RESEARCH HIGHLIGHTS

LEARNING FROM SUBURBIA: RESIDENTIAL STREET PATTERN DESIGN

Introduction

Studies show that street design contributes significantly to the quality and character of a community. Streets by their very nature connect the private with the public domain and link the different parts of a community; linkages that support interaction and exchange—both vital functions of a community. Appropriate street design can also create safe, quiet and healthy environments for people and particularly for children.

Ongoing concern about the environmental sustainability of communities compels a scrutiny of all aspects of development that consume natural resources including street pattern design. Streets consume resources directly and indirectly. Directly, they use up land (between 25 and 35 % of a subdivision) and materials for their construction and maintenance and indirectly, by enabling travel, contribute to CO_2 and noxious gas generation, polluted water runoff and lowering water retention on site. Also, street orientation can enhance or inhibit access to solar energy by the houses on them.

Current thinking on street pattern design appears to be divided between the efficiencies of infrastructure and traffic and the aesthetics of its elements, between reaffirming the conventional suburban pattern and returning to the "traditional models of the past". Few attempts have been made to synthesize the two entrenched, but not necessarily contradictory views.

Objectives

The study's goal was to explore and develop street patterns that maintain a balance between efficiency and quality, between functionality and aesthetic precepts. In exploring and developing new patterns the specific objectives were:

- to identify and maintain the positive attributes of conventional suburban development and those of traditional neighbourhoods;
- to support environmental sustainability and enhance neighbourhood liveability;
- to ensure that the proposed street patterns apply to most suburban sites;
- to adapt them to the current technological and cultural context; and
- to reflect expressed and documented resident preferences.

Method

The research method involved three steps: First an extensive literature review to trace the ideas on street design and the evolution of street patterns (mainly in Canada and US), second a critical analysis of recent and current fringe subdivisions in order to identify their key characteristics and,

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finally, the development of alternative street patterns and their overlay on an existing suburban community.

Findings and results

The review and analysis focused on the two essential but occasionally incompatible aspects of development: Efficiency and Quality.

Efficiency

Use of Land - The literature strongly affirms that conventional suburban street patterns (Fig. 1, excluding gridiron, and Fig.2) consume from 16 to 25 percent less land than the traditional city grid or Neotraditional versions of it. This is mainly due to the use of two standard street types—the loop and the cul-de-sac, and the use of long blocks. Curvilinear street shapes of conventional subdivisions, a strong characteristic, reflects an aesthetic preference and has no impact on land consumption. Irregularly shaped lots do not pack efficiently but this disadvantage proves immaterial at the predominant low densities. Overall, for comparable residential densities, conventional suburban street patterns are more efficient than the traditional gridiron geometry. This finding is confirmed by a strong preference by developers for the conventional street patterns.

Ease of Circulation - It is generally agreed that suburban street patterns move car traffic efficiently and safely. Their geometry seems fully adapted to the car: it excludes traffic at the local street level, as desired, and permits good flow at the collector and arterial levels, as required. By contrast, the traditional city grid pattern has had to undergo many adaptations to enable good traffic flow, the most significant being unidirectional streets and traffic signals. Without these adaptations, congestion, a cause of inefficiency, becomes an inevitable and frequent occurrence. The grid both in theory and in practice proves an inefficient carrier of mechanized traffic. Congestion on new arterials on the other hand, where it occurs, is generally attributed to the segregation and concentration of homogeneous land uses. The full adaptation of the suburban street patterns to the car, however, produces unfortunate side effects—maladaptation to the pedestrian. Their discontinuity clearly inhibits pedestrian access to facilities and transit stops while their curvilinearity lengthens walking trips and makes them confusing.

Figure 2: Barhaven, Nepean: a typical 70s subdivision with curvilinear and discontinuous street patterns. Blocks can reach over 2000 feet in length.

