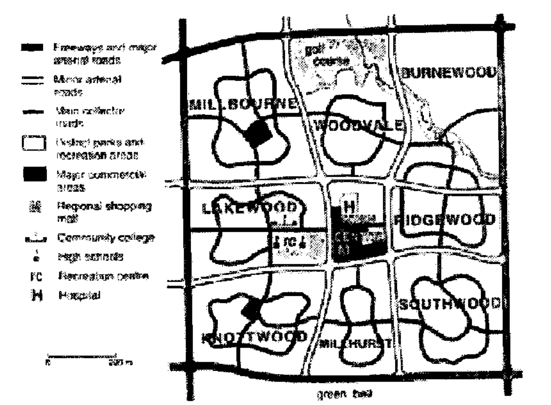


Figure 5-15. Milwoods Large Scale Subdivision

Large scale plans at the regional district level maintained the rectilinear (large grid) geometry because of the original subdivision of crown lands into large orthogonal parcels. That geometry gave way to more curvilinear patterns as the scale decreased. All collector roads within a district bounded by arterials were curvilinear. Though their curvature helps control speed, it was justified mainly on aesthetic grounds. Ironically, they were rarely inhabited or walked on and the aesthetic benefit was lost to the residents of the district.

Source: Plan Canada, Jyly 1994

The design of the typical conventional postwar suburb of the is well adapted to the presence of the automobile. Fashioned with curving streets, cul-de-sacs, loops and segregated land uses, contains and controls the car while it invites nature in. (Fig. 5-16)).
A negative consequence is that, the curvilinear and discontinuous street layout, when paired with low densities of typical conventional suburbs, necessitate longer trips, unfeasible except by car.

Figure 5-16. Contemporary, mature cul-de-sac.

Note the children playing street hockey, an activity made possible by the exclusion of through traffic.

Source: Author

By means of these adaptations, the conventional suburb has inadvertently separated and disconnected people and places. Circuitous and illegible street layouts, wide arterials that intersect infrequently and irregularly, single-use zones, shopping centres accessible only by car, all compounded by low densities, have resulted in spatially dispersed elements and districts.

There has also been a gradual change at the regional scale. Since the 1960s, the role and position of the suburb in the overall urban context has shifted. Previously, the central city provided most jobs; today, jobs are scattered throughout the urban region, with the suburbs claiming an increasingly larger slice of the employment pie. At the same time, metropolitan areas have expanded, increasing commutes in both directions. The role of the arterial has also changed: it has become a commercial strip.

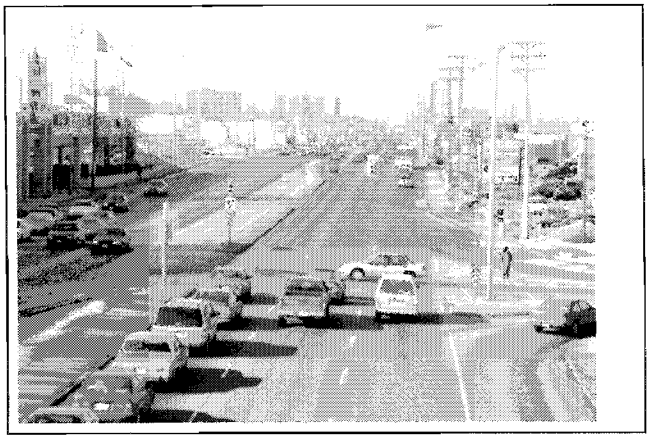


Figure 5-17. Major commercial Strip with a large enclosed shopping mall at one end. **(On the left side of photo)**

Once a residential street, a two-mile portion of this arterial was gradually transformed, like many others, into a commercial strip. This transformation is still occurring both in the extent and intensity of commercial buildings (see photo below).

Source: Author

Businesses immediately grasped the commercial potential of the arterial. They realized that daily volumes of as many as 50,000 drivers would make the arterial a prime location for superstores, fast food restaurants and parking lots (Langdon, 1994). As of 1990, strip malls accounted for 87 per cent of all shopping malls and such malls produced half of all shopping centre retail sales.

Figure 5-18. Transformation of street to strip.
The same artery as in fig. 5-17 above, a few blocks down the road. The house on the left and minor retail on the right show the state of the artery before it became a shopping strip.

Source: Author

Advantages of Conventional Suburban Street Patterns for Today

- Street hierarchy channels traffic away from residential streets and improves circulation.
- The use of loops and cul-de-sacs enhances safety and security, and invites children's play.
- Separation of land uses creates quiet, clean and safe residential areas.

Disadvantages of Conventional Suburban Street Patterns for Today

- Street hierarchy reduces options for drivers, raising the peak time traffic congestion potential
- Arterials of 6-8 lanes, that carry high traffic volumes are too wide for safe crossing.

- Arterials that intersect infrequently result in few places to turn left and in long delays.
- Rear-lotting on collectors and arterials, creates inhospitable and unsafe places to walk,
- The excessive use of curvilinear roads is disorientating and lengthens pedestrian and vehicular paths.

Defining " Neighbourhood"

In anticipating and planning for growth, two fundamentally different approaches have been taken: first, the open-ended grid that can grow uniformly by repeating the elemental unit—the city block— in any direction; and second, the intermediate-sized planning unit—a fully organized cell—that represents the unit of repetition. A third approach, that dominates most of suburban development, is the "community" planning. (or, similarly, Planned Unit Development). It has no regular repetitive element either small or large scale and, as such, it does not constitute a method or a system for growth. The "community" most commonly consists of an acquired piece of land whose size is incidental and can vary from a few to several hundred hectares.

The second approach, the cell unit, is exemplified by cities such as Savannah, Georgia, by Radburn, and by Le Corbusier's urban vision, la Ville Radieuse. It has also been the subject of planning studies, notably by Clarence Perry, Christopher Alexander, Kevin Lynch, and more recently by proponents of neotraditional and Pedestrian Pocket planning approaches (Duany and Plater-Zyberg, 1992, Peter Calthorpe, 1993). While these various approaches share the idea of a repeatable self-sufficient cell, the particulars of the unit's size, configuration, characteristic elements and boundaries differ considerably.

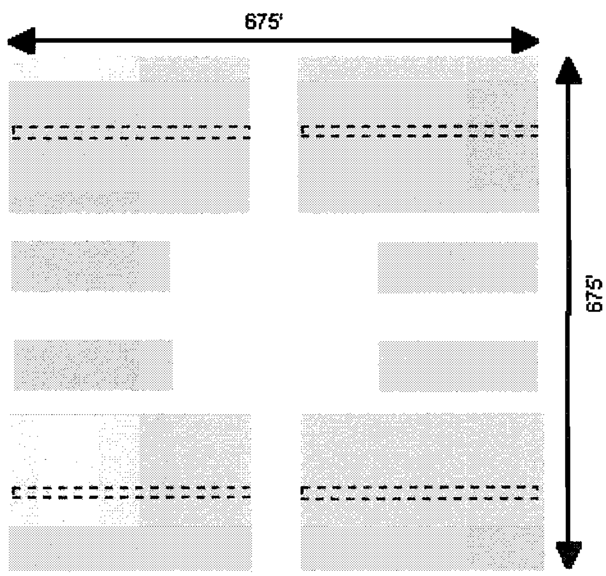


Figure 5-19 . Savannah: The Geometric Cell, 1733-1856

Each ward of 675 by 675 feet (206 by 206 m) was conceived to be a neighbourhood of 40 houses, each house on a 60 by 100 feet lot. (3 units per acre). Four main blocks (300 by 200 feet) with back lanes were residential and four smaller blocks 60 by 200 were meant for public uses. All 8 blocks form a unit around a common open space (appr. 200X200 feet)

Source: Drawing by author

Considered one of North America's most livable cities, Savannah's plan repeats a cell or "ward" presumed to have been derived from Vitruvius (Bacon, 1967). This cell, organized around a large public square, contains four regular residential blocks and four smaller blocks for "public" buildings. Seven per cent of the land is devoted to green space and 42% to streets (fig.5-21)

Savannah incorporates a carefully ordered traffic system of tree-lined boulevards, through streets, neighbourhood streets and back lanes. Streets bordering the cell are the larger through-roads and carry most of the traffic, leaving the streets inside the cell in relative peace.

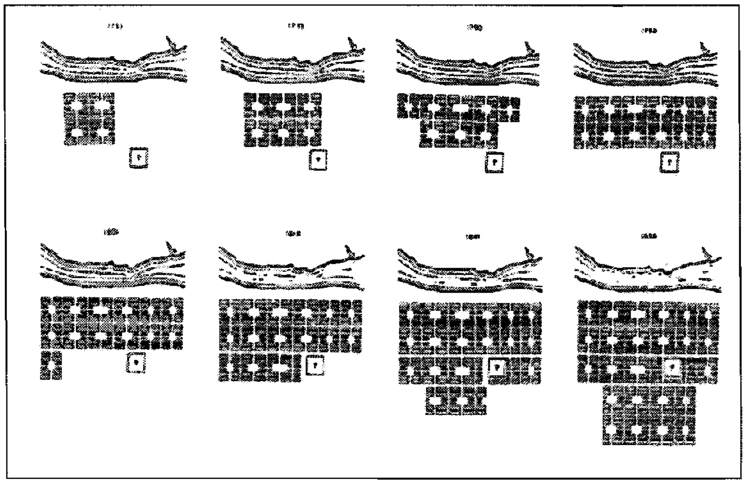


Fig. 5-20. Savannah, Georgia: City growth using wards.

Much like the traditional grid this cellular concept permits a city to grow in any direction where space and topography allow. The important difference lies in that the cells automatically define main roads while they remain protected from traffic intrusion. This is a rare example of how the inherent properties of a cell can be maintained while rendering the larger composite structure functional.

Source: Celular Automata ,199?7

Conceived long before the birth of the automobile, this cellular plan has endured, adapting well to motorized traffic. The city started with four wards in 1733, and fifty years later there were 26 wards (fig. 5-20). The key to its adaptability seems to be the presence of main service arteries at the periphery of each ward (every 675 feet) creating small islands of relative tranquillity. It is a legible, geometric pattern with well-defined boundaries.

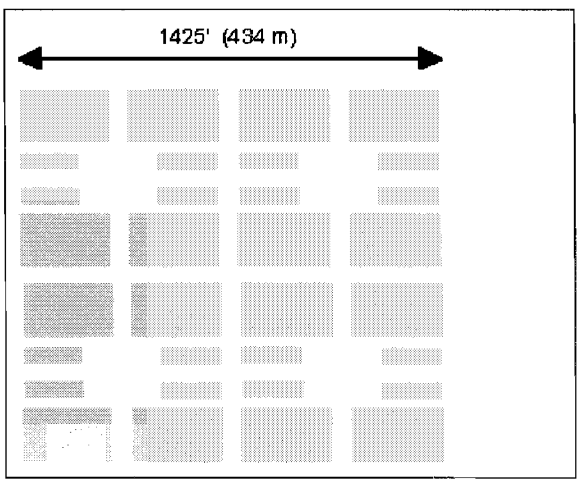


Fig 5-21. Savannah, Georgia: four wards

In this configuration, about a ¼ mile walking distance, the distribution of land uses is as follows:

Residential	**43%**
Commerc. instit.	**8.0%**
Open space	**7.0%**
Streets (ROW)	**42%**
Total	**100%**

As might be expected in a pedestrian city, streets consume a large portion of the land. Open space varied from cell to cell at the expense of the commercial/ institutional use.

Source: Drawing by author.

Ville Radieuse: The Sector, 1932.

Le Corbusier introduced the idea of "the sector" in his plans for la Ville Radieuse (1932). Urban space was divided into a grid of sectors measuring 400 by 400 meters which were surrounded by straight, elevated motor ways that permitted fast and easy access to all destinations. The sector itself, was a pedestrian-only zone of high-rises. Its high population density would support retail and services, creating a relatively self-sufficient cell. Le Corbusier's sector unit was designed for vehicular speed, movement and efficiency, with a clear separation between pedestrians and cars.

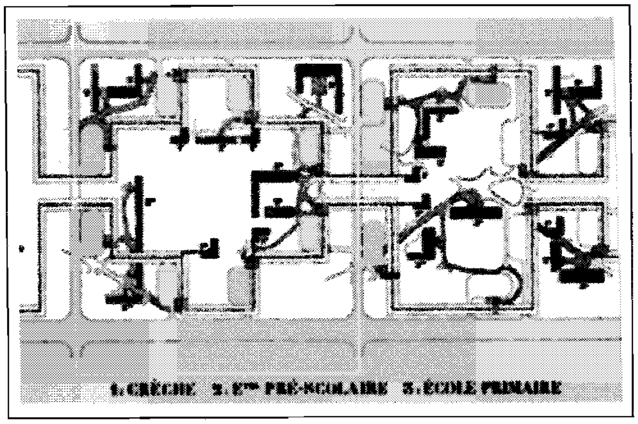
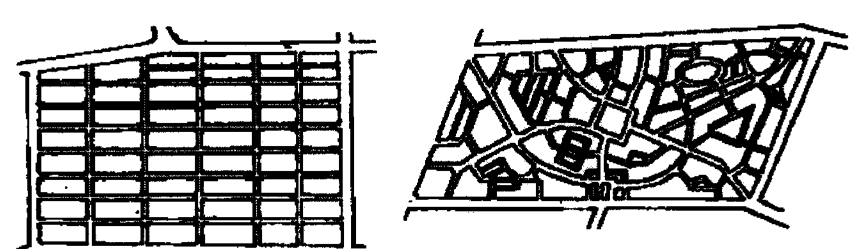


Figure 5-21. Le Corbusier : The Sector
A planned unit (cell) of growth for the motor age. In the same 5-minute walk diameter (400x400 m - white square in diagram) there are no streets - the entire area is dedicated to greenery and parking. Housing type is all of one type: apartment buildings. In contrast to Radburn's popularity, this radical departure from the traditional city plan did not find many followers. The enormity of the scale, the eradication of the street as a social space and the surrender of individual control of personal property made it an unpalatable idea.
Source: Corbusier, 1932

Radburn: The Superblock, 1928

Clarence Stein's approach to the sector concept was to limit the impact of vehicular traffic on the residential neighbourhoods by excluding through-traffic and channeling nonresident traffic to the perimeter of a superblock (figure: 5-5). Unlike Le Corbusier's sector, Stein's superblock did not follow fixed dimensional guidelines or geometry. Its approximate dimensions were based loosely on a 5-minute walk, encompassing between 10 to 13 cul-de-sac streets. Radburn was designed for a population of 25,000 on 2 square miles.

Stein also saw the superblock as a relatively self-sufficient unit containing schools, shops and workplaces. The majority of developments that applied his superblock concept, however, have replicated most of its characteristics except self-containment, thus removing one of its strengths.



The proposed and the present neighborhood street systems. Left: Leading nowhere in particular. Right: Leading to the places where people go.

Figure 5-22.
Perry s concept of a Neighborhood unit. The regular grid is transformed to exclude nonresident traffic by means of a labyrinthine network of streets reminiscent of the "organic" city (fig.4-1)
Source: Southworth and Ben-Joseph, 1997

Clarence Perry's Neighbourhood Unit, 1922-29.

Clarence Perry developed the concept of the Neighbourhood Unit (1922-1929) in reaction to unprecedented regional growth which diminished the sense of community and belonging in residential neighbourhoods. He suggested that new neighbourhoods be planned according to a residential unit that would be self-sufficient but still related to the greater community. This size of this unit —150 to 300 acres was based on the population needed to support one elementary school, i.e., 750 to 1,500 families and on a quarter mile radius (the 150 acre-parcel). The school and public spaces are centrally located and shopping at the periphery by the arterials. The overall density of about 5 units per acre, however, is not sufficient to support transit. Small retail could be viable at this density if supported by four adjoining neighbourhoods units.

