Chapter 3: An Interconnected Street System

Interconnected street systems vs. dendritic street systems.

Street systems either maximize connectivity or frustrate it. North American neighborhoods built prior 1950 were rich in connectivity, as evidenced by the relatively high number of street intersections per square mile typically found there. Gridiron streets systems are the most obvious and most common example of interconnected street networks.[1] Gridiron streets systems provide more than one path to reach surrounding major streets. In most gridiron street networks only two types of streets predominate: narrow residential streets and urban arterial streets that in this book for reasons explained in chapter 2 we are calling "streetcar arterial" streets.

On the other end of the spectrum are the post WWII suburban cul-de-sac systems where dead end streets predominate and offer only one path from home to major surrounding streets. This second cul-de-sac dominated system can be characterized as *dendritic* or "treelike". Streets in this system all branch out from the main "trunk", which in North American cities is usually the freeway. Attached to the main trunk of the freeway are the major "branches", which are the feeder suburban arterial streets or minor highways. These large branches then give access to the next category down the tree, the collector streets or the minor branches in the system. Collector streets then connect to the "twigs and branch tips" of the system, the residential streets, and dead end cul-de-sacs.

This dendritic system has become a ubiquitous feature to urban districts built since 1950.[2] The complex industry that creates new communities is so thoroughly committed to the dendritic street system that alternative thinking is no longer supported. Most municipal and regional transportation planners and engineers speak only in the language of the "street hierarchy", or the hierarchical categorization of streets. This is the language now used to describe this "tree like" dendritic concept and it is almost impossible to easily dislodge. Jurisdictions have rules tied to this street hierarchy taxonomy. Here is only one example of how this works: the Salem OR Planning department requires new developments to assign categories from this hierarchy to all the streets in a subdivision proposal before it can be approved.[3] In 2003 the proponents for a sustainable new community at the former Fairview State Training Center in Salem argued that their interconnected street system proposed was essentially without a flow concentrating hierarchy, but rather was designed

1. A gridiron street system typically has a greater number of intersections than a dendritic street system.

Figure X. This typical sq km in Vancouver, British Columbia has 66 intersections

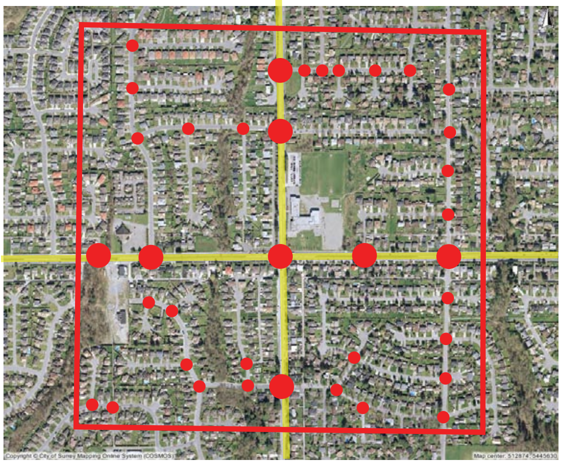


Figure X. This typical sq km in Surrey British Columbia has 36 intersections

2. The street hierarchy was first elaborated by Ludwig Hilberseimer in 1927 and has since prevailed as the dominant model for suburban development (Ford 1999). Between 1930 and 1950 residential street standards became institutionalized by the Federal Housing Administration (Southworth & Ben-Joseph 1997) and by the late 1950s the "normal" suburban street network was dominated by cul-de-sac streets within vast areas of single use residential zoning (Ford 1999).

3. According to Salem's Subdivision Land Use Application, streets in proposed developments must be designed to provide safe, orderly and efficient circulation of traffic in conformance with the Salem Transportation Plan. A key objective of the Salem Transportation Plan (2007) is to "develop a comprehensive, hierarchical system of streets and highways that provides for optimal mobility for all travel modes." This is to be achieved through the creation of a street network made up of: peripheral arterial streets linking outlying districts to each other and the central core area; collector streets that connect local traffic to the arterial system and; local streets that provide property access and neighbourhood circulation (Salem Transportation Plan 2007). Based on traffic type and volume, all streets are classified under the Street Classification System which then determines the specific design characteristics of the street. This is a community that otherwise encourages alternatives to the

car and sustainability. The contradictions between the street regulations and the broader sustainability goals are not recognized here in Salem, Oregon or in most other jurisdictions in North America.

4. Recollection of author who participated in these meetings.

Figure X. Brookside Elementary School in Surrey BC is located in the middle of a superblock, far from the high traffic arterial highlighted above. The closest bus stop is more than half a kilometer from the front entrance of the school.

Figure X. An example of an overbuilt arterial intersection. A solidary pedestrian risks the crossing while a bicyclist fights for position with cars at the intersection.

5. Allen, Eliot. 1996. Benefits of Neotraditional Development. Criterion Engineers and Planners, Portland, Oregon.

to distribute traffic throughout the network. Unfortunately city planners and engineers did not have the discretion to accept this argument, feeling that their own policies made a categorization unavoidable. Having failed, the proponents reluctantly identified the community's proposed "High Street," where shops and community facilities like libraries and schools were proposed, as the "arterial." Unfortunately this designation triggered a reaction at the school district where one of their policies prohibited elementary schools located on "arterial" streets. Here too the school officials felt that they had no discretion in the matter and could only accept a plan where the school was placed less accessibly on a "quieter" part of the site. They recommended putting the school at the end of a cul-de-sac, with ample space for "mothers to drop of their children in cars every morning". At no point did they take the master plans imperative that the school should be "centrally located to make walking convenient and to make the school the symbol of the community" seriously.[4]

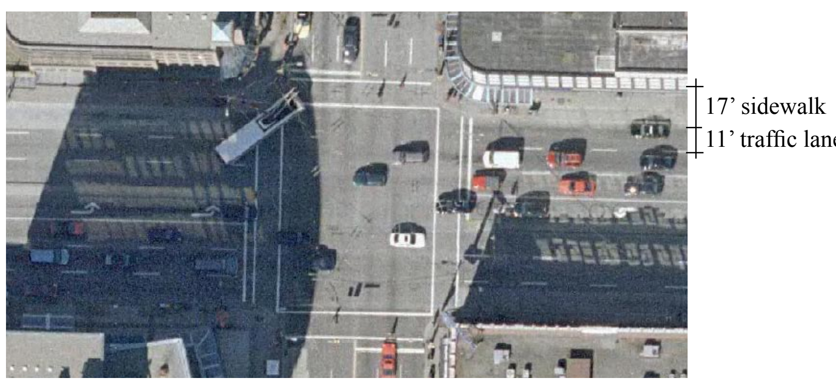
A second example: In 1998 the City of Surrey BC, partnered with the UBC Design Center for Sustainability to design a new "sustainable community" based on principles similar to the ones in this book. An interconnected modified grid system was designed. As part of the process the consultant transportation engineer was required to model the performance of the system. Even though all charrette participants understood and supported the logic of the interconnected grid, including the consultant engineer, she had to artificially assign a hierarchy to the road system or the traffic flow software simply would not run! Thus even the modeling software only acknowledges one kind of system, the dendritic.

