A Computational Response to Arrested Development

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a computational response to arrested development

nay zaw soe

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Current improvements in transportation, communication technology, and a steady rise in globalization has lead to the effect of suburbanization. While the exact effects and implications of suburbanization remain a matter of great controversy, it is undeniable that substantial qualitative changes are taking place in the world economy, with major spatial and social implications. These conditions pose significant challenges to the normative design practices in concern to planning and housing, requiring an approach that operates beyond the quick fix or the local solution.

In order to operate critically and design effectively to these conditions, an examination of socio-spatial urban processes and transformations in the world economy is needed; along with an investigation into the evolution of ideas and approaches to the informal and irregular processes of suburbia making. In this context, the research will generate alternative templates of suburbanization based on strategies that stem from embryonic processes seeking the integration of cultural tradition, regional ecological systems and economic globalization.

The ultimate goal of project is to create an alternative model for suburbanization while critically addressing the phenomena of mass-produced urban sprawl. With alternative templates for localized, sustainable strategies capable of addressing a wider range of scales and interests. These alternative templates will address issues of housing, poverty, and the concepts of urban intensification and density. Dealing with these divergent and complex issues in the patterns of suburban growth in an architectural context, architecture can play a central role in the creation of strategies and generating novel suburban clusters. The end result will focus on understanding the most important changes in the contemporary suburban condition and show how architectural intelligence will help the development community to respond to these trends.
Reemerging interest in the studies of landscape urbanism, along with current studies in the science of emergence, has allowed the architectural community to deal with the challenges of contemporary urban strategies. By applying similar methods to the suburban condition, the research can help to understand and address the significant global shifts in the patterns of suburban growth and decline. Current studies in the field of emergence have helped to understand how all forms and all systems change over time, and the forms of nature and the cultural forms of civilization are inextricably entwined. While landscape urbanism, in its interdisciplinary approach, has helped landscape design to address the dynamics of contemporary urbanism. The practice of landscape urbanism has been largely focused on stitching together the fabric of natural and manmade systems within the surface that supports the city and its ecology. The surface is treated on micro and macro levels by synthesizing both architecture and landscape as a hybrid form to create an environment that can house the existing and the rapidly growing urban life. The success of this practice lies within design communities to make cities "more adaptive, more fluid, and more capable of accommodating changing demands and unforeseen circumstances."

Emergence:

In the book, Architecture of Emergence – The Evolution of Form in Nature and Civilization, by Michael Weinstock, he explains that the evolution and the development of human culture have extensively modified the natural forms and systems that exist on earth. He further describes the collapse of systems, in both nature and in civilization, due to these systems reaching a critical threshold of stability. With the outcome of the collapse, civilization goes through a phase of reorganization. This is where complete loss of social order and dispersal of the people by famine, disease, abandonment of cities and mass migration can occur. In consequence, such system goes through a phase of simplification into smaller and simpler assemblies or reorganization to a lower level of complexity. This occurs until civilization can reorder its cities, people, and subsidiary systems into a more complex system with a higher flow of energy and information. “The world is within the horizon of systemic change that will cascade through all the systems of nature and civilisation, and new forms will emerge.”

In order grasp the scope of this situation, we must look at the system from a bottom-up approach. In this approach we can understand the individual components and their roles over the course of time. This view of understanding the system, not as a whole but as individual components, is considered to be the underlining principle of emergence. Emergence is an explanation of how natural systems have evolved and maintained themselves. In the book “Emergence” by Steven Johnson, he explains that emergence operates in the natural world but is not obvious when one looks at the systems from the outside. Johnson further explains that the complex simplification we know as the laws of motion in large systems emerge from the essential principles of individual particles. To view the system of interwoven complexity, we must first look at the individual thread that makes up the fabric.
Drosscape:

Most contemporary studies illustrate that human civilization, and in consequence city forms, has organized and evolved alongside ecological development. In accordance with systems in nature, the metabolic systems of cities can be characterized by “episodic and irregular expansions and incorporations, collapse and subsequent reorganization in more complex forms with greater flows of energy, information and material.” As the flow of energy is increased in the system due to the increase in complexity, the amount of waste being produced subsequently increases. As Alan Berger phrased it, “there is no growth without waste.” A form of waste being produced from the reorganization of these systems is the waste landscape or “drosscape.” Berger claims that waste landscape is an indicator of healthy urban growth. He also pinpoints two processes that form these drosscape. First is the rapid horizontal urbanization, and the second is from the left behind land and “detritus after economic and production regimes have ended.”