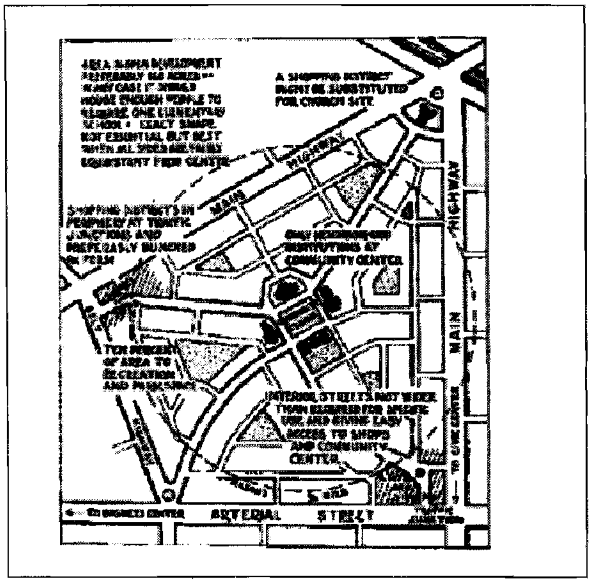


Fig. 5-22.
Clarence Perry's Neighbourhood Unit

Though the principles are clearly stated, the site plan design returns to the organic city model, highly irregular and centripetal. (see fig 4-1) The vital function of shopping (market), however, is located at the periphery. This separation of functions expresses the unresolved tension between the petestrian and the motorcar cities.
Through traffic is discouraged, by means of meanderous paths, it is not entirely excluded.

Source: Southworth and Ben-Joseph, 1997

Perry's concept of the neighbourhood unit has its foundations in the City Beautiful Movement in the United States. The movement's principal proponent, Charles Mulford Robinson, had suggested that neighbourhoods be built around a public focal point such as a *school, park or public building.* This idea dominates most large scale subdivision planning and is an essential element of most current proposals.

Christopher Alexander: A Pattern Language, 1977.

Recognizing the importance of traffic as both a vital element of a community and a hindrance to some of its functions, Alexander proposed a series of ten patterns, each of which he posited as a requirement for the "good" community. Although Alexander did not produce a complete design of an ideal city, a model could be generated using his patterns. As illustrated in figure 5-23, the urban fingers and local transport areas suggest a structure of arterials spaced one mile apart. Using his proposed components, the development area is separated into 300-yard wide local neighbourhoods of about 400 to 500 people (approx. 7-9 units per acre) with through roads delineating the neighbourhoods.

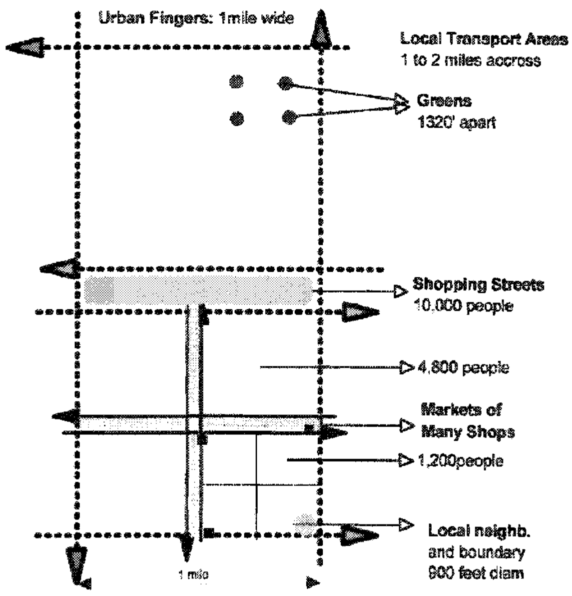


Fig. 5-22. Community design after Alexander.

Alexander does not show a unit of planning drawn with specific dimensions, though he uses numbers to define the requirements for a good plan. On the basis of these numbers and a few sketches, a diagram can be assembled that deals with the regional scale transportation and land use questions.

Its smallest unit, the *neighbourhood,* is about 15 acres in size, intended to be impervious to through traffic and defined by through roads at its perimeter. This unit is roughly 50% larger than the Savannah ward, about one half to one third of the Radburn residential superblock (30 to 50 acres) and one tenth of Perrys or Corbusier s Neighbourhood Unit (Sector).

Source: Author

All these ideas that define a unit and a pattern of growth share a number of elements that appear essential in creating the physical underpinnings of a neighbourhood ; essentially a social network.

Size: An area never larger than 140 acres which covers a distance that is easily walkable; the natural means of personal contact.
Population: No less than 750 families and preferably upward from 1500 hundred households, if a degree of local self-sufficiency in essential services is to be attained.
Circulation: A means of excluding nonresident traffic, preventing travel through the area and diverting traffic to the perimeter
Focal points: Open space a key structural element of the unit plan acts as a focal point and relief or, alternatively, as a complement of common space and public buildings.

Neotraditionalism: The Gridded Small Town Revisited

The motorcar ended the countryside and substituted a new landscape in which the car was a sort of steeplechaser. At the same time, the motor destroyed the city as a casual environment in which families could be reared. Streets, and even sidewalks became too intense a scene for the casual interplay of growing up. ... The car, in a word, has refashioned all the spaces that unite and separate men.." Mcluhan

The exponential rise in automobile use and declining central city environments have spurred high growth at the periphery as suburbs. In the United States, almost two thirds of those living in urban areas now live in the suburbs (Palen 1995). Yet, after fifty years of suburban development, many planning professionals today assert that conventional suburbs do not work. They argue that the spatial configuration of contemporary suburbs fosters social fragmentation, long commutes, too frequent and potentially avoidable use of the automobile. Alternative approaches have been proposed in response to current concerns, most notably Neotraditional and "pedestrian pocket" planning concepts, which are often grouped together under the rubric "New Urbanism".

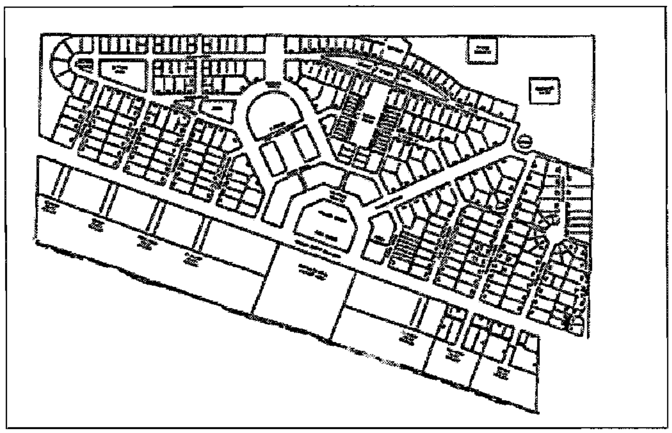


Fig. 5-23. Seaside, Florida, 1982
The first of Neotraditional developments, a 32ha sea resort. Its designers decided to route the main highway through the resort rather than bypass it. Thus "main street" was reborn along with all other characteristics of a traditional small town which the designers proclaim as the model for good suburban planning. Inevitably walkable because of its size and not susceptible to growth pressures because of its seasonal nature it is a model somewhat removed from realities of urban fringe development.
Source: Duany, A. 1994

Neotraditional planners borrow design traditions from small towns to shape new communities. For Seaside, Florida, which is considered the first true neotraditional development, the designers Andres Duany and Elizabeth Plater-Zyberk (DPZ) examined old communities such as Savannah, Georgia, Charleston, South Carolina and Key West, Florida in order to identify elements that made those places both physically attractive and socially rewarding. As a result, in their designs for Seaside (fig. 5-23) and Kentlands, Maryland, (fig.4-14) DPZ employ integrated land uses, a modified grid street network, a variety of housing types and architectural details such as picket fences and front porches.

The intent in using such elements is to induce people to drive less, walk more and use public transit. With these aims in mind, they assert that higher residential densities, grid-like circulation patterns and mixed land use will discourage driving, shorten trips and encourage walking and transit use. "The strong appeal of New Urbanism, then, is that it promises to achieve two very attractive objectives in one stroke—to create improved living environments and to reduce traffic"(Langdon 1994).

The feature which most strongly distinguishes new urbanist communities from conventional suburbs is an attempt, through the shape and character of streets, to make several kinds of connections. First, streets are connected into a network so that people can readily reach other

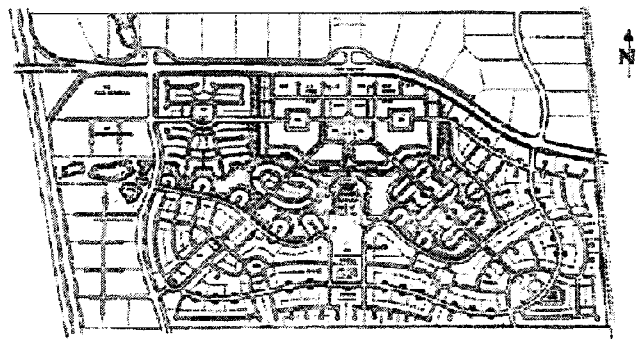


Figure 5-24. Laguna West. 1990s
This development, at least 10 times the size of Seaside and 3 times the size of Kentlands is a well publicized example of New Urbanism. Contrary to intentions, half of the houses are beyond a ½ mile range from the commercial centre and the majority beyond the accepted ¼ mile wallkable distance. Similarly, block size is comparable to conventional suburbs and loops and cul-de-sacs are freely interspersed in the plan. Furthermore, its residential density is as low as in most 90s developments: the "urban" goals have succumbed to market pressures.
Source: Calthorpe 1997

parts of a neighbourhood or town. Second, they link residents to shops and services by locating retail and institutional development within walking distance of where people live. Third, they hope to connect individuals to one another by introducing walkways that are sociable. Fourth, an attempt is made to bring together people of different ages and economic status by offering a variety of housing types and sizes. Fifth, new developments are connected to mass transit. These are all laudable and indisputable planning goals articulated by the New Urbanist movement though they have been continually on the contemporary planning agenda.

After the initial period of interest, with this new approach to suburban design, many designers, planners, developers and consumers have started to examine whether or not new urbanism actually achieves its objectives. Questions which relate specifically to street pattern include:

Are new urbanist developments more pedestrian friendly? Do people drive less?
Are services and retail more accessible? Are new urbanist developments resource-efficient?

Definitive answers to these questions are still pending. There is conclusive evidence, however, on the questions of walkability and of land use efficiency. Many of the large developments are not walkable (eg. Laguna West, fig 5-24)
Recent research (CMHC, 1997) examined and evaluated four alternative planning approaches, including the neotraditional and pedestrian pocket, for livability and sustainability. The study examines Canadian examples of alternative community design, including Cornell in Markham, Ontario, McKenzie Towne in Calgary, Alberta and Montgomery Village in Orangeville, Ontario.

It concludes that infrastructure costs associated with the neotraditional approach are substantially higher (about 35 %) than those associated with conventional suburban design. This is due largely to features of the neotraditional street configuration such as a tight grid pattern, rear lanes and streets with houses on one side only. If residential density is kept constant, land use efficiency does not improve and the per unit development costs rise.

The neotraditional approach to street design shares many of the benefits and drawbacks noted for the turn-of-the-century streetcar suburb. Some additional advantages and disadvantages are listed below.

Advantages of New Urbanism for Today

- Mixing land uses shortens distances between places, and may encourage walking and bicycling for local trips.
- Increasing residential density is fundamental to a well-functioning community
- The grid is a legible pattern and it improves connectivity.
- The use of rear lanes makes a residential street less car-oriented.

Disadvantages of New Urbanism for Today

- The grid allows vehicular traffic to cross residential areas.
- A tight grid requires more infrastructure than the conventional suburban layout.
- The grid uses more land for streets than conventional layouts.
- The use of rear lanes increases per unit housing costs.
- Actual developments have not applied the principles rigorously, raising doubts about their practicality.

6 Proposed Alternative Suburban Street Patterns

Design Objectives

Each of the approaches that were examined has inherent advantages and disadvantages for the contemporary residential subdivision.
A design that balances the advantages of a conventional suburban street pattern and the neotraditional street pattern, while minimizing the disadvantages of each would be the preferred option . Driven by this ideal, a set of design objectives were established as a basis for deciding which design elements to use and in which combinations, in the proposed alternative street patterns.

For each objective, important design elements are identified and, where relevant, the historical precedent is mentioned. In some cases, in order to underscore the link between the precedents and the proposed design alternatives, a morphological interpretation of the design element(s) is presented by way of an ideogram.

Figure 6-1. Suburban cul-de-sac - 1970s

Play, stroll, toddler bicycling and car washing are some of the activities that are safely practiced in this environment.

Source: Author

Objective 1 - Design residential streets to accommodate a variety of uses, including child's play and adult leisure activities.

In many conventional suburbs, all but local streets are designed mainly to move vehicular traffic efficiently. Streets, individually, and collectively in a network, can and should, however, serve a variety of functions. Some streets, such as main streets, may serve many functions (shopping, workplace, meeting place, walking path, parking space). Others, such as local residential streets, may serve different and fewer functions (play area, hockey rink, carwash).

The task is to design streets suited to their main uses and in so doing, to attempt to accommodate conflicting uses and minimize or eliminate secondary, incompatible ones. For example, a low-density residential street located several blocks from a commercial area would probably require little on-street parking.

Objective 2 - Design local streets to provide convenient vehicular access for residents while discouraging through-traffic.

On local streets, it is necessary to balance the needs of drivers and of children and pedestrians. The main function of local residential streets, however, is to provide a safe and comfortable living environment for all residents. Their design, therefore, should be strongly oriented toward pedestrians, children's play and social interaction.

The cul-de-sac, loop and T-intersection, staples of conventional suburban design, have proven to be very effective in limiting through-traffic on residential streets. (Fig. 6-2) Other design devices, such as a narrow street width and regular tree planting and landscaping can also be used in conjunction with discontinuous street types to enhance their pedestrian character.

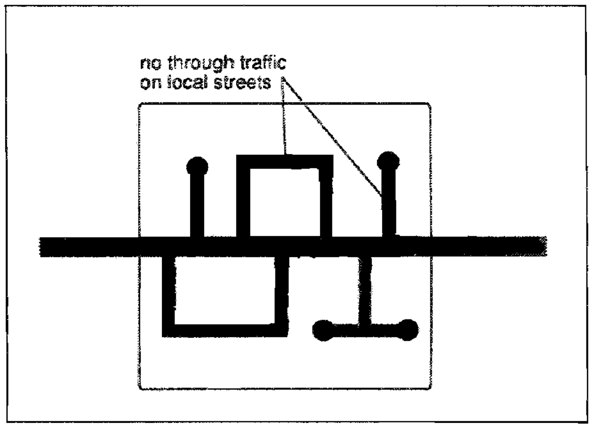


Fig. 6-2. Ideogram: Cul-de-sacs and Loops

Objective 3 - Design an interconnected pedestrian network.

In conventional suburbs car use is necessary, and, conversely, other means of movement, such as walking, cycling and taking public transit, become easily optional.
Of all three means walking in particular has social, health and environmental benefits. It increases opportunities for social interaction, provides exercise, and avoids pollution and resource use. These latter benefits also apply to bicycling.