Why is the dendritic system a problem?

The basic problem with the dendritic system is that all trips collect at one point, usually the major intersection of two suburban arterials or the on ramp to the freeway. With all trips in an area feeding to one point that intersection will typically receive up to 4 times more trips than would an equivalent intersection in an interconnected system.[5] With all of these trips forced through one pinch point, congestion is inevitable unless Herculean road expenditures are made. But huge expenditures for suburban intersections are now routine, with nine or ten 13' lanes and 200+ foot wide right of way intersections very commonplace. While many of these intersections admirably handle the turning motions and through trips for 60,000 or more car trips a day, they are almost impossible to cross on foot, particularly for the infirm. One study of pedestrian deaths in the Orlando area identified just such a landscape as a pedestrian death hotspot, the worst in the region.[6] Apparently many customers were foolhardy enough to try to trek on foot from the Ground Round to T.G.I.F across the 10 lane arterial street that separated them, and there met their end. It would have been infinitely more intelligent to drive.

Transit systems seldom work well in such places either, since the bus stop drop off point at the intersection is still hundreds of yards away from the bus riders destination, separated from the street by hundreds of yards of parking lot.

Major streets within interconnected street systems often work quite differently than in suburbs. The contrary example of the Broadway corridor in Vancouver BC is instructive. This corridor carries 60,000 trips a day. Were it redesigned to suburban standards, Broadway would require at least nine travel lanes, including three turn lanes.[7] It operates with only four through lanes, no turning lanes, and two parking lanes. The parking lanes are used for through traffic during rush hours, a double use of a lane that is common in older communities but unheard of in new ones. Left turns are restricted at many intersections to keep traffic moving smoothly. The lanes are a relatively narrow 11’, with a consequent curb to curb crossing distance of 66 feet, less than half the distance of the comparable suburban intersection, in a total ROW of 90 feet building front to building front. Crossing times for pedestrians, even the infirm, are reasonable over this distance. The remaining space is taken up by 17’ wide sidewalks serving a continuous line of store fronts. The surrounding grid of streets provides alternative options when this intersection is congested, alternatives that do not exist in the suburbs. Drivers frustrated from making lefts always have the option of using the adjacent street grid to position their car on a perpendicular intersection and achieve their destination that way.



Big boxes

A second consequence of dendritic street systems which, depending on your point of view about big box commercial may be seen as a negative is this: dendritic traffic networks that

6. Between 1994 and 2003 pedestrian fatalities declined by approximately 12.8% which sounds encouraging until you realize that the percentage of commuters who walked to work has declined by 24.9% (Ernst, 2004). In fact, walking is by far the most dangerous mode of travel per mile. In 2001 the fatality rate per 100 million miles traveled for public transit riders was 0.75, for drivers and their passengers it was 1.3 but for walkers it was 20.1 (Ernst, 2004). Since the end of the 1930s, guidelines published by the, Federal Housing Authority (FHA) on neighbourhood design have prescribed large-scale developments based on road hierarchies and superblocks whose interiors preclude all but single-family homes and schools (Miles-Doan & Thompson 1999). In their 1999 case study of pedestrian injuries and deaths in Orange County, Florida, Miles-Doan and Thompson argue that “the institutional neglect of pedestrian safety along arterial roads stemming from the historic evolution of the planning profession has serious consequences” for pedestrian safety. They found that incidents of pedestrian injury and death cluster themselves outside of neighbourhoods, along arterial roadways with strip commercial development. Ernst (2004) found that Orlando is the most dangerous metropolitan area for walking with 3.15 deaths per 100,000 people despite the fact that their walk-to-work rate of 1.3 percent is well below the national average. In comparison, Boston has a death rate of 1.02 but a walk-to-work rate of 4.0% making it one of the safer large metropolitan areas (Ernst, 2004). Miles-Doan and Thompson (1999) state that “the long-range solution to the arterial road safety problem begins with reevaluating the planning practice of designing urban arterials as traffic-moving facilities and nothing else.” Typically, pedestrians who want to cross arterial streets need to contend with several lanes of traffic making a variety of movements at street intersections. The City of Orlando Transportation Planning Bureau (2002) found that when these discouraging conditions are minimized, by reducing road width, the number of pedestrians crossing the street increased by 56 percent.

7. Contemporary suburban street patterns are characterized by wide spacings of arterial streets that typically provide six through lanes, right turn lanes, and single or dual left turn lanes (Levinson 1999). In his report *Traffic Circulation Planning for Communities*, Marks (1974) specifies that arterial streets should be spaced one mile apart, accommodate 10,000-30,000 vehicles per day, feature 4-6 lanes with a physical median, turn lanes, signalized pedestrian crossing and have considerable building setbacks. On-street parking is prohibited and pedestrian use is meant to be minimal.

force all trips to one point create a commercial circumstance that favors big box developments over other more neighborhood scale developments. When trips through a certain intersection reach a certain number of tens of thousands per day the major big box chains take an interest. Their store location formulas depend almost entirely on a combination of two factors: 1) the income range of families in the "service area' as taken from the census data and, 2) the number of trips per day through the intersection adjacent to the site they are considering. [8] The service area calculation is based on the distance from the store customers might be drawn, based on a reasonable assumption of how long they might be willing to drive to get there (lets say twenty minutes). Obviously the more the public spends on a smooth flowing auto oriented infrastructure the longer is the radius line for the service area, the more the potential customer base, the bigger the store and parking lot should be! In this way it can be seen that ever greater expenditure on suburban road infrastructure leads logically to ever larger stores that capitalize on this public expenditure. As this process unfolds and other stores make similar decisions the gravitational forces these stores exert on the system lead inevitably to congestion, as whatever capacity the system provides is used up by the decisions of big box corporations. Interestingly, Home Depot Corporation has recently changed the way it calculates store locations and size, moving to a smaller stores more frequently located in the urban landscape. Why? Because increasing congestion in North American cities is shrinking the distance consumers can dependably drive in twenty minutes, and as it shrinks the Home Depot "big" box is shrinking as well.[9]

8. Hahn (2000) looked at two case studies of agglomerated big box retailer developments that were thought to be representative of the industry as a whole and found that in both cases the developer chose a location adjacent to a high traffic intersection and in an area where the average household income was above the national average.

9. ***My research indicates that this decision was more about exploiting untapped urban markets rather than in response to congestion – discuss with PC

Dendritic systems and gated communities

Whatever ones opinion of "gated communities", they are highly compatible with dendtitic systems and generally incompatible with interconnected systems. Dendritic systems by their nature require developments to occur in pods with usually only one access point into surrounding collectors or arterial roads. Since these arterials are usually unattractive and pedestrian unfriendly "car sewers" (in the words of William Kunstler), there is no incentive to connect to them in ways that go beyond the necessary car link. In such an environment it is eminently logical for developers to mark the transition between the unattractive world of the arterial and what they intend as the much more attractive world of their development. The decorative and entry controlled gate is the typical response. This gate serves less to insure safety than to mark a congenial and attractive inside from the threatening and often very unpleasant exterior of the suburban arterial. Social critics often remark on the insularity

Figure X. Atlanta National Gated Community, Alpharetta, Atlanta, GA

10. Kunstler, J.H. 1993. The *Geography of Nowhere: The Rise and Decline of America's Man-Made* Landscape. New York: Simon & Schuster.