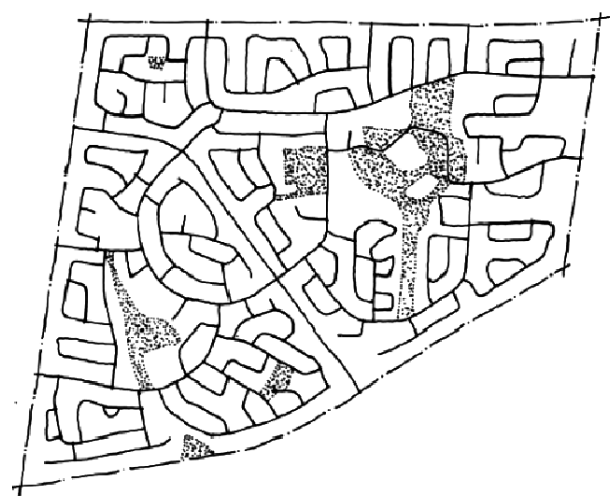
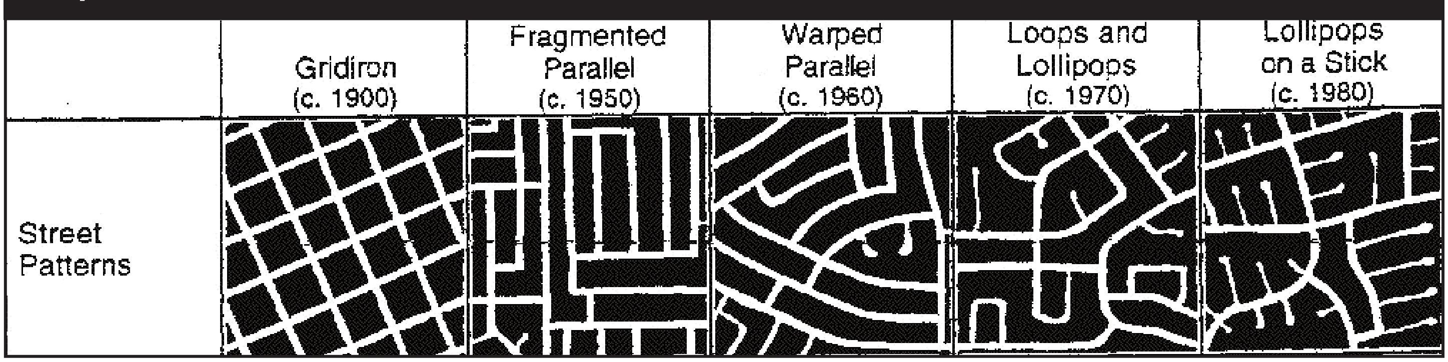


Figure 1: The evolving street patterns of suburban development between 1900 and 1980 (from Southworth, 1997). Increasing discontinuity and reduced connectivity and increasing adaptation to the car.



Amount of Travel - A recent study concluded that among the major determinants of amount of car use (Vehicle Kilometres Travelled), street patterns types ranked 9th as to their degree of influence. The top three are: the number of cars per family, the number of people per household and the location of a subdivision with respect to the Central Business District (BCD). All three have a far greater influence on travel than the street pattern type. Car ownership, a predictor of Vehicle Kilometres Travelled (VKT), is strongly related first to the number of persons per household, second, to household affluence (income) and third, to house size (another sign of relative affluence). Street patterns influence car use but not significantly; to be effective, they must be used in combination with an alternative approach to land use designation and configuration.

Density - Residential density has a strong impact on how efficiently land is used. It is also proportionately correlated to the presence of amenities within a district. The strongest predictor of residential density is land price: the higher the price the higher the density of dwelling units. At the level of the housing consumer, household affluence is the primary indicator of land consumption (expressed in a housing type), followed by a household's stage in life. The higher the income of a household, the higher the likelihood that they live in a single-detached house. Similarly, presence of children is closely linked with the detached house. In contrast to the land price and household characteristics, there is no direct correlation between street pattern type and residential density. No one type has been exclusively associated with a specific residential density.

Quality

The perceived quality of a street is found to depend on a number of attributes which can be divided in two ways: first, those that can be "designed" and the "incidental" and second the physical and the operational. Safety and, partly, security can be designed as can trees, enclosure and comfort but activities, maintenance and cleanliness, for example, are matters of operation and culture not design. Similarly, the density of people, visual complexity, social status, depend on planning, history and, again, culture not design decisions at the street scale. When present, some of these attributes impart a memorable image and a pleasurable feeling. When grouped to reflect a user perspective they can be expressed as: Sociability, walkability and delight. Street patterns can enhance these attributes, particularly when streetscape and land use distribution are also considered.