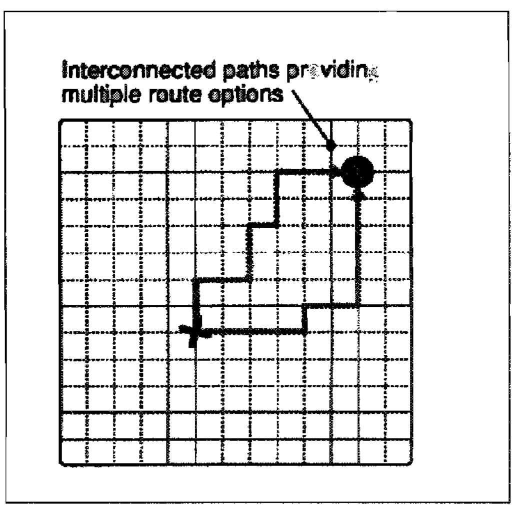


Figure 6-3. Ideogram: interconnected paths

To encourage residents to walk and reap these benefits, a neighbourhood's street system should be interconnected and offer multiple routes to destinations.

The goal, then, is to design a community so that residents are given an attractive and convenient alternative to driving. The design must recognize, however, that convenient pedestrian and bicycle routes is not a sufficient condition for enticing people to walk; it is the presence of meaningful destinations.

Interconnectedness in the street pattern should, therefore, be matched with actual or potential amenities at a convenient walking distance.

Objective 5 - Provide access to useful destinations within a 5-minute walk distance

It is generally accepted that people will walk up to five minutes, or about 400 meters, to reach a local shopping area, a transit stop or a neighbourhood park. Beyond that distance the use of the facility drops substantially or the car is used to reach it.

A street pattern can ensure that destinations can be reached within the 400 meter radius; it cannot, however, create them. Their creation depends on land use distribution which in turn depends on modes of production, exchange, transportation, communication, and work.

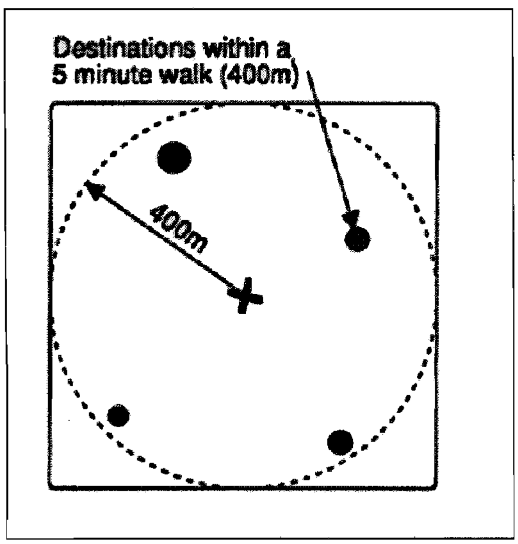


Fig. 6-4. Ideogram: Destinations within 400 m Fig.

A street pattern in conjunction with a land use pattern should aim to create the conditions that are conducive to making a service or amenity viable.

Commerce, for example, thrives on traffic and easy access. It naturally gravitates around heavy traffic arteries and heavily populated districts. The street pattern should build on these affinities.

Objective 6 - Minimize the impact of car traffic on residential areas.

Car ownership and use is widespread and increasing. Even when given the option of accessible and affordable public transit, many people prefer to drive. Recognizing this trend, the street network should be designed to move cars efficiently while taming their negative effects on living (e.g., noise, danger, pollution).
As in Radburn, in order to create purely residential streets, the street hierarchy model of local road, collector and arterial (fig.5-5) associated with conventional suburbs has been shown to control effectively traffic volumes on local residential streets.

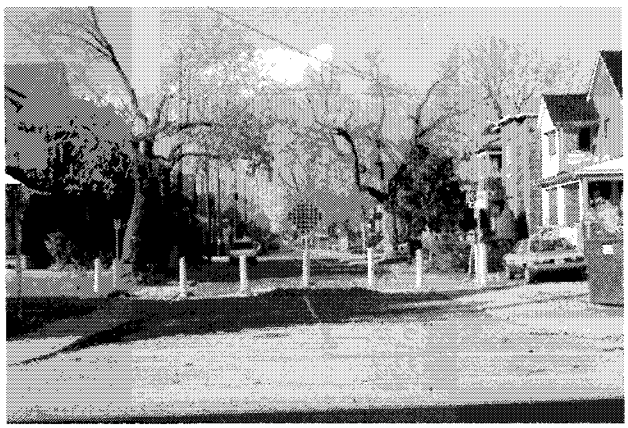


Fig. 6-5. Street Hierarchy

An example of forced hierarchy applied to the grid of a central residential area of a city. One of the many adaptations that existing residential areas of cities have undergone to cope with unwanted, nonresident traffic. The closure turns a previously through street into a dead-end minor, local street. Interestingly, it still permits pedestrian and bicycle access.

Source: Author

Objective 7 - Conserve land by minimizing the amount of land devoted to streets.

Land dedicated to streets is land lost to housing, open space or other uses. Importantly, housing and open space each contribute to the vitality and livability of a district. Employing cul-de-sac and loop arrangements in combination with reduced street width decreases the amount of land required for streets enabling its use for other purposes. While making more land available for housing, this shift also reduces infrastructure costs that are roughly proportional to the street length.

Alternative ROW for Streets:

	Conv.	**Alter.**	**%differ.**
Mews	15.0	12.5	- 16%
Minor Street	18.0	16.5	- 9%
Aver. Street	18.5	18.0	- 3%

(Adopted from *Making Choices* by the Ontario Ministry of Housing 1995)

Figure 6-6. Benefit of Narrower Streets

Reducing of the street ROW and pavement width can increase the developable area and reduce infrastructure costs.

Objective 8 - Design the street network to accommodate incremental change and growth.

Social and technological changes have a direct impact on the urban fabric, most strikingly on public spaces such as streets and squares, and the land uses adjacent to them. As cities evolve, the functions of public spaces also evolve. Public spaces tend to evolve in particular ways: the central market space becomes filled in with buildings, streetcar lines develop into commercial nodes, the lone corner grocery store becomes part of main street, commercial districts spread into residential areas, commerce develops around subway stops and commercial strips follow arterials, often as an extension of main street.

The closed, discontinuous circulation system of the conventional suburb, however, inhibits change and separates neighbourhoods. On the other hand, one fundamental characteristic of the grid is its flexibility and unconstrained expandability.
A merging of the two geometries could create the required balance between accommodating change and growth, and maintaining stability and avoiding disruption.

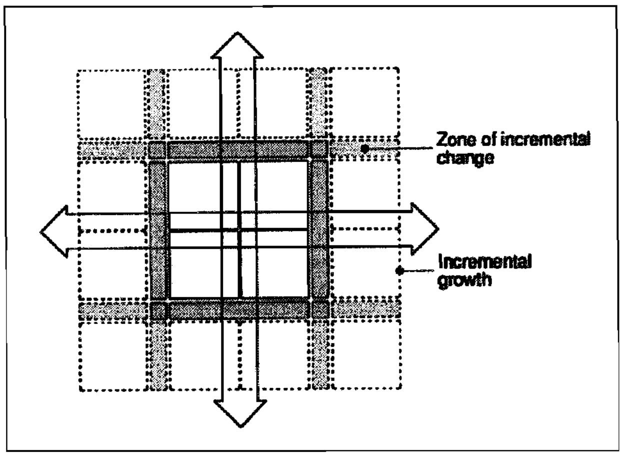


Fig. 6-7. Ideogram: Growth and Change

While growth occurs in distinct repeatable units (cells), zones between the cells absorb incremental change of functions and activities that support city vitality and viability. Thus, residential areas can retain their desirable characteristics .

The Design Approach

Following the established objectives, the design solutions presented in the following section attempt to synthesize the merits of the conventional suburban street pattern with those of new urbanism. The objectives translate into the following principles:

1. The grid, an important feature in the new urbanist planning approach, has these important characteristics. The grid is:

   - The easiest geometry to map in one's mind. As a result, it is not disorienting as is the curvilinear one.
   - A grid is inherently interconnected and the finer it is, the more interconnected.

   Thus, the grid is adopted as an organizing device not as a literal reproduction of a traditional city plan.

2. For good accessibility it is preferable for pedestrians and vehicles to have a variety of route options. The grid offers this variety. Given their vastly different speeds, however, the pedestrian network grain should be finer than the grain of the vehicular road network. The grid of the traditional city, appropriate for a pedestrian speed of 4 km/hr, should be complemented by, but not interfered with, a vehicular grid appropriate for 10 times that speed.

   Thus, two grids for two travel speeds are necessary to form an alternative pattern.

3. The cul-de-sac and the loop, which characterize conventional suburbs, are suitable pattern elements for a residential environment because they proved to be quieter and safer than through streets.

   Thus, in residential areas, maximize the number of cul-de-sacs and loops.

4. By their exclusion of through traffic, loops and cul-de sacs imply a hierarchical street pattern.

   Hence adopt the hierarchical model of organizing streets.

The design section which follows consists of two parts. The first part presents the design elements including the concepts of a residential quadrant and the "bi-way" grid. The second part extends the concepts of the residential quadrant and bi-way grid to the scale of a community by presenting an alternative to an existing suburban community in the Ottawa region - Barrhaven. A final section draws comparisons between the proposed new concept, the existing community and a neotraditional version of the same community.

Design Elements

The design components for the creation of a new plan are taken from recent subdivision developments by analyzing actual built examples, their design intentions and the resulting form. A detailed analysis of Barhaven's existing plan shows that, inspite its apparent lack of an overall order, it does follow certain rules and uses repeatedly similar elements. These rules and elements are common to most conventional subdivision plans. They are:

1. Discontinuous street pattern achieved through persistent use of "T" intersections.

2. Frequent use of cul-de-sacs and loops, in varied dimensions and configurations, both of which enhance the discontinuity of the pattern.

3. The use of minor collectors approximately every 650 feet.

4. The use of major collectors that connect to the regional arterials at roughly 1300 feet intervals.

This proposed concept reinterprets these common elements in a new setting. This setting recognizes the need for a two-scale grid and the need for a zone that invites and absorbs change in public amenities and functions:

Bilevel grid

A fine grid, formed by collectors and residential quadrant streets, is nested into a large grid formed by arterials and the exchange (commercial, institutional, recreation) corridors. This superimposition of a major and a minor grid yields the bilevelsystem. This system would improve traffic circulation while discouraging all but local vehicular traffic inside the quadrant. This approach is modeled on cell concepts (see section on Defining Neighbourhood). One such approach has been applied in various existing European cities where a city is divided into self-contained cells designed to protect residential areas from through-traffic.

In Goteborg, Sweden, the inner city was divided into five zones which are more or less sealed off to vehicles wanting to pass from one zone to another.
After the first few months, there was a 50% reduction in traffic on some roads that were previously main routes. After two years, accidents had dropped by 40% inside the cells and by 10% on ring roads (W. Zuckerman199 ?).

The bilevel grid has the following features:

1. When viewed at the scale of collectors and arterials, the movement system of the high level grid is nonhierarchical and transparent. When viewed at the smaller scale of local roads, however, the movement system is entirely hierarchical and impervious to through-traffic.

2. Growth and change are encouraged, accommodated and channeled. The structure of the supergrid is such that this growth and change can be absorbed with as little disruption to the residential areas as possible. Growth would occur by extending the grid outwards. Change in intensity and diversity of uses would be fully absorbed within the mixed use corridors, leaving the residential quadrants as stable environments.

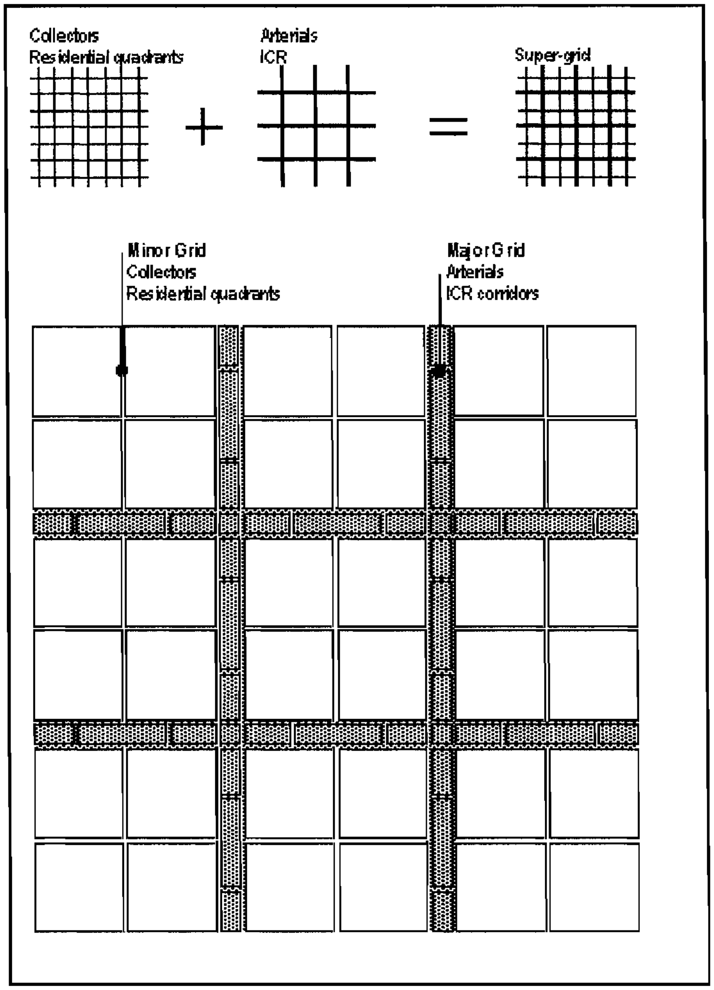


Figure 6-8. The Bilevel Grid

The bilevel grid blends a low rank discontinuous grid with a high rank continuous grid of roads. The higher rank grid consists of twined, one-roads that flank a large zone of mixed land uses.

3. The bilevel grid arterials "biways", would ease local congestion because they are one-way streets with few intersections and only right hand turns into residential districts.

4. The "biways" would half the impact of traffic on residential properties facing them and would make crossing safer.

5. The bi-way grid is an organizing principle not a fixed geometry. It contains the necessary elements for organizing circulation and uses; these can be modified to suit local conditions. The rectilinear geometry need be followed only to the extent that it enables legibility.

Commercial, Institutional, Recreational Corridor (Bi-way)

Change is inevitable and welcomed. Consequently, it is important to design the street layout to accommodate change and growth. The design adopts the use of arterial corridors to absorb change and permit community expansion.

The approximately 100m (350 feet) wide corridors - labeled commercial-institutional-recreational corridors (CIR) - are located along the edges of residential quadrants and form the major grid not just of traffic but also of what thrives and depends on traffic- exchange. The CIR corridors act as a recognizable boundary between residential areas, thus, creating identifiable neighborhoods. They are designed to accommodate mixed land uses, including retail, schools, light industrial, parks and services, all of which benefit from each other. Their transverse dimension is the comfortable size of a normal city block which is also the size that most contemporary commercial, corporate and institutional functions require.

> The presence of retail near residences can encourage people to walk and to take transit to work (Blumenfeld, Cervero and Wu). Cervero and Wu also found that, for non-work trips, the presence of mixed use is a better predictor of mode choice than residential density.

Location of CIR corridor

The CIR corridor is laid out so that all residents can live within a five minute walk of shops, services, parks and transit stops, but without the nuisance of traffic usually associated with commercial streets intruding in residential areas.

Cul-de-sacs and Loops

Both the cul-de-sac and the loop have proven very effective in limiting through-traffic on residential streets. Hence, a maximum number of units will be located on cul-de-sacs or loops.

Figure 6-9. Head of loop facing a park.

The combination of a looped road and a park can create a pleasant, peaceful environment while providing a connection to the rest of the neighborhood.

Source: Author

The characteristics of the cul-de-sacs employed are:

1. The size of the cul-de-sac is limited to approximately thirty houses. This is done in order to minimize the level of vehicular traffic on a cul-de-sac. Alexander (1977: 261) proposes that, to

be effective, a cul-de-sac should not serve more than 50 cars. Depending on car ownership rates, this could translate to between 32 and 50 housing units.