Kunstler, J.H. 2005. *The Long Emergency: Surviving the Converging Catastrophes of the Twenty-First Century*. New York: Atlantic Monthly Press.

Figure X. Seagate is the oldest gated community in New York and features an interconnected street network and relatively high density.

Figure X. It's easy to see why people living in the cul-de-sac development prefer it to the busy arterial environment created as a result of the dendritic street system.

Figure X. From the air one can easily see the difference between heavy traffic arterials and light traffic cul-de-sac

and inherent inequity of gated communities but seldom link their emergence with the dendritic street network which makes them inevitable.[10]

On the other hand, interconnected systems leave development increments that are usually too small for gated communities. Examples DO exist but tend to be of a small scale and therefore less appropriately subject to the criticisms leveled at typically much larger projects in suburban dendritic street systems.

But people like cul-de-sacs!

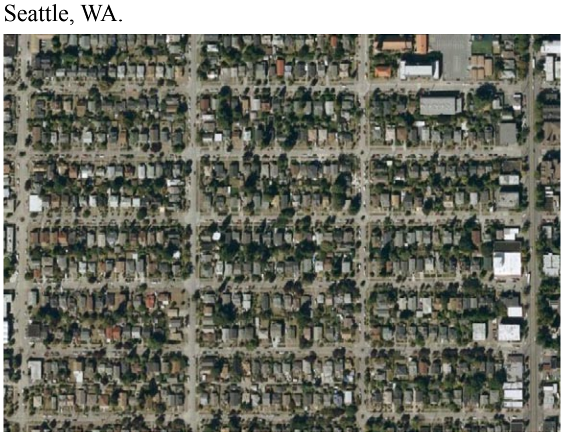
It is often said in defense of dendritic systems that people like the safety and the much reduced traffic flows in front of their houses on cul-de-sacs, and cite this as an overarching justification for the dendritic system we here discuss. While the evidence of that is not universal there is no doubt that many people do prefer the dead end street for these reasons. It is also understandable that given the hostile environment that characterizes the arterial and even collector streets in dendritic systems it is quite reasonable and rational to want to be as far upstream from these traffic impacts as possible. Unfortunately it is just not possible to design these urban landscapes such that everyone lives at the end of a cul de sac. An achievable number might be in the order of 25% of all people living on streets that serve fewer than 100 homes and their 12 trips per family a day by car (for a total of 1,200 cars past your window or one every 40 seconds). People living on other streets further down the system will be subjected to more and more trips. Thus those unfortunates who reside far downstream of the cul de sac will have to tolerate many more cars past *their* homes than would the average resident living within an interconnected street system. Thus the advantages of the cul-de-sac are paid for to the penny by residents less fortuitously situated, proving yet again that there is no such thing as a free lunch.

Why is the interconnected system better?

Interconnected street systems allow trips to be by the shortest possible rather than by an artificially lengthy and circuitous route. Five minute walking distances thus cover much more ground in interconnected street system contexts, easily as much or more than twice as many total acres, making it much easier to provide the services or recreational amenities they need inside this walking distance radius. If an intersection in an interconnected system is congested it allows for "rat running" through the parallel residential streets, obviating what would otherwise be the need for expensive intersection widening and associated expensive property takings. While residents don't like "rat running" it occurs only during times of peak congestion, can be slowed, and is much less damaging to neighborhood quality and much less expensive than prohibiting rat running while adding lanes to main intersections. Interconnected street systems are also safer for pedestrians. A landmark study by Peter Swift[11] determined that pedestrian injuries were four times more likely on wide suburban streets than on typically narrower urban streets (street width issues are discussed below). Finally, it must be admitted that arterials in interconnected systems must be designed for slower speeds than in dendritic contexts. This is because frequent intersections are an elemental feature of interconnected systems and the streetcar arterials that serve them. This frequency of intersections requires that the streets be designed for lower average speeds and that stops be more frequent. Thus under ordinary circumstances a suburban arterial will deliver drivers faster to their destinations than will a more traditional streetcar arterial street. This point is discussed further under the streetcar city rule below. Here suffice it to say that slower average speed in a system that resists congestion and is compatible with urban uses is probably a good thing, not bad. As mentioned above, the Home Depot decision to downsize their stores is instructive. As speeds are slowed in a system, the scale of enterprises scales down with it. If our objective is to reduce distances between desire points it would seem that a strategy which allows for smooth flow but not necessarily fast flow has a certain utility value.

11. Residential Street Typology and Injury Accident Frequency. Swift & Associates, Longmont, CO, Peter Swift, Swift and Associates, Longmont, CO., 1998.

Figure X. These classic block sizes in Vancouver, BC are the same dimensions as the blocks shown below in Seattle, WA.



Four types of interconnected street systems.

Not all interconnected streets systems are grid patterns. In addition to the grid there are at least three other identifiable and distinct but still interconnected systems: the radial system, the informal web, and the warped grid.

The Gridiron

As the name suggests the gridiron pattern is the highly uniform grid pattern of straight streets at ninety degree angles usually aligned with the cardinal axes. The pattern is most common in the US and Canada in cities laid out between 1850 and 1950. This block pattern is best understood as a finer grain subdivision of the larger agricultural 40 acre quarter section. Typically one 40 acre quarter section would be subdivided into two 640 foot segments in one direction and four 320 foot segments in the other, resulting in 8 blocks of 5 acres each. This pattern has two principal advantages over all others. It automatically aligns all intersections perfectly at even right angles and can be extended infinitely in all directions as the city grows. It is often criticized as dull but can be extremely dramatic in some circumstances. Manhattan and San Francisco are two good examples. It is also easy to get oriented in a grid system and provides vistas to distant parts of the city or region down the uninterrupted visual corridors of the street.

Figure X. Radial street layout in Washington, DC

The radial system

Washington DC is the best North American example of this pattern. It is a highly interconnected system but with streets that do not align with the cardinal axes. Rather in this system the major streets typically radiate from significant squares or public monuments. Orientation is not to the north south east or west but to key landmarks in the urban fabric. Blocks are not cut evenly from the fabric of 40 acre quarter quarter section in this pattern, but are nevertheless typically close in size to the 320 foot by 640 foot module of the gridiron. It is undoubtedly a dramatic pattern and can function as well as the gridiron. However, moving traffic and pedestrians through complex intersections where more than two main arterials intersect can be difficult.