Sociability - The "sociability" of a street, is identified as a critical aspect of a street's quality. Informal contacts that develop into social networks are at the root of feelings of belonging and security, prime factors in resident satisfaction. Street activity cannot be "designed" but it can either be encouraged or inhibited by certain street characteristics. The most significant, and negative, influence on it is exerted by traffic and the effect is proportional to its volume. To the extent that a street pattern encourages speed (as in through-streets) it will invite more traffic. To enhance sociability, particularly with regard to children's safety and play, most authors recommend discontinuous street patterns, of the kind found in typical suburbs. These patterns show consistently a lower rate of accidents and a higher level of perceived security.

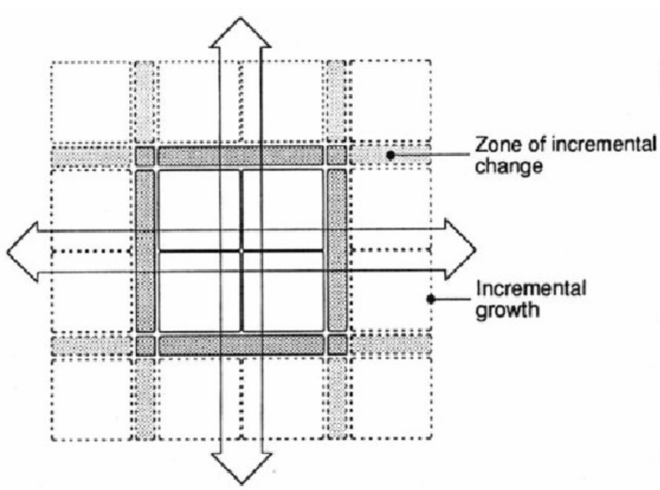
Walkability - "Walkability" of a street pattern implies both easy and enjoyable access to amenities and services such as schools, recreation, retail and workplaces. Such access is found to increase resident satisfaction. The presence of these amenities can be affected by a street pattern but clearly not determined by it alone. Conventional suburbs

Figure 3: The original city of Savannah (1733), measuring 435x435 m, has four identical cells. Each cell is organized around a common green that inhibits through traffic and creates a tranquil environment. The city today ranks as one of the most liveable cities in North America.

provide few such amenities and, when made available, their distant location makes them inaccessible on foot. The discontinuous, indirect and confusing street pattern of conventional suburbs further aggravates their inaccessibility. In addition, collector and arterial streets, because of the traffic volume on them, become inhospitable and unsafe, thus making travel on foot unpleasant and undesirable. Recent Neo-traditional subdivisions, which have adopted the grid pattern for its connectivity, create more clear and direct pedestrian routes but, ironically, to destinations beyond walking distance. Walkability demands both a conducive street pattern and, more importantly, a sensible arrangement of land uses.

Open space - Nothing delights people more in an urban environment than to view nature. Open, green space has been found to have social and psychological benefits and to explain the strong consumer preference for sites with natural endowments. It provides visual relief and opportunity for relaxation, it becomes a place for casual contacts, and forms a haven for kid's play. Green space also has environmental benefits: it cools the air, absorbs CO_2, and retains rainwater. With all these benefits, it emerges as a key element of quality in a development. Because of its many positive qualities, open space has been shown to make increased residential density more acceptable to residents. Though most subdivisions incorporate open space in their plans, ranging from 1.6 to 16 per cent of their area, only few stand out for their effective design and use of open space'. The best example of regular use of open space remains the plan of Savannah, Georgia (Fig.3)

Figure 4: Four residential quadrants, in the centre, bounded by the twinned arterial that defines and sustains a mixed-use zone. The open grid structure applies to large scale elements only.



Lessons learned and their application

From the user perspective, each pattern geometry has distinct advantages: discontinuous patterns provide safety, sociability and efficiency while grid patterns provide connectivity; all highly desirable attributes. To achieve them all, a fusion of the two is required.

For this purpose, an alternative approach to street pattern design is adopted that has the following elements (Figures 4 and 5):

1. A return to the orthogonal geometry for clarity of organization and directness of pedestrian access.

2. The adoption of a repeatable unit of growth, a cell, for consistency of benefits and efficiency of development (Fig. 4).

3. The predominant use of loops and cul-de-sacs for local streets for safety, tranquillity, sociability and land use efficiency (Fig. 5).

4. The use of open space as a structural component of the cell layout for connectivity, relief, comfort, water retention, interaction and delight (Fig. 6).