2. The length of the cul-de-sac is limited to approximately 60 m. This is done primarily to slow traffic on the cul-de-sac. Other means to that end can be used such as narrow street dimensions, humps, chokers, entrance gates, or curves.

Street Hierarchy

The proposed street patterns adopt the street hierarchy model while adapting it so as to minimize its shortcomings (e.g., traffic congestion, circuitous routes). This model normally contains the following two types in addition to the local streets mentioned above:

Arterials

The arterial carries high-speed, high-volume nonresidential traffic. Arterials occur at half mile intervals and enclose and area of approximately 160 acres. This is roughly 10 times the area of the traditional city block (200X 350 feet) surrounded by the originally pedestrian street pattern. This tenfold increase in scale is proportional to an order of magnitude increase in travel speed. To serve their function as connectors between communities and activity centres, as well as between communities and highways, they are <u>twined</u> (bi-way) and each part flows in one direction only. The half mile grid provides ample opportunity for smooth flow with few interruptions. It provides minimum and only right hand access to adjacent properties not directly but through lanes. Given their frequency the arterial biways are ideally suited for public transit. As public transit routes and main connectors between community areas, they are also ideal for providing access to amenities and facilities. Hence the mixed use zone between the two sides of the bi-way. Also the one-way flow reduces the crossing distance and permits the introduction of bikeways on the residential side of the arterial.

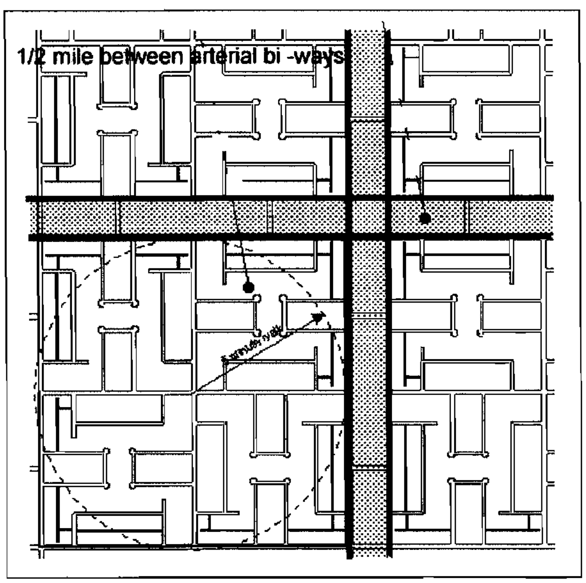


Figure 6-10. Hierarchy
Twinned arterials, residential collectors and local streets.

Arterials **are not just roads. They become zones, bounded by one way roads, that can include all functions of the main street, the strip and the shopping mall.**

Collectors **terminate at each arterial every half mile. they intersect at a quarter mile within the district.**

Local streets **loop in and out of the residential block and do not traverse it.**

Collectors

The collector is the principal traffic artery within residential areas. The collector carries traffic between arterials, to lower-order streets. In this scheme there is only one level of collector. It provides access to adjacent properties and is the link between residential quadrants. It is strictly residential and could be curved to induce lower speeds. Two collectors intersect a quadrant and stop at the arterials. The low traffic volume within the four quadrants warrants a roundabout at this intersection rather than traffic lights. Since they are confined to the quadrant and do not intersect the arterial, they would be safer for both pedestrians and bikes.

Figure 6-11. Collector with School

Collectors in existing neighbourhoods can become a liability as the traffic on them increases or as they progressively accommodate incompatible functions .

Source: Author

Local Streets

The local street conducts traffic between homes and collectors. In the case of the perimeter properties, bordering the bi-way arterial, cars exit on the one way road not directly but via the rear lane. This measure preserves the flow of the arterial and increases its safety. In this scheme local streets serve only local residents. Since all local streets are either loops or cul-de-sacs , nonresident traffic would not find it advantageous to enter them. The street dimensions are designed to slow vehicular traffic; 8 m for local streets. Narrower pavement widths of 5.5 to 7 m are possible and have been used successfully in Radburn and Greenbelt new towns as well as in recent neotraditional communities.

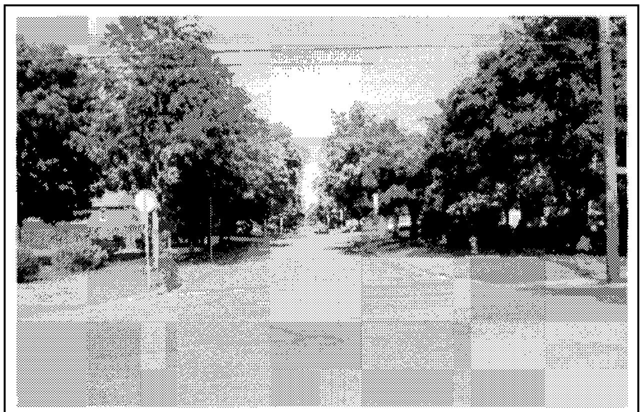


Figure 6-12. Local Street at Minor Collector

Note the absence of sidewalks on either side of the local street. Given the low level of resident-only traffic, a local street can be considered primarily a pedestrian realm; omitting sidewalks, at least initially, reduces development costs.

Source: Author

Back Lanes
The lane provides rear vehicular access to residential properties making the streetscape less car-oriented. Lanes can also provide children with an interesting and relatively safe play area. In this scheme the back lanes are used to gain access to properties facing the arterials. This serves to increase the speed and safety of the arterial. The extra cost of constructing lanes would be justified on the increased safety and efficiency of the arterial and on the grounds of serving more units facing the arterial; the cumulative cost of individual driveways for these units would be higher. Lanes at the perimeter blocks facing the arterials make functional and economic sense.

Comparing Paved Area per Unit:

1. Conventional Subdivision (15m. Lot)		**m^2**
Street:	half of 8.5 pavem.	63.75
Driveway:		36.00
Driveway apron:		24.00
Total		123.75
2. Compact Development (9m Lot)		**m^2**
Street:	half of 8.5m. pavem.	38.25
Rear Lane:	half of 5.5m. pavem.	24.75
Parking:	2 spaces	36.00
Total:		99.00
Difference:	**- 24.75 m^2 or a 20% reduction**	

Figure 6-13. The economy of back lanes when combined with medium density.

The 9m lot frontage of the compact development can still accommodate single family units. This calculation would show an even greater economy when applied to 6m lot frontage of townhouses.
(Adopted from: *Making Choices*, OMH, 1995)

Pedestrian Paths
Exclusively pedestrian paths, of varying widths, are included in the proposed design where needed to complete and extend the pedestrian access network. They complement the connected grid of local streets.

Variety of Residential Lot Types

A street pattern, as was demonstrated earlier, does not dictate either density or housing form. These are decided separately on grounds of economy, efficiency, preferences, image etc. Similarly, it does not impose a choice of lot types or sizes. Nonetheless, any pattern inevitably creates grades of properties by virtue of their ease of access, proximity to traffic, proximity to amenities (e.g. park or shops). In each case the pattern creates conditions more conducive to one type of housing rather than another. More people can benefit from proximity to a shop or a transit stop and conversely a shop or stop depend on large numbers for their viability. Therefore the development plan of a given site should anticipate and encourage a variety of lot dimensions and housing forms each appropriate to their relationship to the other elements of the site, existing or projected. At the perimeter of the site surrounded by the bi-way arterials townhouses and low-rise apartments would be most suitable for the location. Conversely, detached and semidetached housing would be more appropriate near the centre of the area.

Open Space

Open space is the most cherished attribute of any urban region. Most subdivision plans include some form of it, and planning regulations require a minimum ratio of open pace in every new development. Several guidelines recommend ratios based on area or population. Studies have established its microclimatic, social, psychological and environmental benefits. (D. Carruthers 1994, J. Petit at all 1995, R.Kaplan 1985) To maximize these benefit of open space, its use as a design component needs to be structured with the same rigour and consistency that is applied to circulation and sanitation.

OPEN SPACE RATIOS

Existing Communities	
1. Savannah	**8 to 10 %**
2. Toronto (suburbs)	**1.6 to 16.7%**
3. Kentlands	**28%**
4. Laguna West	**20%**
Guidelines	
5. per 1000 people	**2.4 ha (6 Acres)**
(converted to %)	**16%**
6. per 1000 people	**2.8 ha**
7. per 1000 people	**1.0 ha**
8. Neighborhood	**10-25 %**

See explanations for each of the figures on the right

Figure 6-14. Open space ratios of existing communities and guidelines for new ones.

1. Based on the dimensions of the ward (or cell)
2. Based on an analysis of 10 old and new suburbs
3 and 4. Based on an analysis by M. Southworth
5. Based on a Report for the Chartered Institute of Housing and the Joseph Rowntree Foundation.
6. Based on Kopeland and DeChiara, *Planning Standards*, 1975
7. Based on the *Residential Site Development Advisory Document* by CMHC
8. Based on A. Nelessen, 1996

The most striking example of this approach is found in the plan of Savannah, Georgia. (see section: Defining Neighborhood). The proposed design adopts a similar structured approach to using open space. Within that structure, it develops variations that enable the uses of the open space to vary within a larger district. These variations alter the proportion of area dedicated to open space from 8% up to 12 %, and modify its size from 40,000 sq. feet to over 150,000 sq. feet. As a structural element it also performs the function of a connector as opposed to simply a destination. *In that capacity it would relieve the isolation of the cul-de-sacs and loops and would reestablish the lost connectivity between streets, common to the traditional grid.*

Open space becomes more important as residential density increases. It has been shown that people will accept higher densities if open space is close by and well maintained (Whyte, 1968; Perks and Wilton-Clark, 1996, and Cervero, in JARP 1998). Based on this finding, the structured approach to using open space enhances the opportunities for immediate or future increase in the density of residential areas.

Since the primary users of open space in a neighbourhood will be children, it is important to consider the relationship of play activities to other site components, such as pathways, roads, parking and the layout of buildings.

Small parks are attractive to children because of the concentration of activity. However, to encourage their use, the location and size of play areas in a residential area should be:

- Conveniently accessible by walking routes free from heavy vehicular traffic.
- Along children's traffic routes.
- For preschool children, located within sight of as many housing units as possible.
- For school-aged children, located within 200m for less structured activities and 500m (about a five-minute walk) for more structured activities
- Play areas for preschool children range in size from 150 sq. m to 300 sq. m.

Figure 6-15. Children at play

Children need a variety of opportunities for play. In each case the most essential attribute is protection from traffic.

Source: National Geographic, 1967

7 Quadrant Configuration

The objectives underlying the design of residential quadrants are to:

- prevent nonresident through-traffic
- maximize the number of dwellings on cul-de-sacs and loops
- situate open space for maximum accessibility to residents
- make open space a structural element
- accommodate a range of housing types

Many variations are possible in configuring the residential quadrant (see appendix B). Though different, all quadrant designs follow the above principles and demonstrate that, when needed, variety can be achieved within a larger order.

Residential Quadrant - Street Pattern

Two collectors and two arterials delineate the boundaries of a residential quadrant. At the smaller scale of a quadrant, the streets are laid out in a modified grid. Cars cannot traverse the quadrant. Streets loop into and out of the quadrant, thus, eliminating non-resident through traffic.
The use of looped and narrow local streets would reduce the speed of all vehicular traffic while excluding non-resident traffic through the residential areas.

Since back lanes add to the development cost, in this proposed plan, they are used only for those lots which front an arterial, where the cost is justified. In addition to the typical service functions, back lanes can provide an alternative safe play area for children living in houses not facing internal streets.

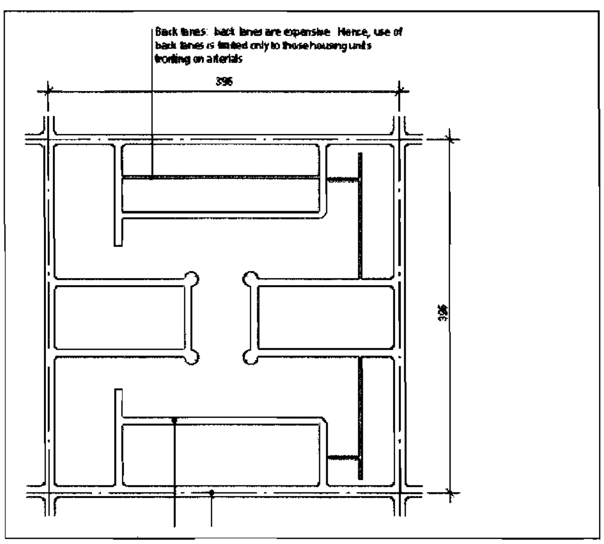


Figure 7-1. Quadrant Street Pattern

The top and right roads border the CRI corridor; they are unidirectional and permit only right hand turns into the quadrant. The back lanes parallel to them serve the buildings facing the CIR corridor.

Residential Quadrant - Pedestrian Path Network

The pedestrian movement system, consists of a continuous grid which provides several direct route options to parks, public transit, retail and services. This system generally overlaps with the internal vehicular movement network, which is designed to limit the intrusion of cars into the quadrant, thus, creating a safe local street environment for pedestrians and cyclists.
The three open spaces in this configuration act as connectors and the most direct route to the intersection of the mixed use (CIR) corridors where services and transit are to be found.
The quadrant is conceived, both in layout and density, to enable pedestrian access to parks, retail and public transit within a five-minute walk.

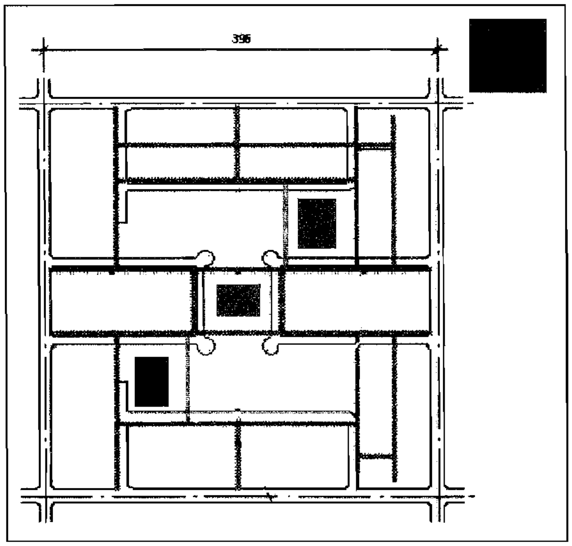


Figure 7-2. Quadrant Pedestrian Network

Note the diagonal spine of open spaces that creates a direct route to the intersection of the twined arterials where transit and services would naturally be located.

Residential Quadrant - Land Use & Density

The overall residential density of a quadrant may vary. However, the relative density within the quadrant would be as indicated with high residential densities on the arterials, intermediate densities on collectors and moderate densities in the central area.