Figure X. Informal web street layout in Cambridge, MA

The informal web

Boston and Cambridge Massachusetts are two characteristic North Amercian examples of this pattern. This pattern is the legacy of an early North American rural road pattern common prior to the Ordinance Survey method of subdividing the North American landscape. In the absence of the organizing grid of 40 acre squares, earlier Noth American cities organized themselves around a web of streets that connected key villages and crossroads, thus laying down the main bones of a web of major streets that connected locations via whatever angle happened to be required. The spaces between these major connections were eventually filled in with generally rectilinear blocks, again in the natural increment of between 250 and 350 in width and 400 and 700 feet in length. Navigation in such a system is not via the cardinal axes of from one monument to another, but, as in the case of Boston/Cambridge, from one city “square” (they are seldom square) to another: from Kendall Square to Inman Square to Harvard Square to Scolly Square etc.

The warped grid.

Grids don’t need to be rectilinear and aligned with the cardinal axes to be grids. The grid can be twisted and warped so the streets curve, usually to match the contours of the landscape. When twisted and warped like this blocks will naturally vary

Figure X. Warped grid street layout in Riverside, IL

Figure X. This superblock in Hollywood, Florida is one square mile with only two entrances from the surrounding streets.

somewhat in size. Warped grids create more opportunities for dramatic landscape features than gridirons. This form is usually associated with the romantic period in North American city design with Frederick Law Olmsted as its most significant proponent. No complete North American city is designed this way unfortunately. However most cities have at least one district done in this style dating from the period between 1860 and 1930 when this style was popular. Riverside Illinois by Olmsted is the most famous of these.

Block size

The land left inside surrounding streets is called a block. Traditional cities have blocks of about 5 acres including street space and between 3 and 4 if one only counts the developable land outside of the right of way. Exceptions exist all over the place of course, notably Manhattan with its much smaller 200 foot wide by 500 foot long blocks of less than 3 acres each, and Portland with its extremely small but very walkable blocks of only 200 foot square, or just less than one acre each.

At the other end of the size spectrum is the suburban “super block”, a large block who’s attributes are a bit harder to describe and understand. Super blocks are always very large but frequently 40 acres (again, the legacy of the original subdivision of the North American landscape into one mile sections, half mile quarter sections, and quarter mile quarter quarter sections). Super blocks can even be as large as one square mile, the norm in Phoenix and much of Florida. Whether they are quarter mile or full mile or some size in between they are still defined as the land inside a surrounding road. Developable land inside such large blocks most often needs additional streets to access interior parcels, thus they are usually equipped with penetrating branching dead end road networks that could connect across the block but don’t. As discussed above, every parcel inside a super block typically has only one point of access to the surrounding street system. In the case of Phonix all of the streets on the one mile grid serve a variety of essentially gated complexes inside the one mile squares. The result is a city where the through streets on the one mile grid are all heavily loaded with traffic and generally incompatible with pedestrian friendly commercial uses. They simply accept too much traffic load from the interiors of the one mile superblocks they serve.

Plusses and minuses

Superblocks have the advantage of excluding through traffic across the block, provide more options for parcel configurations inside the block, and require less road length to serve parcels than gridirons. This is why they have been increasingly favored

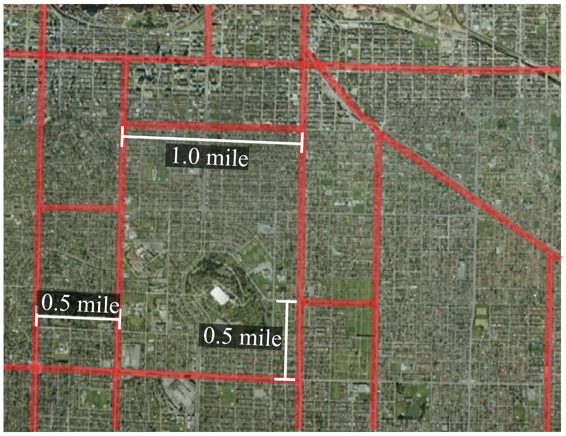


Figure X. "Streetcar" arterials in Vancouver, BC

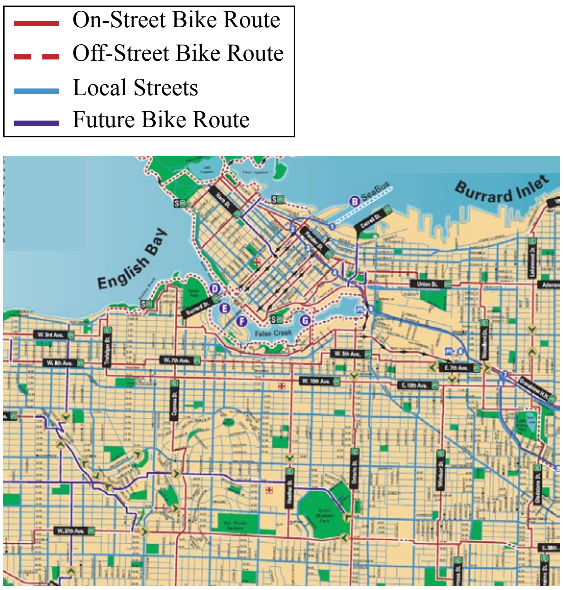


Figure X. The bike system in Vancouver, British Columbia

since 1950. On the other hand they prohibit through movements across the block and thus force traffic onto arterials and overload arterial intersections, prevent congestion flows from exercising any optional routes, make pedestrian trips frustratingly indirect, provide bicycles no option but to compete for road space on the arterials with cars and trucks, and degrade the value of parcels fronting arterials for pedestrian friendly commercial use consequent to the excessive through traffic usually found there.

Traditional smaller urban blocks are much more permeable for both car and pedestrian traffic and allow for more frequent "streetcar" arterials (Vancouver for example has a streetcar arterial every half mile on average, which means that you are never more than a five minute walk from a commercial "streetcar street"). The distribution of traffic and the more frequent provision of streetcar arterials within walking distance makes this form inherently more compatible with a strategy to promote transit, biking and walking. For example, bikers who are not enthusiastic about keeping pace with traffic on the arterials can take advantage of the parallel street network for a safer and slower ride without sacrificing directness. Vancouver has a very successful bike network of designated bike streets that typically run parallel to the streetcar arterials. On the other hand traditional blocks have the perceived disadvantage of allowing through traffic past all residential lots and require more road length on average to access and serve lots than in superblocks.
Also, fixed grids limit the ways that parcels can be configured much more than do
superblocks.

Which is better? If sustainable community design is the frame of reference when choosing between the superblock or the urban block option the choice is obvious. The imperative to provide options to the car provokes a clear choice for the smaller urban block.