The uncontrolled growth and rapid increased in horizontal urbanization (urban sprawl) can be comparable to a similar occurrence in nature, cancer. Many can agree with Alan Berger that this growth can produce waste in many forms. Waste from excessive watering, contamination to the local system from increase of automobile dependency, to “oversized parking lots or duplicate big-retail venues.” And as much as advocates of urbanization would argue that more and more people today are moving back to the cities, this is not entirely true. Reasons such as loft living has become fashionable, the number of single-person households has grown and commuting time has increased. Still, the growth of suburbia continues due to the same reason why families after the war moved to Levittown. Although the suburbia of today is very different from the post war suburbia, the reason for people to move to suburbia remains the same. The lower-density development characteristics such as lower ambient noise and increase in privacy, better schools, less crime, and a generally slower lifestyle are more preferable than the urban environment. As the middle class grows, the demand for suburbia will continue.

MATERIALS AND METHODS

The initial period of the project will operate on a descriptive research method. The aim will primarily be to gather knowledge pertaining to reasons of suburbanism and investigate the relationship of key political concepts to the generation of new urban spatialities. Along with gathering information on key events, projects, and texts that illustrate contemporary responses to the opportunities and problems created by growth. The initial aim will be to focus on post-World War II housing and planning in a number of European and US Cities, offering a vantage point from which to consider critical issues such as density, regeneration, mixed use and new working and living patterns, and it also reviews the development of ideas about housing form and production. This research portion will address the dynamics of contemporary sub-urbanism and its integrated knowledge and techniques from environmental engineering. In order to fully analyze the science of complexity and emergence in the research, digital design tools will be employed.
Much of the first phase of the project will be to classify, compare, summarize and interpret information; the second phase of the project will focus on a specific problem and applying a solution that is accompanied by appropriate information. Both portions will meet the Student Performance Criteria (SPC). Along with meeting the minimum NAAB criteria from Realm A-C, the project will incorporate A-9, A-11, and B-8.

**A-9 Historical Traditions and Global Culture: Understanding of parallel and divergent canons and traditions of architecture, landscape and urban design including examples of indigenous, vernacular, local, regional, national settings from the Eastern, Western, Northern, and Southern hemispheres in terms of their climatic, ecological, technological, socioeconomic, public health, and cultural factors.**

**A-11 Applied Research: Understanding the role of applied research in determining function, form, and systems and their impact on human conditions and behavior.**

**B-8 Environmental Systems: Understanding the principles of environmental systems’ design such as embodied energy, active and passive heating and cooling, indoor air quality, solar orientation, daylighting and artificial illumination, and acoustics; including the use of appropriate performance assessment tools.**

In order to operate critically and design effectively within the current suburban model, an examination into the evolution of suburban tissue is required. This includes exploring the history of suburbanization and its characteristics. To understand suburbia holistically, the term “sprawl” will need to be further defined and the progression of sprawl will need to be examined. First, the term needs to be defined. As is the case with many negative terms, there is often a good deal of disagreement on the actual target of disapproval. Second, the progression of sprawl during the pre and postwar years will need to be discussed. As sprawl progressed, so did many of the anti-sprawl arguments. These anti-sprawl campaigns will be showcased in this paper, along with anti-sprawl remedies that were placed into action since 1970s. Finally, the article will showcase specific sprawl tissue patterns that define suburbia. It is important to understand the development of decentralization and its characteristics before critically operating upon the suburban model.
DEFINITION

Regarding the definition of sprawl, many anti-sprawl reformers believe that sprawl is a recent phenomenon caused by specific technological innovation or government policies. Arguably, characteristics associated with sprawl have been visible in most cities throughout history. Sprawl has been a persistent feature in cities since the beginning of urban history. In any city at any given time some parts will be increasing in density as the density in other areas declines. As cities mature, they have tended to extend outward at decreasing densities but what was new in the twentieth century was that sprawl became a mass phenomenon. For the purposes of this article, sprawl will be defined in the most basic and objective way possible: low-density, scattered, urban development without systematic large-scale or regional public land-use planning. Sprawl should not be considered a fundamentally negative phenomenon – rather, it should be understood as an organic process that can be positively directed rather than eliminated.