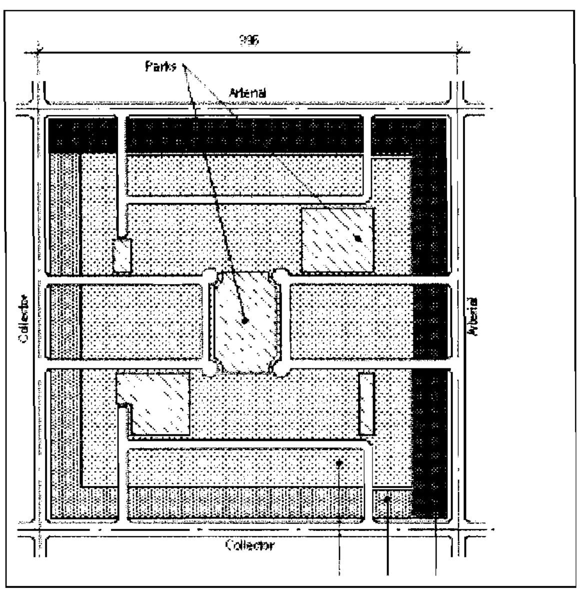


Figure 7-3. Land use

Areas:

Quadrant:	**15.68 ha**	**(100%)**
Residential:	**10.12 ha**	**(64.5%)**
Parks:	**1.45 ha**	**(9.3%)**
ROW—local roads:	**2.24 ha**	**(14.3%)**
ROW—rear lanes:	**0.33 ha**	**(2.1%)**
ROW—1/2 of perim. roads:	**1.54 ha**	**(9.8%)**
Total ROW:	**4.11 ha**	**(26.2%)**

Properties facing the park could be developed at intermediate densities

The density and unit mix of a residential quadrant shown below is one of many probable arrangements and serves as an example only. Both density and mix may vary while its street pattern and park layout remain unchanged. A variation could be based on the proximity of the quadrant to regional uses such as industry, university, large sports facilities and the like. A second variation, at least in density, could be due to the natural evolution of the neighbourhood through the change in household composition and the subdivision or subletting of housing units. Because people are willing to trade off density for proximity to open space, lots facing the parks are likely to be built more densely either initially or in time.
This configuration enables the majority (67%) of the housing units to be placed on cul-de-sacs and loops, each of which passes by at least one open space. Of these units about a third face the open space directly, an important advantage for supervising kids at play. Of the remainder about half, (15% of the total) face residential collector streets and the rest (18% of the total) border the mixed use zone across the one way street. No units back onto other uses or onto roads. Every street is habitable, walkable and safe.

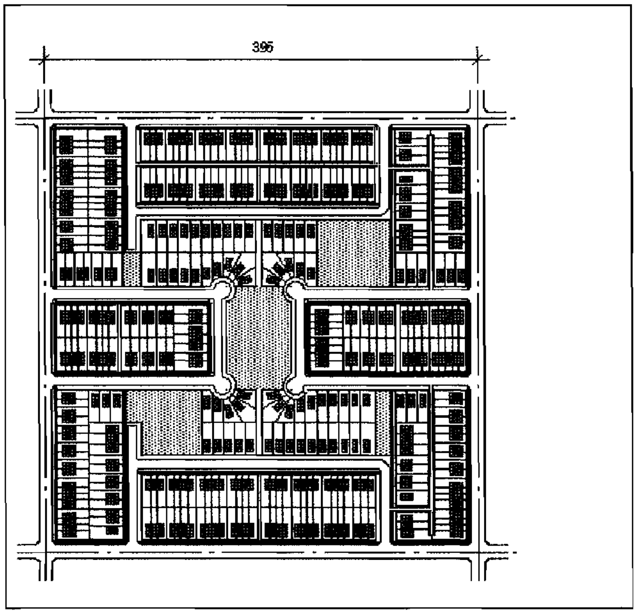
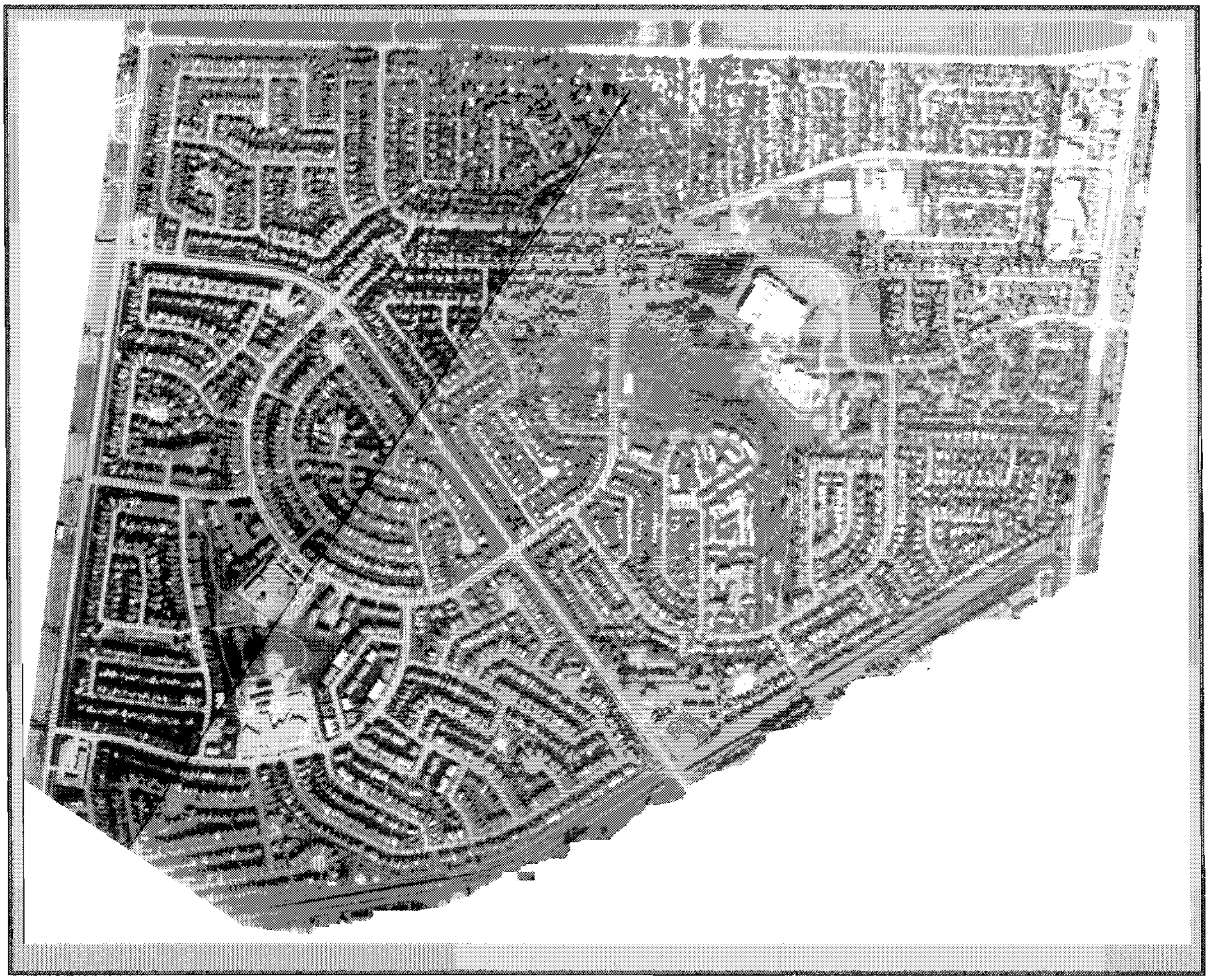


Figure 7- 4. Potential built form

Number of units:	**382**
Population:	**1,146 persons**
Gross residential density:	**24.36 units / ha**
Ratio of park:	**1.27 ha / 1,000 p.**
Units at perimeter:	**126 (33.0%)**
Units on cul-de-sacs or loops:	**256 (67.0%)**
Detached units:	**83 (21.7%)**
Semidetached units:	**98 (25.7%)**
Townhouse units:	**201 (52.6%)**

BARHAVEN, NEPEAN (AS BUILT- AERIAL PHOTO)

Barhaven, Nepean is a classic example of a 70s subdivision. Several of its attributes express a perfect adaptation to the car as the prevalent means of personal transportation. This subdivision was used as the basis on which to overlay and compare two hypothetical site plans: one in the Neotraditional manner and another resulting from this study, namely, the quadrant unit.

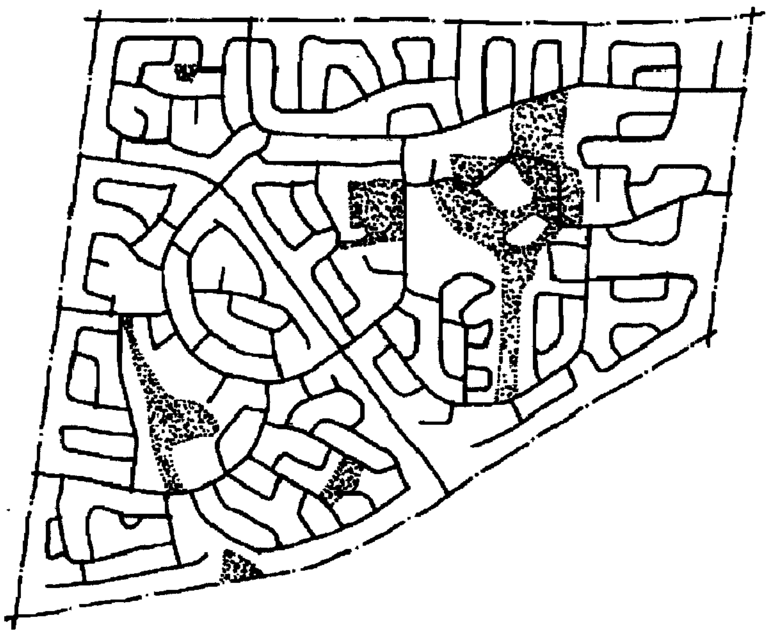


On this photograph (from Natural Resources Canada) one can see:

- the labyrinthine pattern of local streets and their continuous change of orientation and direction.
- the very long blocks particularly at the perimeter often longer than 1200 feet.
- the virtual absence of four-way intersections
- the infrequent yet regular connections to the arterial on the tree sides
- the almost random distribution of institutional buildings and parks
- the emergence of commercial uses at the crossroads (upper right corner an aprox.400-feet wide zone parallel to the arterial). Housing units back on to that zone rather than face it.

Application of the Proposed Approach to Barhaven, and Comparisons

1. As-built - Conventional Suburban Street Pattern

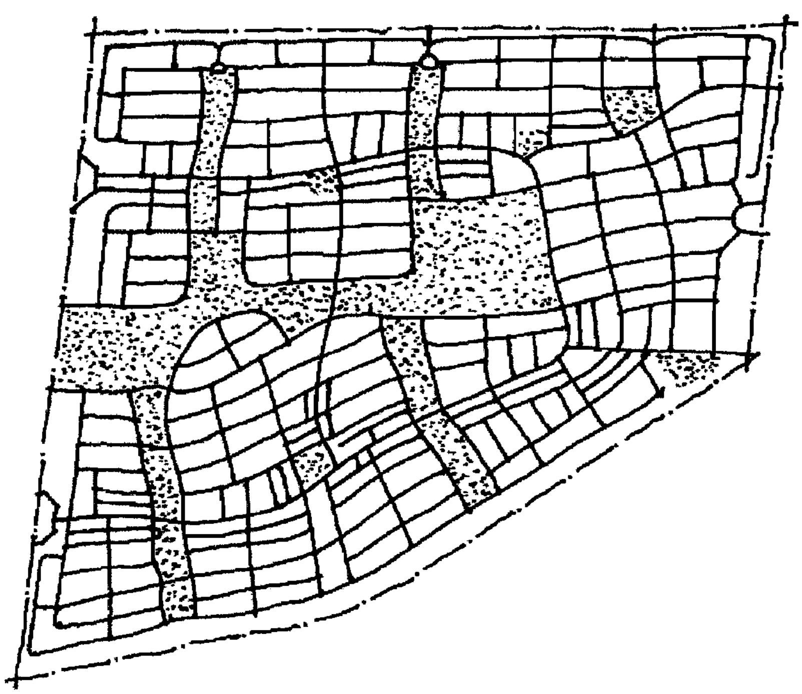


This Street pattern is:

- **Hierarchical, having arterials, collectors and local streets**
- **Curvilinear**
- **discontinuous for pedestrians and vehicles**
- **open space is located beyond walking distance for most residents**

Note: Regional arterials bound the site on three sides while the lower side is bounded by a railway line.

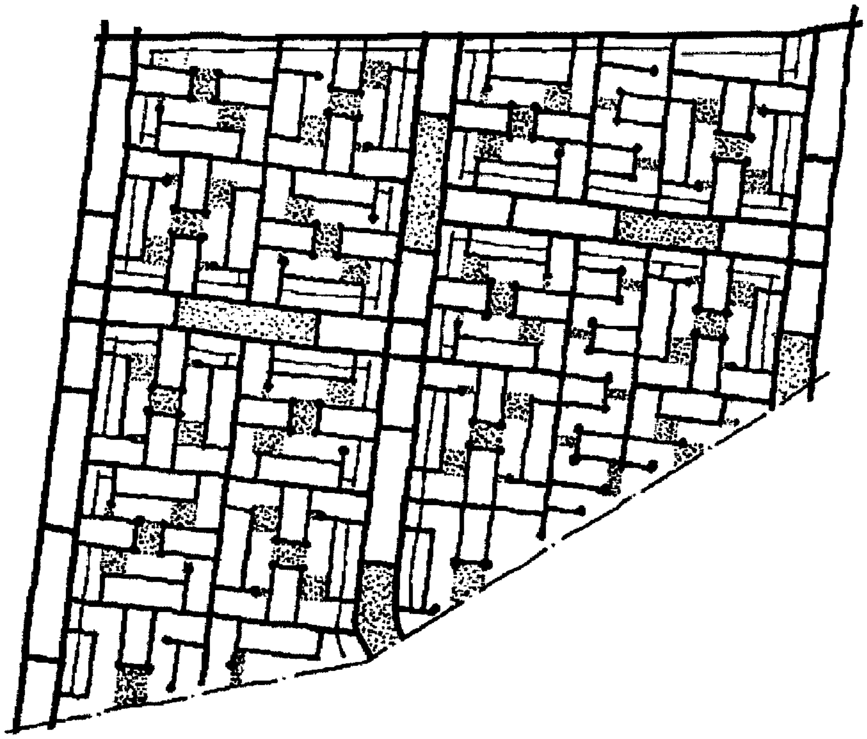
2. In the manner of New Urbanism (theoretical design)



This street pattern is:

- **a modified grid, nonhierarchical**
- **no loops or cul-de-sacs**
- **the grid becomes discontinuous at the edge of each "neighborhood"**
- **One collector-type road links the entire site to the regional arterials**
- **open space is located at the perimeter of each "neighborhood" at walking distance.**

3. In the manner of Residential Quadrant -



This street pattern has :

- **A continuous, open and twinned grid of arterials**
- **A minor discontinuous grid of collectors and local streets**
- **A continuous, open network of pedestrian streets and paths**
- **residential quadrants opaque to through traffic**
- **corridors of mixed-use zones accommodating current and future non-residential uses.**
- **open space within each quadrant that form part of the path system**

Comparison of the three Approaches

Two types of comparisons are made: one to evaluate the efficiency of land use with respect to the proportion given to each use; a second to compare the attributes sought by residents: safety, quite and openness.

Table 1. Land Use Distribution: Areas and Percentages of Alocations to Main Uses

	As-built Convent. suburban		New urbanism Proposal		Residential Quadrants	
	ha	% of total	ha	% of total	ha	% of total
Residential	184.2	54.5	158.2	46.8	176.3	52 2
Commercial & Insitution.	13	3.8	22.4	6.6	22 4	6.6
Recreat. &Open Space						
Community Centre	7.2	2.1	7.3	2.2	7.2	2.1
Public Parkland*	24.6	7.3	26.1	7.7	33.6	9.9
Buffer	2.4	0.7	7.6	2.3	0.0	0.0
Subtotal:	34.2	10.1	41.0	12.1	40.8	12.1
Transporatation						
Public streets	95.6	28.3	100.2	29.7	83.7	24.8
Private streets	1.7	0.5	0.0	0.0	0.0	0.0
Lanes	0.0	0 0	6 9	2.0	5.5	1.6
Subtotal:	97.3	28.8	107.1	31.7	89.2	26.4
Vacant Land	9.0	2.7	9.0	2.7	9.0	2.7
TOTAL LAND AREA	**337.7**	**100**	**337.7**	**100**	**337.7**	**100**

*This table is based on the one that appeared in the "*Conventional and Alternative Development Patterns, Phase 1: Infrastructure Costs*" report by CMHC. To enable direct comparisons, the ratios of some elements are kept identical, if no grounds for change could be established.

