Residential Street Pattern Design

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INTRODUCTION

Streets connect the private with the public domain and also link different parts of a neighborhood. These linkages support social interaction and exchange—both vital urban functions. Street design can contribute significantly to the quality and character of a community. Well designed streets create safe, quiet and healthy environments, particularly for children.

Current thinking on street pattern design is divided between concern for infrastructure and transportation efficiency, and neighbourhood quality. This generally translates into a battle between proponents of conventional suburban loops and cul-de-sacs, and those of "traditional" grids. The latter approach is typified by Smart Growth, New Urbanism, and Neo-traditionalism. This paper proposes an alternative to both these street pattern models, one that balances efficiency and quality. The design process involved incorporating the positive attributes of conventional suburban development while taking into account today's technology and consumer preferences.

EFFICENCY AND QUALITY

Street Efficiency. Efficiency in land and infrastructure development can be achieved by combining two standard street types: loops and cul-de-sacs found in the post-war suburb and long blocks common to grid and conventional suburban layouts. Contrary to popular opinion, the curvilinear street pattern associated with conventional suburban subdivisions is not inefficient. In fact, for comparable residential densities, loop and cul-de-sac street patterns are more cost efficient than a traditional gridiron geometry (which is why they are preferred by most developers). According to the technical literature on street planning, conventional suburban street layouts consume 16-25 percent less land than the traditional grids advocated by New Urbanism (see Fig. 1.)

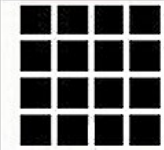
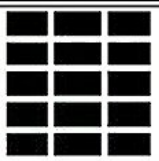
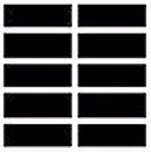
	 Square Grid. (Miletus, Houston, Portland etc.)	 Oblong grid. (most cities with a grid)	 Oblong grid 2 (some cities, or in certain areas)	 Loops. (Subdivisions - 1950 to *now*)	 Cul-de-sacs. (Radburn, 1932 to *now*)
Percent of area for streets	**36.0%**	**35.0%**	**31.4%**	**27.4%**	**23.7%**
Percent of buildable area	**64%**	**65%**	**68.6%**	**72.6%**	**76.3%**

Figure 1. Comparison of area used for streets, among five typical street patterns.

Traffic efficiencies can also be attained by a creative combination of loops and cul-de-sacs, and grids. Loop and cul-de-sac street patterns have evolved since their beginnings in Radburn in 1928. Their geometry has been easily adapted to the automobile by excluding traffic at the local street level, and permitting good flow at the collector and arterial levels. However, the loop and cul-de-sac, which are designed for the automobile, are poorly adapted to the pedestrian. Their discontinuity inhibits pedestrian access to facilities and amenities, while their curvilinearity lengthens and confuses walking trips.

In contrast, the traditional grid patterns that predate the automobile were designed for the pedestrian but have required major adaptations such as one-way streets and traffic lights in order to achieve good automobile traffic flow. Without such adaptations to the grid, congestion is inevitable. On the other hand, when congestion occurs on arterial roads in a conventional suburb, it is generally caused not by the street network but by the segregation and concentration of single land uses such as regional shopping malls or office parks. The grid is a more inefficient and hazardous carrier of vehicular traffic. At each grid corner there are 16 possible intersecting paths for which priority has to be deciphered by the driver (or controlled by traffic lights). By comparison, T-intersections, common in conventional subdivision plans, have only 3 intersecting paths, where priority is easily grasped. In addition, the frequent grid intersections undermine the car's main advantage over other modes--rapidity of travel. Thus the grid compromises either speed or safety or both and, at high traffic volumes, even with traffic lights and stop signs, the grid creates gridlock. New urbanists argue in defense of the grid that conventional suburban layouts encourage car use. A recent study found that car ownership rates, household size and house location have a far greater influence on car use than street pattern type, which ranked ninth in influence.

Street Quality. The perceived quality of a street depends on both physical and operational attributes, some of which are incidental and some of which are designed. Street life, visual interest, social status and population density are incidental attributes dependent on culture and

history. On the other hand, some qualities such as safety, security and comfort are a function of design. Physical attributes, whether designed or incidental, may also be reinforced—or undermined—by operational attributes such as the level of maintenance and cleanliness. Taken as a whole, these attributes can produce a memorable image and a pleasurable feeling in the user, expressed as sociability, walkability, and delight to the pedestrian, and driving ease and safety to the driver.

The *sociability* of a street is critical to its perceived quality. Informal contacts that develop into social networks are at the root of feelings of belonging and security, which are prime factors in resident satisfaction. Street activity cannot be designed but it can be encouraged--or inhibited--by certain street characteristics. The most negative influence on sociability is heavy car traffic. To the extent that a street design encourages speed (as in wide through-streets) it will invite more traffic. To enhance sociability, particularly with regard to children's safety and play, most traffic experts recommend discontinuous street patterns of the kind found in conventional loop and cul-de-sac suburbs. Such street patterns consistently show a lower rate of accidents and a higher level of perceived security.