HISTORICAL CONTEXT AND DEVELOPMENT

An important fact about cities from the beginning is that there was a transitional zone between the urban and the exurban. In this zone, houses of powerful families who had the means to build and maintain working farms or villas or second houses where they could escape congestion and noise that characterized the center of large cities. Despite the obvious problems of large concerted cities, several factors made high densities in cities a necessary. First, cities had to be developed around a strategic point due to geographical feature (trade routes, harbor, bridges, water, etc.). Until the widespread availability of inexpensive public transportation, which was a development of the late nineteenth century, most urban functions had to be located in close proximity to one another. Second, the size of the urban core had to be a military consideration, since most cities until the nineteenth century were walled for security reasons. For example, citizens that lived outside the walls of Rome were called suburbium, meaning what was literally below or outside the walls. As most cities went through their early economic growth, populations from surrounding areas were drawn into the city center; which cause an increasing in concentration while decreasing in decentralization. Then, as the economy matured, the balance shifted as the number of residents who were able to move outward to the suburbs and exurbs increased, which exceeded the number coming into the city.

To understand this cycle, modern London is a good example because these trends are most visible. In the seventeenth and eighteenth centuries, there was a vast influx of population due to the changes in agricultural production, which forced thousands of families off the land and into the new modes of industrial production. During this period, a group of Londoners that had profited from the expanding economy was able to build or lease houses well beyond the city limits. The direction of the suburban growth at this time was to the west, what is now London’s Central West End. For many, this involved a long distance commute back into the city. There were developments to
the east but it was vastly different. This area accommodated large-scale warehouses and industrial facilities near the great London Docklands. The industrial activities attracted the working class families, causing the densities in these areas to rival those within the city limit. The migration from the central London to suburbia and exurbia was offset by the continued arrival of poor newcomers from the countryside. This resulted in a constant centralization and decentralization. By seventeenth century, London’s density curve started to drop and flatten significantly as the center started to lose population and the periphery started to fill up. Along with London, cities throughout Europe experienced the full impact of the industrial revolution in the nineteenth century. By 1921-31, London area displayed many of the traits that are associated with postwar suburbs.

This progression in decentralization was not isolated to Europe; cities in America were noticing the decrease in density by the 1920s. The progression to suburbia was no longer confined to the wealthy and powerful; it had become a mass movement in both northern Europe and America. For example, the process was noticeable in lower East Side of New York, where the city began emptying out rapidly after 1900 as soon as immigrants accumulated enough money to allow them to get better housing in less dense neighborhoods farther afield. At first, the movement was towards nearby communities like Williamsburg and Greenpoint in Brooklyn. Once public transportation became inexpensive, people eventually moved outward towards northern Manhattan and the outlying boroughs. After several decades of outward movement, both the residential and the employment density curves in the New York area flatten rapidly. The trend applied to the new and more heavily industrialized cities as well, Manchester or Liverpool in England, for example, behaved in ways substantially similar to Chicago or Baltimore in the United States. Either in Europe or in America, aside from increase in public transportation or rising automobile ownership, the most important variable is when these cities reached economic maturity. As cities matured by the end of the nineteenth century, decentralization and sprawl became a widespread trend.

A key factor in this growth and movement was the expansion of infrastructure. During the interwar years American cities finished the process of paving streets and sidewalks, installing curbs, gutters, streetlights, and sewers, and generally completing the package of urban amenities. Along with expansion of the highway system in many cities and construction of a number of limited-access superhighways, and planning for a great national superhighway network helped the process of suburbanization. By the end of 1930s, the outlines of the multinucleated city, with its adjacent suburban and exurban zones that are associated with the postwar era were clearly visible.

At the end of World War II, the sprawl in United States was much more apparent than in Europe for a brief period. One reason was that, most European cities had to be immediately rebuilt, allowing public interventions in the development process. This allowed for public planners the opportunity to implement idea about reshaping the city. The second reason for the divergence in urban development patterns between the United States and
Europe was the difference between the degree of wealth and population. After the war, many cities such as Hamburg, Berlin, Vienna, Glasgow, and Birmingham saw their populations remain stable or even decline, and these cities grew slowly in respect to cities in American. In the first two decades after the war, population in the United States increased from 150 million to over 200 million. More specifically, population gain in individual cities was faster. For example Lost Angeles population doubled during this time, from 4 million to over 8 million. Along with Miami urbanized area grew nearly threefold, the Phoenix area nearly fourfold, and the San Jose area more than fivefold. As the population matured, the average household size decreased, and due to increased in wealth, many smaller family units were able to secure more living spaces. The result was a reduction in densities at the core and a growth in the suburban areas that were very low in density by historic standards.