An assessment of the differences by element indicates the following:

Residential

The conventional design has more land dedicated to residential uses than either of the alternatives. When all developable land is taken into account, the conventional design has 58.3% of the site as developable, the quadrant scheme 55.9% and the Neotraditional design 53.4% These differences, though small, are important to the land developer who seeks to maximize yields. They are partly attributable to the proportion of land allocation to other uses.

Commercial and Institutional

The alternative designs allocate roughly double the amount of the as-built design to commercial and institutional uses. This is done hypothetically with the intent to create a more self contained community than the existing. The decision to raise the proportion of land dedicated to these uses, must be accompanied, as we have seen earlier, by raising the residential density of the district to create a sufficient population base for these amenities. If this were the case, the result could be a more livable community.

Recreation and Open Space

Both alternative designs dedicate considerably more area to open space than the as-build community: the New Urbanist scheme 20% more and the Quadrant scheme 40% more. As was seen earlier, open space is a critical attribute of the community environment. Thus, other things being equal, the community with more open space will be more livable and be experienced as more desirable. This perception is further reinforced by the proximity of the open space. In that respect, the Quadrant option stands out as the most suitable and the existing community as least.

Transportation, Circulation

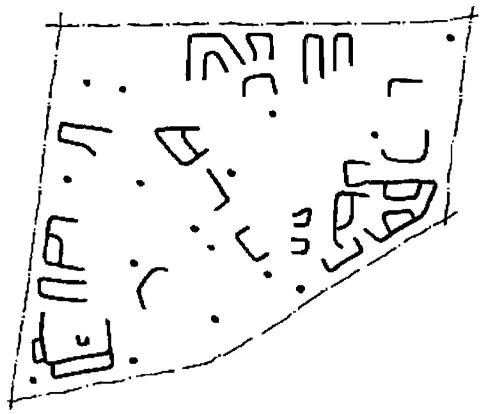
The Quadrant option consumes the least amount of land for streets: 27.3%. By comparison the existing community uses 28.8%, a small 5% higher than the Quadrant, and the New Urbanist scheme 31.7% a significant 16% increase. Streets increase the cost of development and reduce the amount of land for other uses. A significant disadvantage of the conventional scheme is its lack of direct and convenient pedestrian paths.

Summary

While the conventional design has marginally more developable land than the Quadrant scheme, it also uses more land for streets as does the Neotraditional design; a cost and environmental consideration. By contrast the Quadrant scheme raises the quality of the living environment by assigning more land to open space and making it easily accessible to the majority of residents.

COMPARISON OF QUALITATIVE ATTRIBUTES

A. Loops and cul-de-sacs



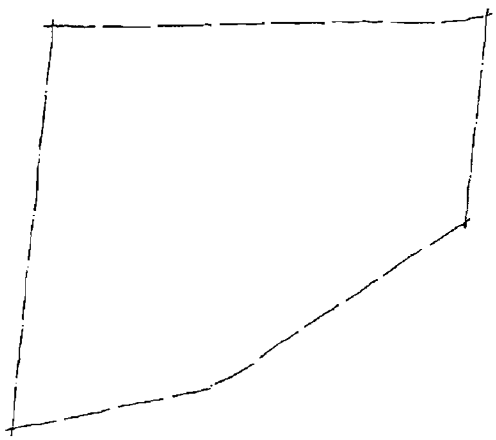
1. As-built.

Cul-de-sacs: 16

Loops: 30

Entry Points 8

It should be noted that a good number of streets are local but also carry traffic from adjacent cul-de-sacs and loops - these are not shown because they are traversible and do not belong to either category; they are minor class collectors.



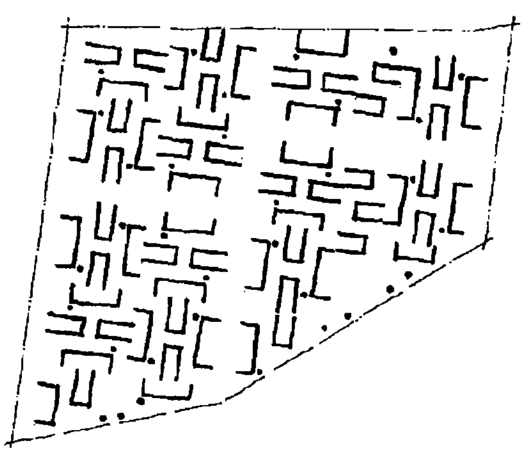
2. Neotraditional

Cul-de-sacs: 0

Loops: 0

Entry points: 11

This design avoids in principle cul-de-sacs and loops, hence the absence of any streets on this drawing.



3. Residential Quadrants

Cul-de-sacs: 34

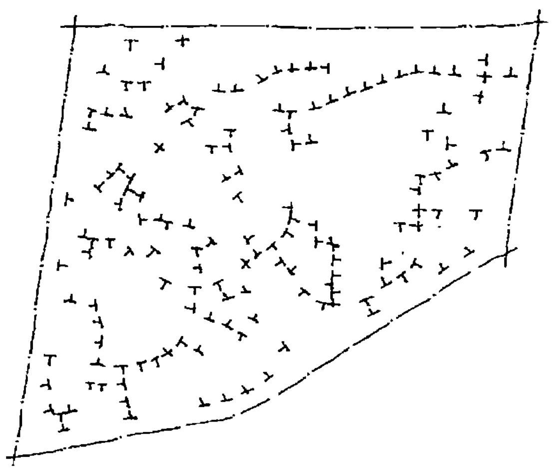
Loops: 62

Entry points: 25

The density of lines on this drawing indicates that the majority of houses are located on loops or cul-de-sacs.

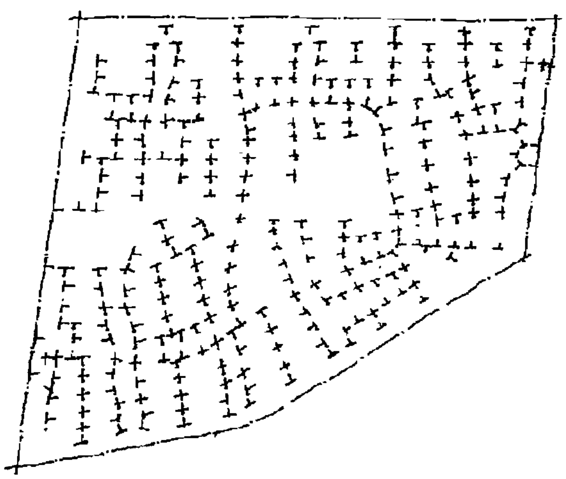
COMPARISON OF QUALITATIVE ATTRIBUTES

B. Intersections



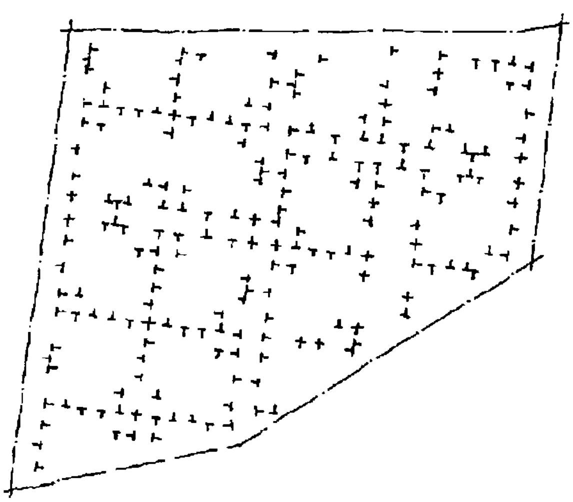
1. As-built

T-intersections:	**129**
Four-way:	**7**
Total intersections	**136**
Entry points	**8**



2. Neotraditional

T-intersections:	**187**
Four-way:	**86**
Total intersections	**273**
Entry points	**11**



3. Residential Quadrant

T-intersections:	**177**
Four-way:	**20**
Total intersections	**197**
Entry points	**25**

Comparative Analysis of Street Patterns

Table X: Comparison of qualitative attributes of street patterns among three versions of a suburban community.

	As-built Conventional plan (BASE)	New Urbanism proposal	change	Residential Quadrants	change
Portion of site in streets	28.8%	31.7%	2.9	26.4%	-2.4
T" intersections	129	187	58	177	48
Four-way intersections	7	86	79	20	13
Total intersections	**136**	**273**	**137**	**197**	**61**
Entry points	8	11	3	25	17
Loops	30	0	N/A	62	32
Cul-de-sacs	16	0	N/A	34	18

Evaluation of the Three Approaches

- The residential quadrant alternative has more loops and cul-de-sacs than the other approaches: 62 loops and 34 cul-de-sacs. The new urbanist alternative has, not surprisingly, no loops and no cul-de-sacs as this is a stated objective of new urbanism. The built version of Barhaven has 30 loops and 16 cul-de-sacs. The residential quadrant alternative has a significantly higher number of dwelling units on cul-de-sacs than the conventional approach. This is a surprising difference given that the conventional design was based on the intention to provide this ideal residential environment to the maximum number of residents because of its marketability. It would seem that it is possible to rationalize the current suburban street pattern and extend its inherent benefits to larger numbers of community residents.

- The residential quadrant alternatives devote less land to streets than the new urbanist alternative even though the same street standards are employed. Compared to the new urbanist approach, Quadrant devotes approximately 17% less land to streets. This economy in land allows a greater area to be devoted to other uses.

- The Quadrant scheme has the same area of park land and buffer as the new urbanist alternative, but has 11% more residential area. Moreover, the accessibility of the open space is much greater.

- The Quadrant scheme devotes approximately 8% less area to streets than the existing Barhaven. This is the case even though the quadrants have a denser street pattern, i.e. more linear measure of streets, than the existing version of Barhaven. This economy in land stems from the reduced street standards employed in the residential quadrant alternatives.

- The residential quadrant alternative has more access points to and from the community, thus, making the community more connected to other communities.

- The residential quadrant alternatives have a more fine-grained, interconnected and less circuitous pedestrian path network than the other two approaches.

- Despite the highly interconnected pedestrian path network, Quadrant A has 28% fewer vehicular intersections than the new urbanist alternative. Furthermore, 90% of intersections within Quadrant A are “T” intersections.

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Figure 6-13. The economy of back lanes when combined with medium density.
Figure 6-14. Open space ratios of existing communities and guidelines for new ones.
Figure 6-15 Children at play

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APPENDIX A

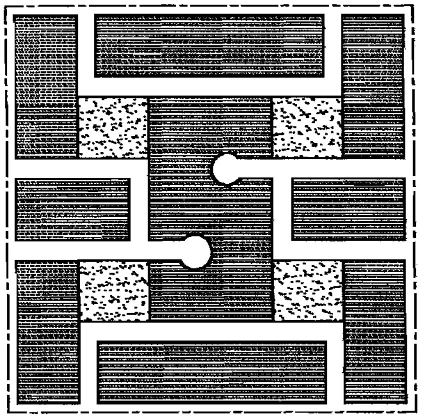
This appendix illustrates eight varied configurations of the basic unit of planning and growth: the quadrant. Following a rectilinear geometry, the quadrant is formed of four elements: Loops, cul-de-sacs, open space and the boundary zone (of commercial institutional and recreational uses) on two sides.

The variety in configurations is generated by the size of the blocks, the number of loops and cul-de-sacs and the number, size and positioning of open spaces:
The block sizes vary from 340 feet to 720 feet .
The number of loops is constant and the number of cul-de-sacs varies from none to four.
The open space ratio vary among the nine regular quadrants from 8 to 12 percent of the total area and its positioning can be symmetrical, asymmetrical, central or distributed. It can be a single large space of about 4 acres or distributed in three or four spaces taking up to a maximum of 4.8 acres.
Because the quadrant has a fixed geometry, the percentage of area dedicated to streets remains constant, low and predictable: 26%.

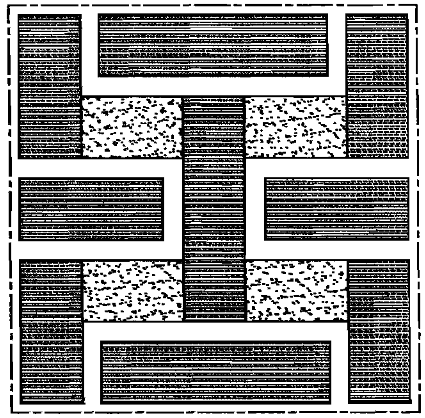
Each of these illustrated options generates a distinct pedestrian movement pattern within the quadrant. Each of these nine quadrants can also be combined with three different ones to form a complete district of four quadrants where a variety of functions can be accommodated by the diverse open spaces - all within 5-minute walk.