Satisfaction surveys of suburban residents often mention *walkability*. Walkability implies comfortable access to amenities such as schools, recreation, retail, and workplaces. The presence of these amenities can be affected by a street pattern but clearly not determined by it alone. However, in many conventional suburbs discontinuous, indirect, and confusing street patterns of loops and cul-de-sacs compromise accessibility. In addition, collector and arterial streets are inhospitable and unsafe because of high traffic volume, discouraging pedestrian use. Recent New Urbanism-type subdivisions that have adopted the grid pattern, create clearer and more direct pedestrian routes. Yet the amenities in these communities are generally beyond the five-minute walking distance desired by today's consumers. Walkability demands both a conducive street pattern and, equally important, a land-use arrangement that makes amenities accessible to pedestrians.

Viewing nature, whether it is in the form of parks, boulevards, or treed avenues in an urban environment is a source of *delight*. Green space has been found to have social and psychological benefits that explain the strong consumer preference homes facing parks, lakes and so on. Well-designed green space provides visual relief and opportunity for relaxation, becomes a place for casual contacts, and forms a haven for kid's play. Green space also has environmental benefits: it cools the air, recycles carbon dioxide, and retains rainwater. It is important to note that quality open space has been shown to make increased residential density more acceptable to residents. One of the most successful examples of open space use in an urban plan remains the eighteenth-century plan of Savannah, Georgia. Savannah's public open space is accessible and peaceful. Its thoughtful distribution delivers its benefit to the largest possible number of city dwellers. The city plan is organized in repeatable 675 foot-square "wards," each with a square in the center.

A city dweller behind the wheel expects as much pleasure out of driving as out of walking. Narrow, twisted and crowded streets may please pedestrians, but they frustrate drivers. To be enjoyable, driving requires unimpeded flow, perceived safety, and rich visual experiences on a large scale. These qualities are generally achieved by reducing and simplifying

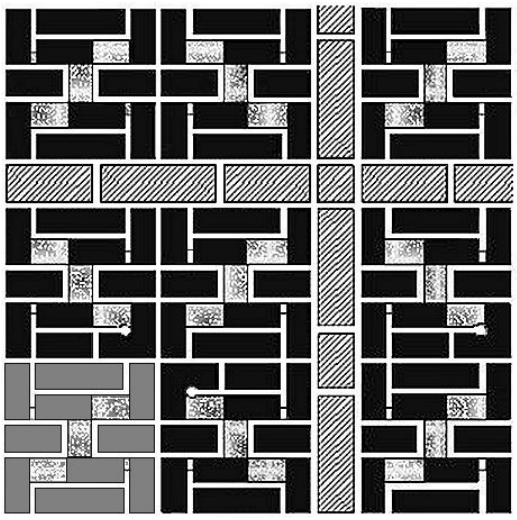
intersections, increasing lane widths, lengthening straight stretches, dividing traffic lanes, widening curves, and completely separating opposing streams of traffic by man-made or natural dividers. Treed boulevards acquire some of these qualities but the road that encapsulates all these positive attributes best is the urban parkway.

THE BEST OF BOTH WORLDS

For users, each of the two predominant suburban street pattern alternatives--loop and cul-de-sac, and grid--has distinct advantages. Discontinuous streets with loops and cul-de-sacs provide safety, sociability and transportation and land-development efficiency; continuous grid patterns provide connectivity and easy orientation. The two patterns can be combined to create a street layout that provides all of these attributes, while minimizing their respective disadvantages. The principle design goals of this new combined street layout is to prevent nonresident through traffic, to maximize the number of houses on cul-de-sacs and loops, to situate open space for maximum accessibility, and to accommodate a range of housing types. To achieve these goals, the alternative approach would have the following characteristics: orthogonal geometry for clarity of organization and directness of pedestrian access; loops and cul-de-sacs for local streets for safety, tranquillity, sociability and land-use efficiency; open space as a structuring and connecting element of the layout as well as for environmental and social benefits; a road hierarchy of local, collector and arterial, for distributing and moving car traffic effectively; and arterial roads that function not merely as traffic conveyors but as activity generators as well.

Figure 2. The building block of residential districts is a 40-acre (16Ha) block (bottom left of drawing).

The fundamental building block of this alternative approach is the residential quadrant (Fig. 2). It is roughly ¼ mile square (40 acres) and can be crossed on foot in five minutes. The quadrant is bounded by two collector streets and two arterial streets. Within the quadrant, residential streets are laid out in a modified grid so that cars cannot cross the quadrant, eliminating non-residential traffic. The use of looped, narrow streets reduces the speed and volume of vehicular traffic. Highest density would be at the edge of the quadrant adjacent to



the arterial streets, intermediate density adjacent to the collector streets, and moderate densities in the center. A continuous pedestrian footpath system provides residents with several direct route options to, public transit, retail, recreation and services. Connections made

on foot are established by way of an extensive and accessible network of open space and parks. By exchanging street space for open space the degree of connectivity is enhanced, walking is made visually rewarding and developable land increases.

CONCLUSIONS

The study summarized here draws lessons from recent and past subdivision street pattern designs. It examines how well they function, fulfill residents' needs and expectations, and address environmental concerns. In developing an alternative pattern that integrates the most important and desirable attributes of each approach, the study concludes: first, that it is possible to maintain the efficiency and quality of the conventional suburb while adopting the geometry of the grid; and second, that 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 grid-based city, and by recasting the arterial street in the role of activity generator, it is possible to create communities that are efficient, viable, livable, healthy and highly marketable.

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