As the majority of the development and population increased at the fringe, the older central cities struggled. By the end of the postwar years, the inner cities of Newark, Detroit, Saint Louis and other went through the phase of restructuring itself in order to compete with the suburbs. The result was an increase in urban gentrification. Entire districts like Boston’s Back Bay, South End, Philadelphia’s Society Hill and Rittenhouse Square, Washington’s Georgetown and Old Town Alexandria, Chicago’s Old Town and Lincoln Park, and San Francisco’s North Beach and Western Addition were transformed to accommodate wider demographic groups. For the others, the decline in housing prices in many urban areas allowed for minorities groups to reside. As a result from the cycle of restructuring to accommodate for new economic activates, cities had to change in urban forms or create new ones.

SPRAWL TISSUE PATTERNS AND DEVELOPMENT MODELS

To understand the urban structure and growth in the 1920s to 1930s, three urban land use models were created, using Chicago as a prototype. First was the concentric zone model, which was developed by Robert Park and Ernest Burgess. According to this model, the city grows outward beginning with the Central Business District (CBD) in the middle. The second ring contains industry and lower quality housing. The third ring contains modest older houses occupied by the working class. The forth ring is where more spacious housing for the middle-class families and finally the fifth zone is for people who work in the center but choose to live in the suburbs. Although this model was limited in its ability to capture the complex reality of a city, it was very popular due to its clarity that allows for most people to comprehend. The second model was the Sector Model, created by Homer Hoyt. According to this model, the city develops in a series of sectors, not rings. Certain areas are more attractive for different activates. The center again is for CBD but as the city grows, activates expand in a wedge, or sectors, form the center. Once a district with high-class housing is established, the most expensive houses are built on the outer edge of that district further from the center. Industrial and retailing activates develop in other sectors, as well as low-class and middle-class residential sectors. Hoyt observed that, in reality, development in cities didn’t expand outward in tidy rings but instead various kinds of uses pushed...
As wealth increased, the median size of American houses has risen dramatically. Median lot sizes in cities and suburbs, in contrast, after fluctuating in the 1970s and 1980s, started a significant decline in the 1990s. This change is visible on the fringe in most metropolitan areas, where not only are lot sizes smaller but more of the dwelling are attached or multifamily units.


outward in distinct sectors and at different rates. The third was the Harris-Ullman model, which was created during the postwar years by Chauncey D. Harris and Edward L. Ullman. This model was much more complicated in order to solve the problems for the previous two models. According to this model, a city includes more than one center that activities revolve. Examples of these nodes include: ports, neighborhood business center, university, airport, and parks. Some activates go with particular nodes while other do not. For example, a university node may attract well-educated resident, bookstores, and copy places or the airport may attract hotels and warehouses. All three of these models assume the notion that the city is constantly expanding outward with the most affluent resident in the fringe. Due to the necessity of graphic clarity, both models did not account for several important features of urban life. For example, urban gentrification of the core of cities in both Europe and North America had been demonstrated, and cities are not limited to a unidirectional growth. To describe this complicated and constantly shifting metropolitan pattern, Jean Gottmann coined the term megalopolis.

During this time, the Federal Housing Administration (FHA), established in 1934, had issued new subdivision design incentives, and along with an increase in automobile ownership resulted in alternative suburban tissue. For example, Clarence Stein and Henry Wright design of Radburn, New Jersey was radically different than pedestrian focus grid. The Radburn model had hierarchy of streets, with no through traffic, instead relying on cul-de-sac and loop streets to access the home. The streets were categorized as local, collector, and arterial. The result was a greater emphasis on the separation between vehicles and pedestrians traffic. By the early 1960s, Planned Unit Development (PUD) legislation was adopted to account for the negative consequences of the typical subdivision developments. PUD standards allowed for a higher density than typical subdivision, greater diversity of use, including clustered housing to create open community space, and were generally more holistically designed. This resulted in having inner suburbs look and feel much like the adjacent communities within the central city.
San Antonio  Detroit
-48% change  -49% change

Baltimore  Houston
-58% change  -5% change

Dallas-Fort Worth  Seattle
-32% change  -41% change

Cleveland  Minneapolis-Saint Paul
-43% change  -54% change

Buffalo  Saint Louis
-54% change  -57% change

Kansas City  Los Angeles
-64% change  +26% change

San Francisco-Oakland  San Jose
-41% change  +47% change

The Census Bureau’s figure for “urbanized areas,” 1,000 people per square mile
The difference between city and suburbs have blurred as the suburbs have become more diverse and heterogeneous than ever.