CONFIGURATION OPTIONS

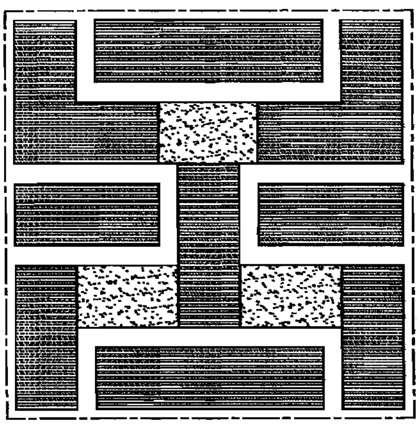
SEVEN BASIC SCHEMES



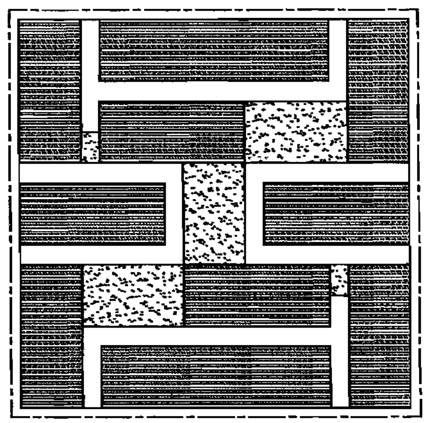
Scheme One



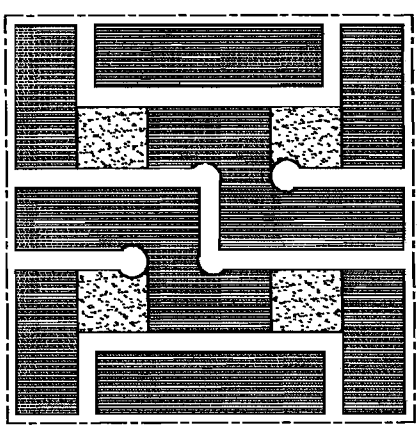
Scheme Two



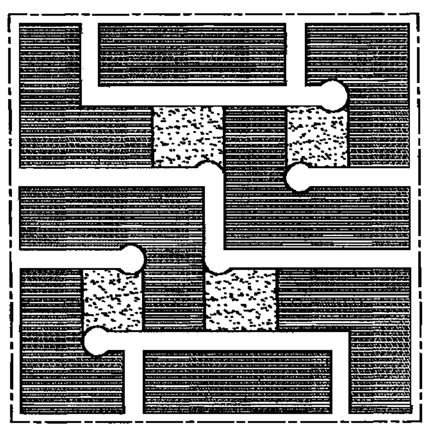
Scheme Three



Scheme Four



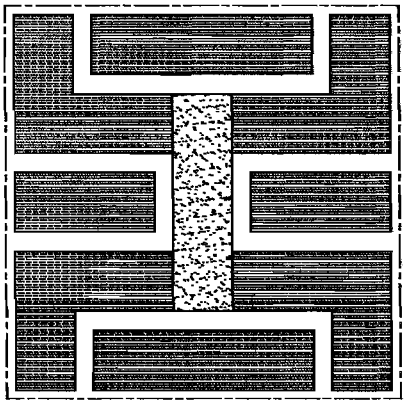
Scheme Five



Scheme Six

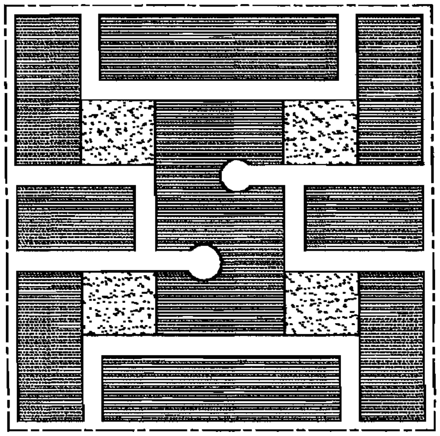
CONFIGURATION OPTIONS

SEVEN BASIC SCHEMES



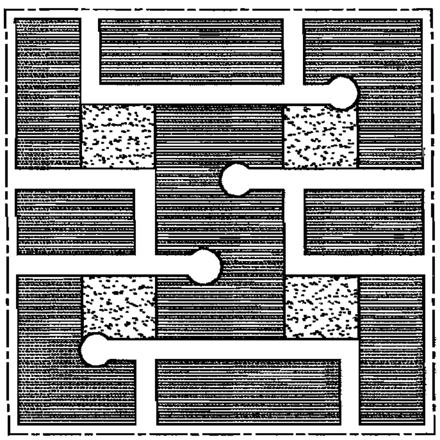
Scheme Seven

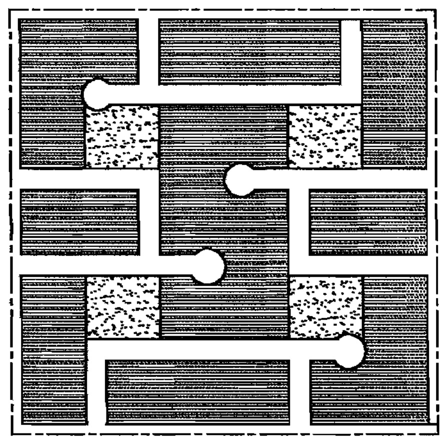
VARIATIONS ON THE BASIC SCHEMES

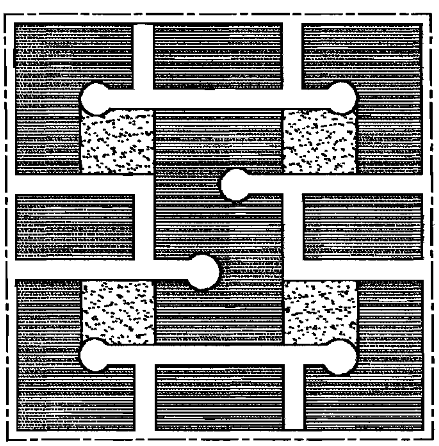


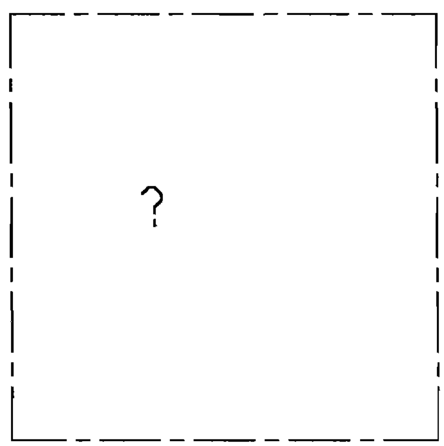
Scheme one

VARIATIONS

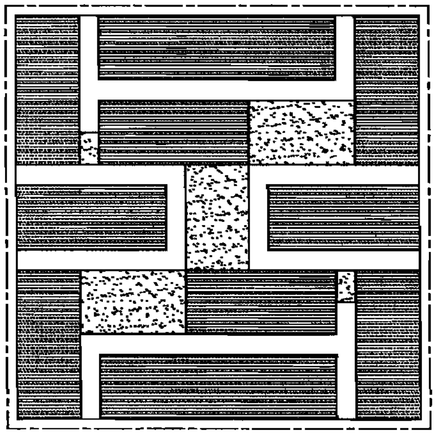






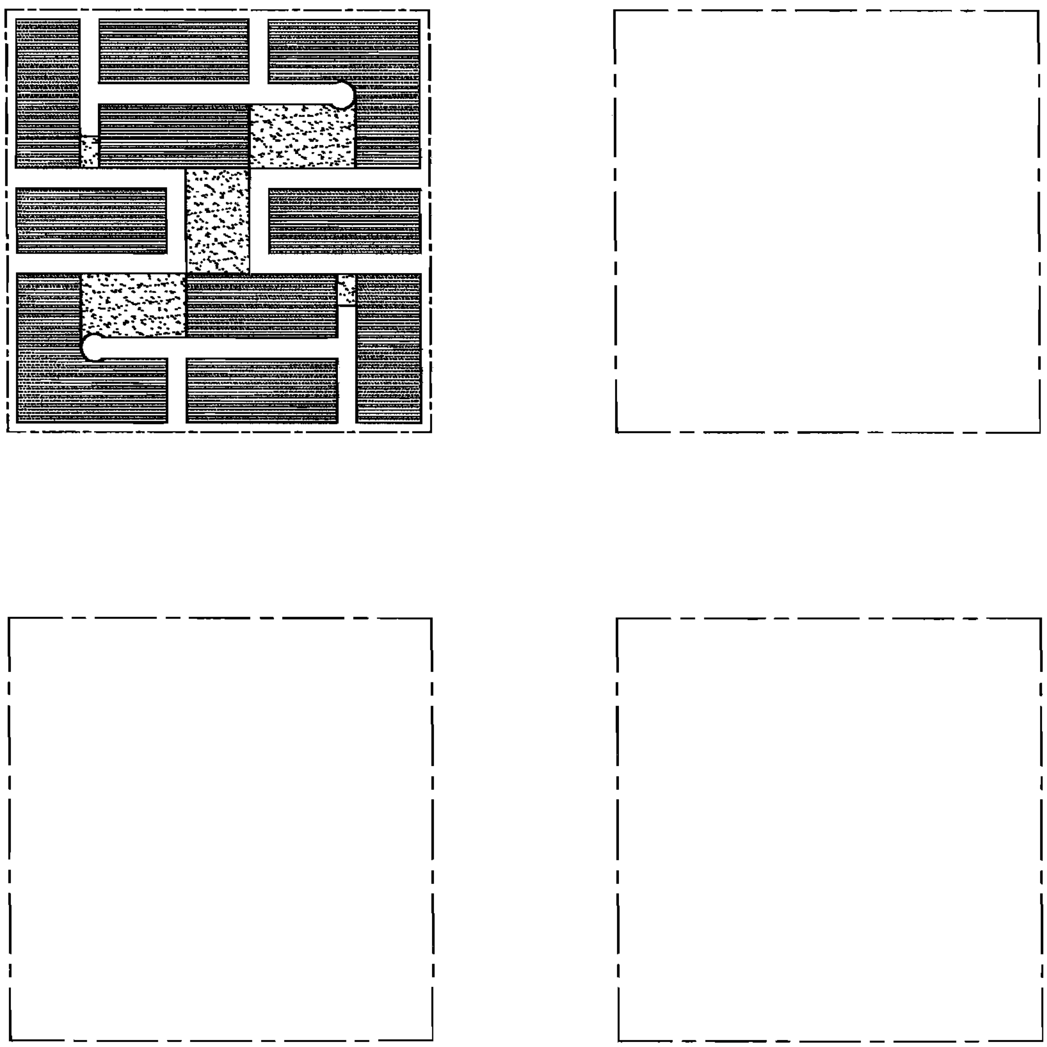


VARIATIONS ON THE BASIC SCHEMES



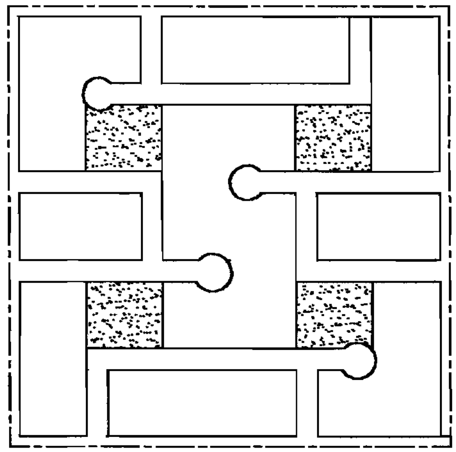
Sheme Four

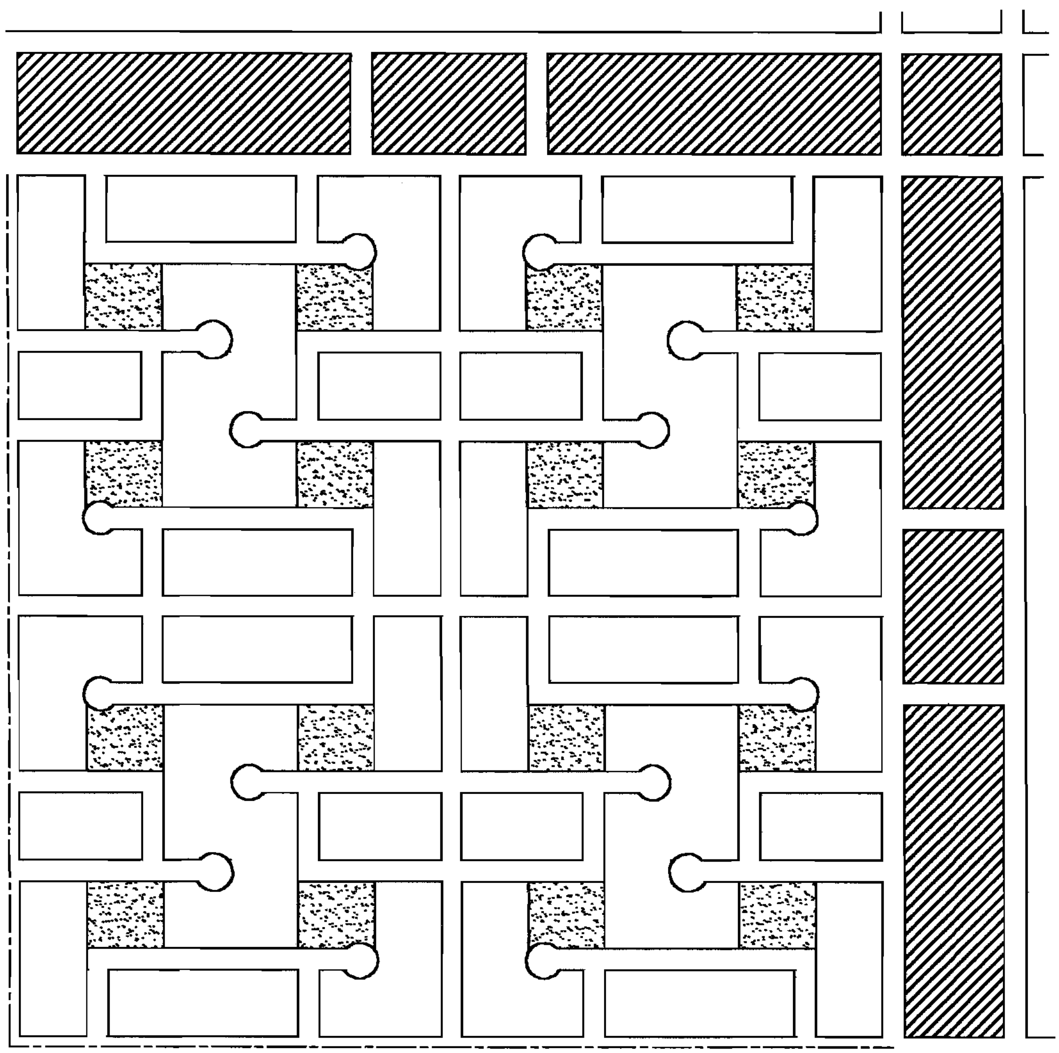
VARIATIONS



FROM ELEMENTS TO DISTRICTS

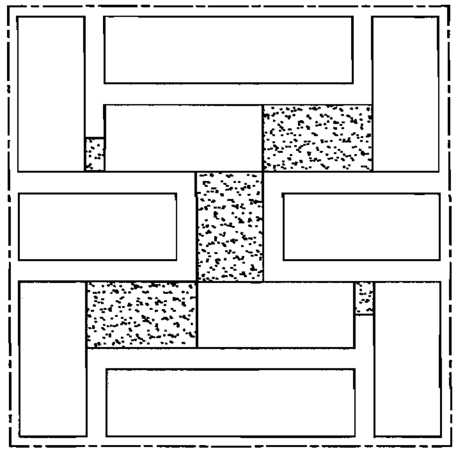
Scheme One
(Variation)