5. The acceptance of a road hierarchy of local, collector and arterial, for distributing and moving car traffic effectively (Fig. 4 and 5).

6. The transformation of the arterial from a mere traffic conveyor to an activity generator (Fig 5).

Features of the quadrant design

The quadrant design (Fig. 6) has the following features:

1. 16 ha (40 ac) area

2. 400 by 400 m (1320 by 1320 feet) dimension; a regular 5-min walk distance.
3. 8 percent of area is devoted to open space

Figure 5: Each 16 ha quadrant is bounded on two sides by the twinned arterial that contains the mixed-use activity zone.The quadrant is not traversible by car.

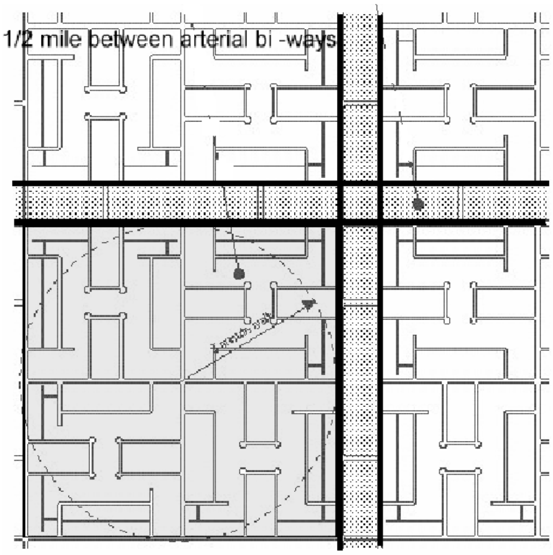
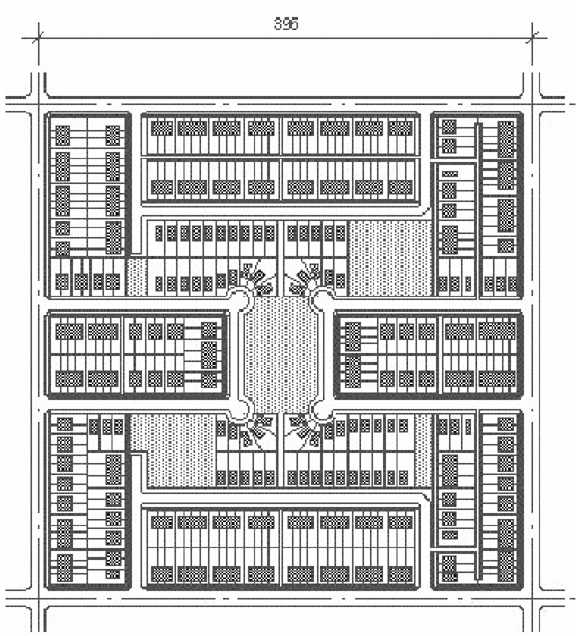


Figure 6: The proposed quadrant, one of ten possible variations, shows a 16ha entirely pedestrian precinct. Similar in area to fig 3, it features a diagonal spine of open spaces linking all its parts to the cross-roads of mixed-use zones.



4. 26 percent of area to streets
5. All streets are habitable (no backlotting)
6. Complete pedestrian accessibility
7. Entirely impervious to through-traffic
8. Proximity to facilities/amenities/conveniences
9. High potential for residential density mix

Conclusions

The study drew lessons from recent subdivision street pattern design and from street patterns of historic cities. It examined how they both function, how they fulfill residents' needs and expectations and how they accommodate environmental concerns. In developing an alternative pattern that integrates the most important and desirable attributes of each approach the study concluded that:

a) It is possible to retain the efficiency and quality of the conventional suburb while adopting the geometry of the grid.

b) It is feasible and desirable to combine the tradition of the main street and the convenience of the commercial strip in a zone of mixed land uses that both relies on and supports transportation.

By fusing the street patterns of conventional suburbs with those of the traditional grided city, and by recasting the arterial street in the light of its activity generation potential, it is possible to create communities that are efficient, viable, liveable, healthy and highly marketable.

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Research Report: *Learning from Suburbia; Residential Street Pattern Design (External Research Program)*

Research Team: Sevag Pogharian and Julie Tasker-Brown

A full report on this project is available from the Canadian Housing Information Centre at the address below.

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