New housing developments evolve along with new urban developments. For one thing, single-family houses have become much larger than they were in the postwar decades, as the average size of a new house was around 1,500 square feet at the end of the war to nearly 2,500 square feet by the end of the century. During this same period, lot size decreased from 10,000 square feet in 1950 to 8,750 square feet in 1999. Although at the turn of the century, a typical middle-class suburb lot size were around 25x100 feet, then by 1920, it had increased to 50x100 feet and by 1950s lot size reached 100x100 feet. In general the data from U.S. Bureau of the Census, Construction Statistics shows that 1975 to 2003, house sizes increased while lot sizes decreased gradually. This characteristics shows that, American cities grew much faster in urbanized land area than in population in 1950s, by the end of the 1990s this process had slow down or reversed itself.

CONCLUSION

As with all natural processes, every change in the urban system affects everything else in the system. Any changes made by an individual member can affect the neighborhood to some degree, and eventually propagate to the metropolitan area. When many individuals make changes in a certain direction, it can lead to major shifts in the pattern of developments. To understand sprawl, it is necessary to look constantly back and forth from edge to the center, from the most specific to the most general, and from the individual to the neighborhood to the urban system as a whole. Arguments can be made to locate the forces that were the cause of the urban panorama, for example the grid or the planners that created subdivisions. Others will argue that it was the, developers, or governmental organizations like Fannie Mae or the FHA, but ultimately, the decisions were made by the people. The choices of millions of individuals and families that decided where and how they wanted to live shaped the suburban model that is in place today.
SITE SELECTION METHOD

This issue of urban expansion of the city limits of Lincoln was occurring at an alarming rate to the east and now south, which was out of Lincoln’s predetermined growth limit and affected the public works system as it could not extend that distance. By 1967, the City Planning Department stepped in and basically drew a boundary line, in which new developers could not pass. This took place new Steven’s Creek, the outermost edge of the Salt Creek drainage basin. This was important because it was the farthest point in which sewers could reach without having to be pumped. In the past, Lincoln’s forceful, and possibly over aggressive annexation policy from the 1950 plan had encompassed most urban growth within the city limits and with that limit being intensified something had to be done. People wanted to live there and developers, because of the money, wanted to develop there, so a petition was circulated in order to change the zoning ordinances of the area. The city pushed back and revised a solution that required at least one acre of land and cutting off utilities to any urbanization that happened outside of the three mile radius. However, this motive made little progress in growth to the north and especially west of Salt Creek, a natural boundary.

This example of Lincoln enforcing its founding principles had impact on the infrastructure as well. The public works encountered higher costs for the services of sewer treatment and electricity to the easternmost development. The fire departments, which had been strategically located in the previous plan, were now out of reach for some. Health issues with slower moving drainage to Salt Creek caused some disruption by Lincoln officials as a concern. The horizontal expansion led to inadequate traffic capacity in some areas, especially the commute to the downtown. With the residential density becoming more heterogeneous in nature, drive times varied and much traffic redevelopment happened at a very steep cost to the city (as much as 1 million dollars per mile in 1965!). A 1966 study regarding the metro area transportation revealed that a more substantial system is needed to support (at that time) a rapidly growing population. It incorporated extensive construction of new arterial roads that would occur over a large area of Lincoln, lessening traffic congestion, especially.
TOWNSHIP AND SECTOR SIZE

A way of subdividing and describing land in most of the United States. Texas, Hawaii, and most of the original 13 states are not described by the PLSS. The system starts with a principal meridian, which is a north-south line. There are 37 principal meridians in the United States. Each principal meridian has a base line that runs east and west through it. Land is described as being east or west of the principal meridian, and north or south of the range line associated with that meridian. Land is typically divided into six square mile townships. Townships are described with reference to their principal meridian and base line.
SITE SELECTION METHOD