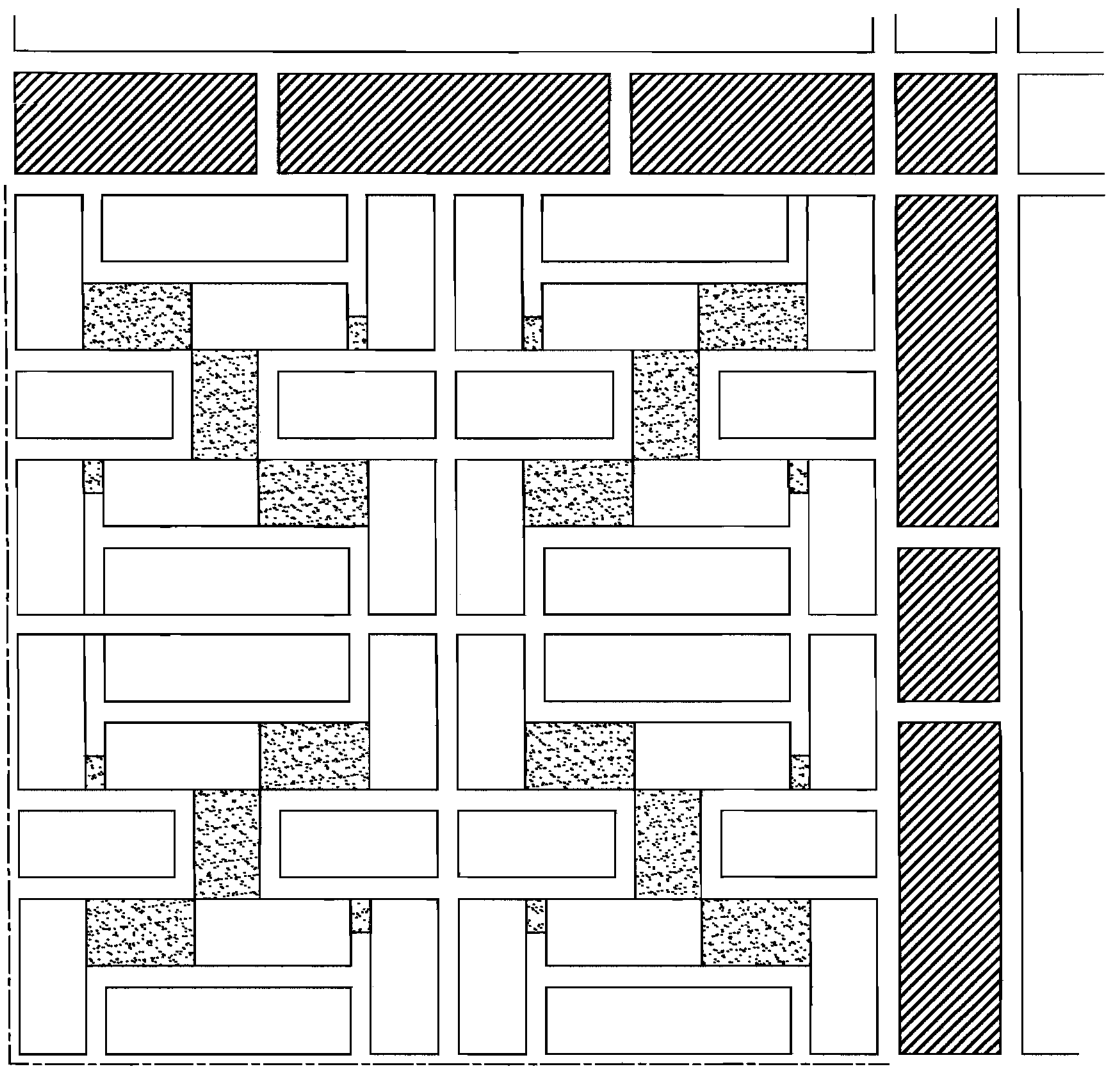




FROM ELEMENTS TO DISTRICTS

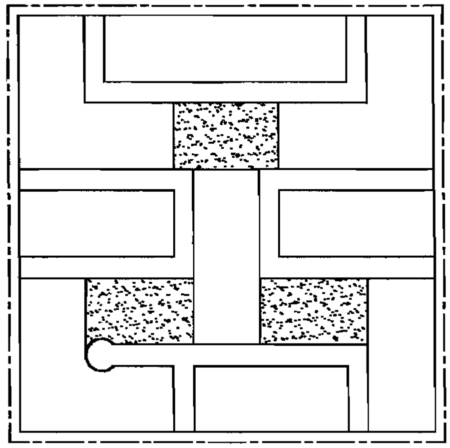
Scheme Four

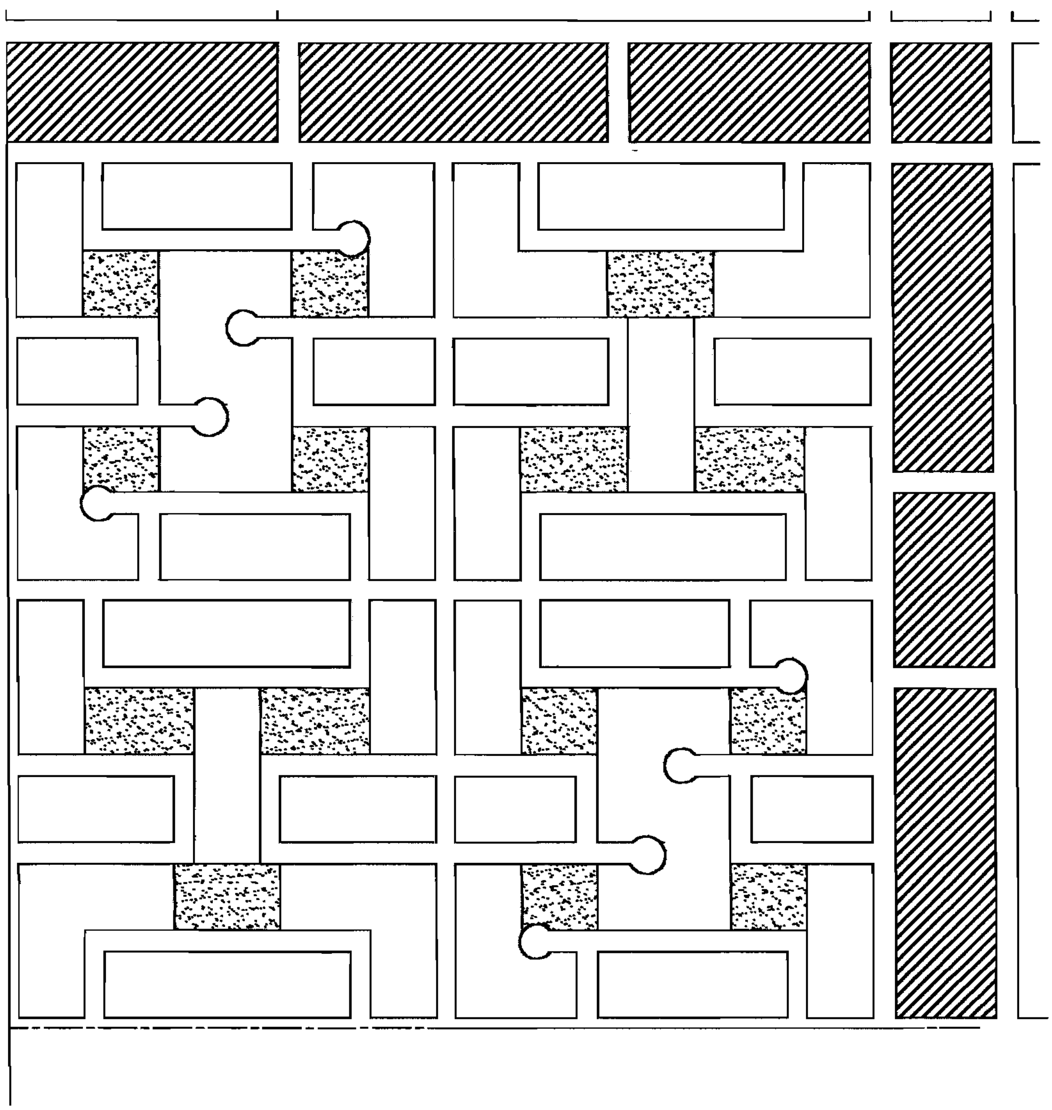




FROM ELEMENTS TO DISTRICTS

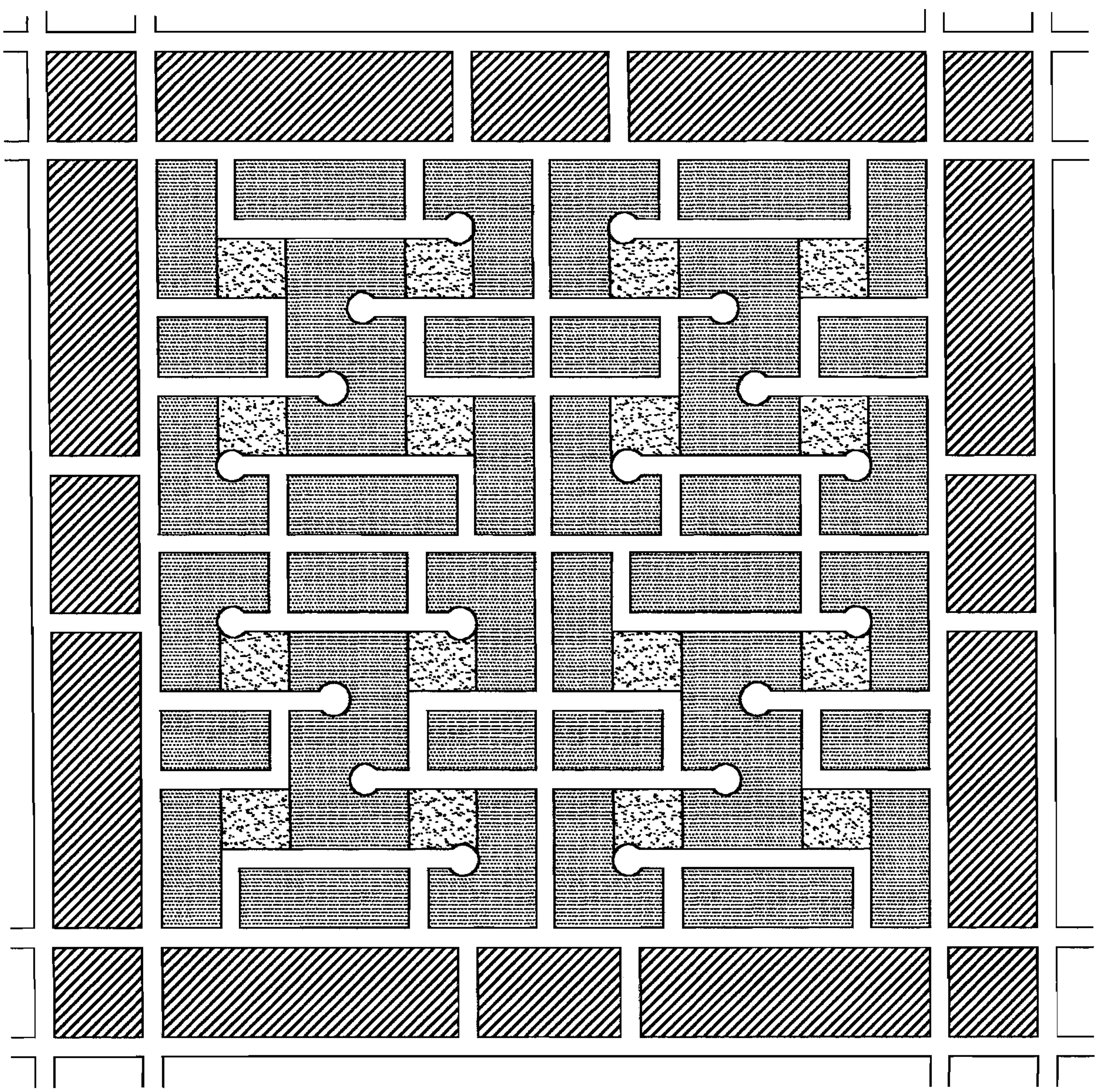
Scheme One
+
Scheme Three





RESIDENTIAL DISTRICT - UNIT OF GROWTH

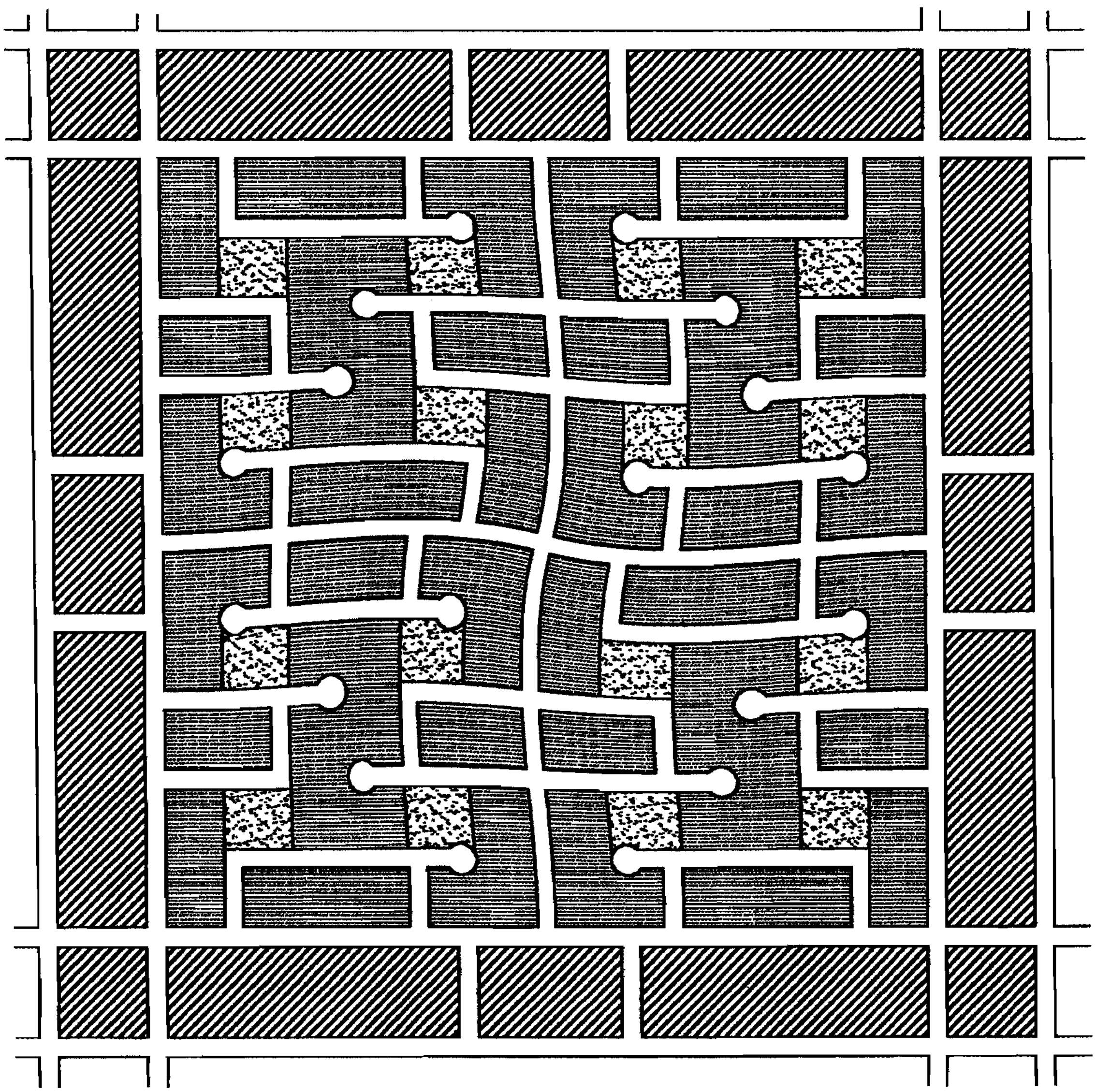
A residential district consiting of four quadrants becomes the unit of growth. It is bounded by a mixed use belt which is formed by twinned arterials. This belt contains service and exchange functions.



RESIDENTIAL DISTRICT - UNIT OF GROWTH

A residential district, consisting of four quadrants, becomes the unit of growth. It is bounded by a mixed use belt which is formed by twinned arterials. This belt contains service and exchange functions.

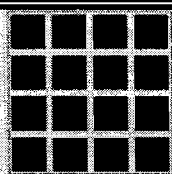
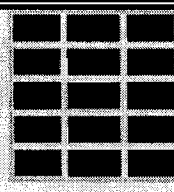
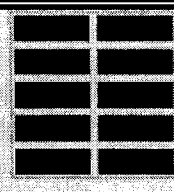
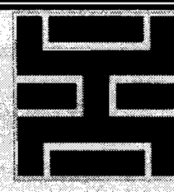
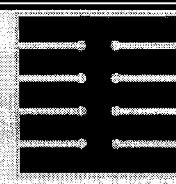
Note: the collectors within the district have been slightly curved to calm traffic.



APPENDIX B

STREETS AND LAND USE EFFICIENCY

TABLE 1: A comparison of area used, street length, block length and buildable space among five typical street patterns.*

	 **Square Grid.** (Miletus, Houston, Portland etc.)	 **Oblong grid.** (most cities with a grid)	 **Oblong grid 2** (some cities, or in certain areas)	 **Loops.** (Subdivisions - 1950 to now)	 **Cul-de-sacs.** (Radburn , 1932 to now)
Percent of area for streets	**36.0%**	**35.0%**	**31.4%**	**27.4%**	**23.7%**
Percent and area change	base 14,4 ac	-3% 14.0 ac	-13% 12.5ac	-24% 11.0 ac	-34% 9.5ac
Area gained	base	0.4 ac	1.9 ac	3.4 ac	4.9 ac
Total street length (int.)	6140	7040	6040	5040	4312
Block length(s)	**264'by 264'**	**360', 410'**	**597'**	**470', 740'**	**C-D-S = 530**
Percent of buildable area	**64%**	**65%**	**68.6%**	**72.6%**	**76.3%**

*The comparison is based on a distric area of 40 acres (16 ha), that lies within a square of which the sides are 1320' (402 meters). This is the average distance for a 5-minute walk. This boundary square includes half of the perimeter road. The street ROW is assumed 65' for all cases. All blocks (except the first) have a depth (or width) of 200' (61 meters)