Parcel Size

It may be obvious but bears emphasis. Block size determines the range of parcel sizes possible. In most North American cities this is so commonplace that it seldom gets mentioned. But it is remarkable that in cities like Seattle or Vancouver every single land use has somehow been fit into parcels inside traditional 640 x 320 foot blocks with lanes leaving development parcels that are, at the most after ROW and lane space are subtracted 550 x 120 feet or less than 3 acres in size. Thus 40 story towers and single family homes and everything in between have been fit onto the exact same block. So while block size will limit the

Figure X. Typical block structure in Kitsilano, Vancouver

Figure X. Typical block structure in downtown, Vancouver

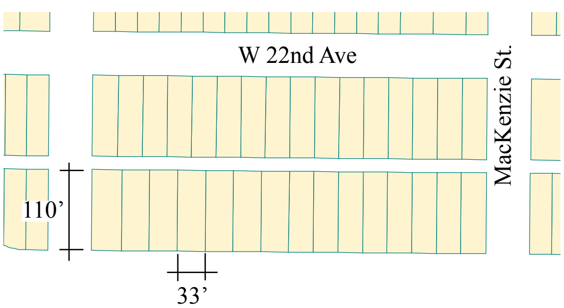


Figure X. This typical block in Vancouver yields 32 lots with the standard size of 33’x110’
Source: VanMap

12. This study is available online at: http://www.jtc.sala.ubc.ca/projects/ADS/HTML_Files/ChapterTwo/matrix_us_2.htm

Figure X. Portland, OR is known for it’s 200’ x 200’ block size

range of parcel sizes and types it is astonishing to see how many different ways they have been designed and utilized.

Single family home parcels

The most pressing issue in sustainable urban design is probably the single family home parcel. This parcel type has been the driver for many if not most of the symptoms of illness described in chapter one. Some have argued that the single family home is anathema to sustainability and should be eliminated entirely. Yet the market for single family homes remains very strong and it is unlikely that this will shift dramatically barring precipitous economic crisis in North America. Fortunately there are ways to configure the single family parcel that is compatible with sustainable community design and that is the small lot. Traditional streetcar cities were largely organized around the single family home lot. Most parcels in Vancouver are single family home lots in neighborhoods that are pedestrian friendly and where options to the car exist. The secret is the 3,500 sq ft. lot with a 33 ft. frontage. Virtually all lots in Vancouver are 33x110’. At this size the lot yield is about 32 lots per block. At this size the gross density of the block would be approximately 6 to 7 parcels per acre. Since duplexes and secondary suites are allowed throughout the city, the gross density in dwelling units vs. parcels is over 10. Our analysis of two traditional Vancouver blocks, blocks that appeared to be all single family homes, actually had a density of over17 units per acre.[12] The secret was that most of the homes actually had a hidden secondary suite and some of the homes contained three units. By using small lots for detached homes it is easily possible to preserve the single family home option, and certainly the single family home “feel” of the street, and still create sustainable communities. Single family home lots can be as small as 2,500 sq ft if the footprint of the new home is small and the home is high rather than wide or deep. This issue is discussed further below under the “different dwelling types on the same street” principle.

Ideal block and parcel size

Various arguments have been forwarded favouring the small “Portland Block” for its abundance of corner opportunities and its walkability. The longer “Manhattan Block” has been promoted for similar reasons. However, those two blocks have very shallow parcels, never deeper than 80 feet, tightly constraining the building form options available and making it impossible to provide lanes in the middle of the block for service and secondary access. For this reason Portland residential neighbourhoods are afflicted with driveways that cross sidewalks every house lot, compromising the safety and

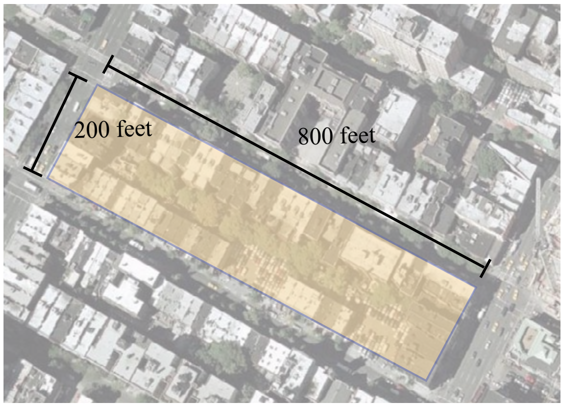


Figure X. Manhattan blocks are 4 times as long as blocks in Portland


Figure X. The smaller block size in Portland, OR favours single building blocks


Figure X. The larger block size in Vancouver, BC allows for more diverse design solutions

comfort of the sidewalk and eliminating at least a third of on street parking spots. In downtown Portland, lacking lanes, all loading and delivery must compete for space with pedestrians on the sidewalks. The same is true in Manhattan. Conversely, in Vancouver and Seattle, where blocks are the more common 640 x 320 foot increment, parcels can be over 110 feet deep, even after subtracting 20 feet for the rear lane. These somewhat larger blocks have provided suitable footprints for the proliferation of new condominium high rise buildings for which Vancouver is now famous. Ideally these towers should be between 60 and 80 feet square. Any smaller and they are diseconomic, any larger and they are too fat to get natural light into the core of the building (not to mention ugly). The point tower on the podium base pioneered in Vancouver would not have been possible on a smaller block, or larger blocks for that matter. Indeed, in Portland where new tower developments are now coming on line, the smaller block is creating a trend toward single building blocks, were a whole block is occupied by one podium building of about 150 feet on a side and a usually somewhat fat tower in the middle of the base. While some good results are possible with this form it tends to predetermine design outcomes more decisively than the larger Vancouver block and would in time lead to a city of single buildings surrounded by a square of streets; probably not a good thing.

In residential areas, the larger Vancouver block allows for a rear lane to keep driveways from crossing sidewalks and allowing the front façade to be free of garage doors. Narrow lot homes have many advantages but most of them are compromised if half or more of the frontage is given over to garage doors. The phenomenon of the “snout house,” a house that is all garage and no façade to the street, is common in California for this reason, where small lots are popular but rear lanes are not.


Figure X. A snout house is characterized by a protruding garage that takes up most of the street frontage, squeezing out front yards and making it hard to find the front door. Source: Dolores Hayden’s “A Field Guide to Sprawl” / Photograph by Jim Wark


Figure X. Cleveland: 24' curb to curb width


Figure X. Nashville: 24' curb to curb width

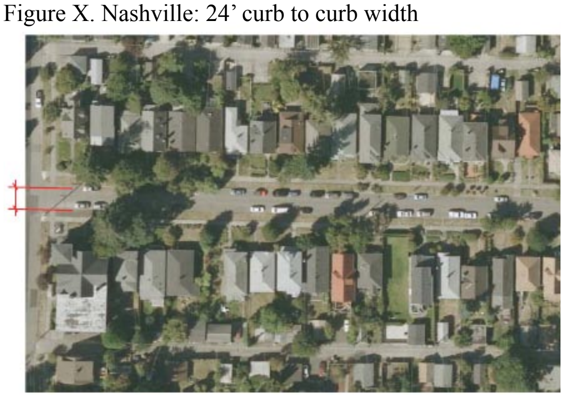


Figure X. Seattle: 24.5' curb to curb width

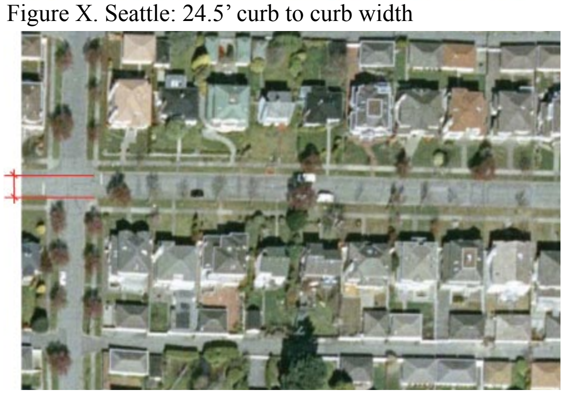


Figure X. Vancouver: 26' curb to curb width

Finally, the deeper lot allows many creative options for the site, including front to back duplexes and lane houses, and/or generous rear yard gardens. Finally, why not bigger than this? If blocks were 400 feet wide rather than 320 feet you gain rear yard space but lose yield. While possible to use the deeper lots in a way that achieves a threshold density of 10 dwelling units per acre, it is not easy. Too many of the units end up away from the street in back yard conditions. The other option is to narrow the lots thinner than 33 feet to gain back this yield and keep the units on the street. But when accounting for necessary side yard setbacks of at least 4 feet on each side (for access and fire) the 33 foot lot only has 25 feet to work with. Dropping the lot much below 33 feet means buildings quickly become too thin to create efficient floor plans.

This complaint does not account for block length however. Why not longer than 640 or shorter for that matter? Here there is more flexibility. The breaking of the quarter mile into two even increments makes a certain intuitive sense and has proven itself to be walkable in many North American settings, but it is by no means a universal increment. One can reduce the length down to 400 without tremendous loss in land use efficiency or up to 800 before the blocks become a very serious barrier to easy pedestrian movement or starts to compromise the overall permeability of the system.

Road Width

Now for the nub of the matter, road width. Prior to 1940 most residential streets in North America were less than 28 feet measured curb face to curb face. Most of these streets allowed parking on both sides of the street in seven foot wide parking lanes. This left only 14 feet of travel lane in the middle to handle two way traffic. The typical car is about six feet wide, so two cars approaching from opposite directions are going to have to go damned slow if cars are parked on both sides of the street to avoid hitting each other. This presumably unsafe condition motivated a change in standards after 1950 typical curb to curb width became 34 feet, comprised of two 10 foot travel lanes flanked by two seven foot wide parking lanes. This width allowed free flow of two way traffic without the need to slow down when cars approached from opposite directions. As time passed, many municipalities decided it would be a good idea to widen residential streets even more, allowing additional space for parking and travel ways such that 40 foot wide suburban residential streets are found in many parts of North America.

There have been a number of unanticipated negative consequences associated with this trend. Most surprising is that streets that were made wider to be safer turned out to be much more dangerous. A study by Peter Swift associates, *Residential Street Typology and Injury Accident Frequency,* found that wide suburban residential streets were associated with four times more pedestrian deaths per unit population than were narrower traditional urban streets. How can this be explained? The answer appears to be induced speed. Pedestrians hit by cars traveling 35 miles per hour are ten times more likely to be killed than pedestrians hit by cars traveling 20 miles per hour. Wider suburban streets designed to allow two free flowing two way traffic and generous parking strips signal drivers that it is ok to travel at speeds much higher than narrower traditional streets.[13] This phenomenon is even more extreme when one considers that the parking strips on most suburban streets are rarely used since these landscapes also include generous driveway space. Thus drivers are provided with as much as 40 feet of clear width to command when driving. Even when these streets are posted with 20 mph speed limits, as they often are, it takes a tremendous act of will to slow to that apparent crawl when the freeway scale generosity of the road width invites speeds twice that fast.

It took decades for the engineering community to begin to come to grips with this phenomenon and to coin a term to describe it.[14] The term is "side friction". Traditional urban streets have "high side friction" because the travel way is too narrow for passing oncoming cars at speed, the abundance of parked cars on both sides, the trees in the boulevard, the pedestrians on the sidewalks that one may or may not be able to see behind the cars and trees, all of these things conspire to create an atmosphere of uncertainty and caution in the mind of the driver. Thus the driver responds by driving slow, no matter what the posted speed.

Alternatively, wider suburban streets have "low side friction." There the travel way is generous enough to pass oncoming cars at speed, parked cars are rare providing an even greater enticement to move quickly, and nothing is hidden from the drivers field of view by trees etc. – all of these things conspire to psychologically license the driver to feel safe at speeds much higher than those posted. Increased pedestrian fatality is the result.

Fire access

But pedestrian and auto safety was not the only motivation for wider streets. Fire access was a powerful motivation as well. The average size of North American fire equipment has been steadily increasing. It is common for ladder trucks to require 15

13. Peter Swift, Residential Street Typology and Injury Accident Frequency (Longmont, CO: Swift and Associates, 1998).

14. The first mention of the term "side friction" seems to be in 1936 in a paper for the Highway Research Board (Barnett et al. 1936). Sources in the 1940s and 1950s continue to use it within a highway context (Barnett 1940; Holmes 1958) however, understanding how the concept applied to residential streets took far longer.

Figure X. Narrow, "queuing" streets create conditions with high side friction (top) as compared to a suburban street with low side friction (bottom).

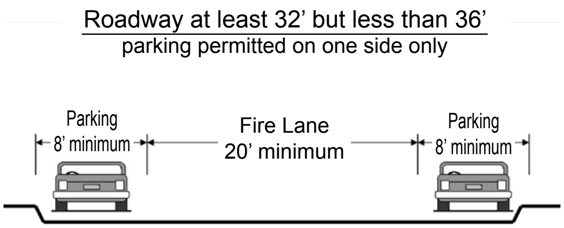


Figure X. A typical Emergency Access standard with 36' (11 m) curb to curb width (source: Ontario Fire Department, California)

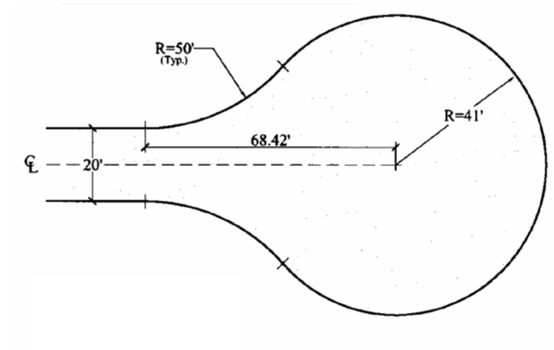


Figure X. A typical Emergency Access standard for cul-de-sacs takes up approximately an 1/6 of an acre (source: San Joaquin County , California)

15. Dedman (2005) writes in an article for the Boston Globe, "Few communities in Massachusetts are adding firehouses to serve new subdivisions" resulting in slower response times, which frequently result in deaths. Communities of all income levels are facing these problems."

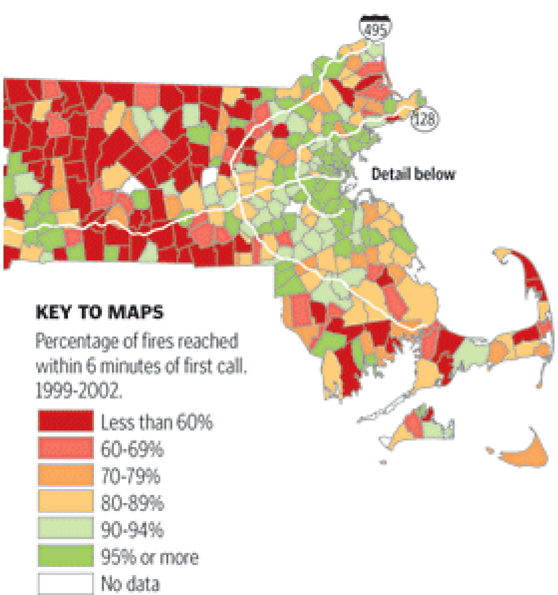
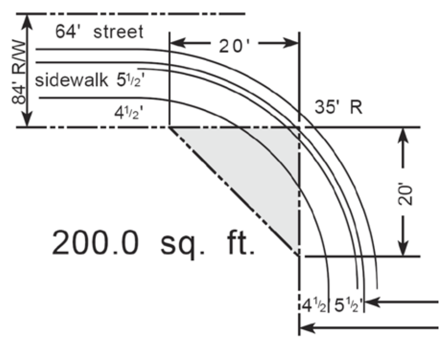
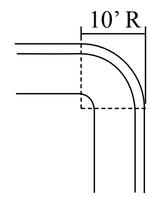


Figure X. Shows the emergency response times in the Boston Metropolitan area.
Source: Boston Globe analysis of National Fire Incident Reporting System data
Graphic: GLOBE STAFF/ David Butler, Bill Dedman

or even 20 feet of street width to set up stabilizer arms extending from the sides of trucks. Concerns about the need to speed to the scene of a fire can lead to demand for 13 foot wide travel lanes in both directions on even short cul-de-sac roads that serve only 20 to 30 homes. A similar concern about cornering at speed can lead to standards for corner curb radii so generous as to seriously lengthen pedestrian crossing distances at intersections and thus compromise their safety.



A typical arterial curb radius in a hierarchical street network is 35'



A typical neotraditional curb radius is 10'

Ironically but sadly predictably the increase in these standards has not led to enhanced safety. The same Peter Swift study found no difference in fire related fatalities when comparing districts with narrow streets to those with wider ones. More depressing still were the results of a study on fire response times in the Boston Metropolitan area. In this study it was found that response times became higher as one moved away from the urban core, in exactly those same suburban communities where wider streets were required. It seemed that whatever the benefit of wider streets for fire safety, it was far outweighed by the difficulty of getting quickly and directly to the fire via circuitous dendritic road systems, and the impossibility of funding enough fire stations within a short distance of all homes in communities with very low density sprawling residential development.[15]
In other words, in urban areas a service area for a fire station serving 20,000 people might be one square mile. In suburban areas the same population might be spread out over twenty times more land, and thus the fire station serving the area would on average be many times further away from homes. This of course suggests a larger contributing symptom to the disease of our unsustainable metropolitan areas. Fire officials, like other officials, are only allowed to comment very narrowly when projects are considered. Fire officials are typically called upon only to speak to issues road width and design, and seldom if ever on larger issues of density and interconnectivity – issues which seem more significant when the evidence is examined.

Figure X. An example of a queuing street with on-street parking and a narrow through lane

16. Looking at neighbourhoods of varying age in five study areas (Maricopa County, Arizona; Orange County, Florida; Minneapolis-St. Paul, Minnesota; Montgomery County, Maryland; and Portland, Oregon), Knapp et al. 2004 found that lot sizes rose between 1940 and 1970 and then fell continuously, reaching an all time low in 2000. Hubble (2003) found similar trends in Las Vegas where the average lot size for a new home fell 500 square feet in the last two years. In 2001 only 13% of new residential lots were smaller than 4,000 square feet, however, in 2003 this number had doubled to 26% (Hubble, 2003). According to the US Census Bureau's American Housing Survey the median lot size fell 26% between 1995 and 2001(US Census Bureau).

Figure X. The aerial photograph taken in Surrey, BC shows shallow lots with large frontages dominated by driveways

Figure X. The aerial photograph taken in Kitsilano shows deep, narrow lots with lane access

Queuing streets

Thus it seems that the traditional 26' to 28' street in an interconnected system was better after all. This kind of street is now called a queuing street, a somewhat misleading name that tries to signify the "taking turns" way that one or the other approaching car will typically pull over into an empty parking space to allow a more generous space for the other to pass. This natural street calming strategy, coupled with short blocks and frequent stop signs, is a more effective traffic calming strategy than speed bumps. It saves pavement, and makes for a much more attractively scaled pedestrian friendly streetscape. A recommended ROW for a sustainable queing street, capable of handling a large number of car trips but at speeds compatible with pedestrian and bike safety is as follows: 6' sidewalk, 10' tree boulevard, 7' parking, 14' travel way, 7' parking, 10' tree boulevard, 6' sidewalk. All of this fits within 60', which happens to be the most common ROW width found in streetcar city residential districts. Some narrowing can occur in the tree boulevard and sidewalk but it is not recommended. Developers will justifiably be anxious to reduce total width as this extracts from developable salable lands. But these pedestrian support and ecological elements are as important as the travel way for reasons discussed below under infrastructure.

Lanes and Alleys.

Most North American cities built primarily between 1850 and 1950 have blocks equipped with rear lanes or alleys (I will use the single term rear lanes or lanes to refer to these). After 1950 when lot frontages increased from 33' to 50 or more feet they were no longer needed. There was plenty of space out front to get the car in and still have a space for the house façade. There were other reasons too. Lanes were considered unfashionable to buyers and developers were understandably unwilling to pay money to provide two public access ways, the street and the lane, to every parcel. This logic prevailed until recently. The average house lot size in typical middle class subdivions had been steadily shrinking back toward the original standard 3,300 square foot lot.[16] The lane makes sense again. When lots get this small there are only two choices. They can be configured wide and shallow with frontages over 45 feet but depths of only 73 feet. This leaves room on the façade for the one or two car garage but precious little for the back yard, putting rear windows of houses within 40 feet of each other. The other problem is that driveway curb cuts will occur every 40 feet and be about 20 feet wide meaning 50 percent of the front yard space will be driveway, that driveways will cross sidewalks half the time, and that half of the on street parking spaces will be lost to curb cuts.

The other option is the narrow deep lot with a lane. A 33 foot 3,300 sq. foot lot is 100 feet deep. This lot requires a lane to avoid the "snout house" effect, where streets are all garage doors and no facades. Installing the lane steals 20' from the mid block of course; but it eliminates the need for driveways of any kind and therefore does not add to the total amount of pavement required per block, however it adds to the *developer's* costs. Typically street infrastructure is installed by the "horizontal" developer who buys the land, subdivides it, and sells off lots to the "vertical" developer or the house builder. If lanes are installed they are a cost to the horizontal developer. If not the cost of the necessary driveways is off-loaded to the vertical developer.

It is very difficult to work through the geometric and cost and amenity trade-offs associated with lanes for these and other reasons. Fear of crime is often cited as a reason to avoid lanes, even though we find no correlation between crime rates in lane served areas of Vancouver and those without. Municipalities are often adverse to lanes, feeling that it is hard enough to take care of streets without the added responsibility of publicly owned lanes. For this reason many developers who see the attraction of lanes but have fought a losing battle with municipalities will throw up their hands and privatize the lanes, and even all the streets, managing them through a neighborhood association. The neighborhood association has neighborhood wide taxing authority (in the form of required association fees enforceable via liens on property) and responsibility for maintenance of all common infrastructure. The general trend, particularly strong in the US, towards tax cutting measures in cities, has forced municipalities to off-load as many costs as possible. Typically any digression from standard street designs will trigger an opportunity for municipalities to suggest developers privatize streets, shifting responsibility to the homeowners in the development for their perpetual maintenance. Whether the privatization of urban public realm infrastructure is a good or bad thing is debatable (the author believes it is anti democratic), that debate lies beyond the scope of this book. The important point here is that any discussion of lanes in municipalities that don't presently allow them is likely to trigger a move to privatize the system, and that citizens and devloepers should be prepared for this. It constitutes a huge disincentive to more healthy urban infrastructure and is yet another in an all too lengthy list of cultural impediments to healthy change.

The corner

Like all elements of street design, intersection design is far more complex and contentious than one at first imagines possible. But to radically oversimplify, the challenge is to reconcile the issue of moving large vehicles around corners with the need to safely and comfortably get pedestrians across them. The two are in conflict. Fire safety and school bus vehicles, the vehicles that will most often be invoked when setting performance standards for turning motions, have long wheel bases and thus corner more easily when there is a wide radius curve to navigate round. But wide radius curves at corners shave off sidewalks right where you need them most, where people need to stand and look before crossing. Most jurisdictions apply minimum standards for turning radius based on the needs of fire trucks and school busses rather than the needs of pedestrians. As with any other standard, turning radius requirements are seldom absolute, even though they are often presented as if they had legal standing. Municipalities are free to set their own standards even if they digress from practices adopted by the majority of other municipalities if they have a reasonable rationale and their decision has been exercised in an atmosphere of due diligence.[17]

One very effective way to satisfy both the fire truck turning demand with the pedestrian safety demand is by using “neck downs”. Since cars are always prohibited from parking near intersections this space can be given over to sidewalk and boulevard uses. Curbs are extended further towards the center line of streets eliminating the parking bays and allowing for 20’ curb face to curb face distance used exclusively as two way travel lane. Changing to a two way travel lane from the 14 foot queuing street is required to allow space for turning or approaching cars to easily fit next to a car that may be waiting at the stop sign. Thus the recommended cross section at the neck down would be 6’ sidewalk, 14’ boulevard, 20’ travel way, 14’ boulevard, 6’ sidewalk for a total of 60’. The much wider boulevard provides a more generous area to shave back with the radius curve that might be required by fire trucks or school buses. It also pushes the pedestrian safety zone further out to the center line of the street and shrinks the crossing distance to a mere 20’. Streets with neckdowns cost more than streets without them unfortunately. Additional cost is for the extra curb if supplied and the frequent need to double up on storm drain inlets. If neckdowns are absent, proponents of sustainable design should be sure that engineers remember the existence of the parking lane and that measurement of the radius curve is not from the edge of the curb but from the edge of the travel lane. Figure X to the left provides one common configuration for a residential street with neckdowns in place with a radius that has been tested against the

17. Local levels of government generally have a great deal of input when it comes to the adoption and implementation of design standards. In Oregon for example, land use laws allow local governments to establish local subdivision standards for street widths that shall “supercede and prevail over any specifications and standards for roads and streets set forth in a uniform fire code adopted by the State Fire Marshall, a municipal fire department or a country firefighting agency” (Neighbourhood Streets Project Stakeholders 2000). Organizations like West Coast Environmental Law advocate and empower local governmental agencies to adapt their standards and guidelines to be more in line with social and environmental perspectives (West Coast Environmental Law 2002.

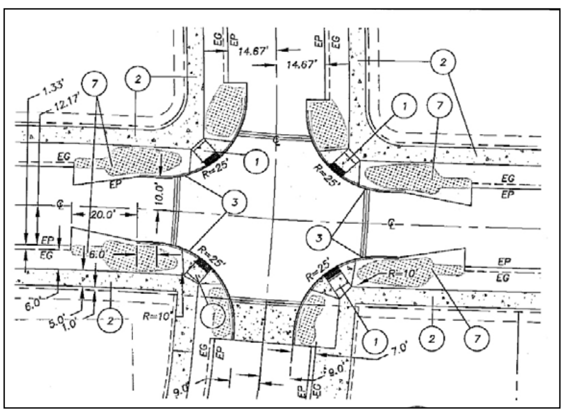


Figure X. Engineering drawing from Pringle Creek development showing “neck downs” (copyright WH Pacific Inc.)

longest school bus wheelbase known to man. Of course School buses are both a symptom of the problem (no one walks to school) and a geometric demand that makes it worse (everything must be designed to conform to their monstrous proportions). But here suffice it to say that the school bus issue is just one more example of how intricately nested are all of the elements that conspire to make our new communities unhealthy, and terrifically resistant to change.

Conclusion

It's a simple idea and easy to grasp. Interconnected streets good, dendritic streets bad. What gets complicated is unpacking all the unhealthy habits that conspire to block a logical return to interconnected worlds and neighborhood health. The interconnected street system is the very armature of a healthy urban landscape. Preserving interconnectivity in areas where it exists and finding ways to build it into areas where it has been frustrated should always be part of the therapy. In already built up suburban areas where the network of disconnection is firmly entrenched, this can seem impossible. There the best and in some cases only opportunity for new connectivity is in shopping center redevelopment; but the importance of this one move should not be discounted. Urbanizing these important social and commercial destinations can go a long way to restoring health. Lifestyle malls where people can walk have become tremendously popular, precisely because people are starved for walking opportunities in these auto dominated worlds. In new suburban developments of 40 acres interconnectivity should be a first principle, even if this results in a small island of connectivity in a sea of dendritic pod development. Many New Urbanist projects hold firm to this principle even though the value of internal connectivity is limited in such a context, and good on them.

Working at the policy end is more effective. Portland Metro Planning Council is working hard to impose an interconnectivity standard requiring a through street at least every 600 feet. The brilliance of this standard is its simplicity. It represents a measured and reasonable requirement from the public sector, insuring the public good is represented while not unduly proscribing the actions of the development community. It would lead inevitably to some set of patterns that would emulate the function of the traditional North American 640 x 320 foot block (a 640 foot minimum would have been a bit better given the sectioning of that landscape; but that's a detail). Finally it creates a policy framework where individual projects with interconnected internal systems can be integrated into an interconnected whole.