The graph focuses on the relationship between open spaces and the areas in which urbanization or suburbanization has occurred. It is also important to recognize the city of Lincoln’s projected expansion in the next twenty years as noted by the city of Lincoln Urban Development Department. This allows for a visual illustration of which sectors are possible for development and eliminates those within city limits in which development cannot occur.
A st & S 84th st
(Feasible sector development)
A st & S 84th st

(feasible sector development)
A st & S 84th st
(feasible sector development)
A st & S 84th st
(feasible sector development)
Cities simultaneously emerged from the collapse and reorganization of the founding system of civilization, in five geographically separated and ecologically stressed regions across the world. The evolutionary development of city forms and their extended metabolic systems was strongly coupled to multiple changes of the climate and ecological system within which they were situated, and to the rise in the flow of energy from intense cultivation, increased social complexity and to the evolution of information systems. The proliferation of cities, systems of cities and their extended metabolic systems across the world was characterized by episodic and irregular expansions and incorporations, collapse and subsequent reorganization in more complex forms with greater flows of energy, information and material. The extensive modification of ecological systems at a variety of spatial and temporal scales is still evident in the arid and denuded landscapes that persist today.

- Michael Weinstock
fig. 5.1 built networks, including historic as well as contemporary examples

settlement patterns
sand model

crack pattern no. 1

the supply system of leaves

crack pattern no. 2
TAXONOMY OF PATTERNS

Integrated taxonomy of patterns. This taxonomy both distinguishes and unites the main general pattern types encountered in the tissue pattern studies. This taxonomic structure can be sliced at different levels to create different typologies for different degrees of resolution.

Using this systematic kind of taxonomic structure, one can either use the broader, blunter end of the spectrum (distinguishing, say, three or four most basic types) or a much finer distinction. The whole system can retain a systematic integrity, yet in practical application it can be flexible through selective use of the most useful types for particular purposes.

This Taxonomy can be seen to be structured by recognizing pure (elemental or homogenous) types at each level of resolution. From this starting point, one may deal with heterogeneous layouts in at least two different ways. One may create permutations of basic types, to create hybrids; or one can create a continuous spectrum or continuum interpolation.
As a first and fundamental step, in order to make distinction between two types of formation: those relating to absolute physical geometry, as opposed to those referring to abstract topology. These may be referred to respectively as composition and configuration. The terms are set up here so that they may refer either to the product of formation (a composition or configuration) or the process of formation.

The distinction between composition and configuration can be made specifically and systematically. This means that one can make a distinction between compositional properties and configurational properties of patterns.

One can recognise the labels rectilinear and orthogonal as compositional, and the label cellular as configurational. Therefore the term grid, which connotes rectilinear, orthogonal and cellular properties can be seen as composite, combining compositional and configurational overtones.
As a first and fundamental step, one can make a distinction between two types of formation: those relating to absolute physical geometry, as opposed to those referring to abstract typology. These may be referred to respectively as composition and configuration. The terms are set up here so that they may refer either to the product of formation (a composition or configuration) or the process of formation.
### Nodegram parameters (in %)

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<th>X-junctions</th>
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<tr>
<td>C</td>
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<tr>
<td>D</td>
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### Example configuration

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### Cell and cul ratios

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<td>1.0</td>
<td>0.71</td>
<td>0.05</td>
</tr>
<tr>
<td>Cul ratio</td>
<td>0.5</td>
<td>0.0</td>
<td>0.29</td>
<td>0.95</td>
</tr>
</tbody>
</table>

### T-ratio and X-ratio

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometry</td>
<td>A-type</td>
<td>B-type</td>
<td>C-type</td>
<td>D-type</td>
</tr>
<tr>
<td>Fully two-dimensional</td>
<td>Length</td>
<td>Adjacency, Continuity, Connectivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Square, Oblong, Quadrilateral</td>
<td>Rectilinear, Orthogonal, Wide or narrow, Straight or curved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectilinear, Orthogonal, Wide or narrow, Straight or curved</td>
<td>With three-way nodes (T-junctions), With four-way nodes (X-junctions), With pendant nodes (culs-de-sac)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real numbers, including fractions</td>
<td>Rational numbers, typically integers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.5m Long, 7.3m Wide, 62° angle</td>
<td>Links = 72, Nodes = 49</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
fig. 8.1 T and X ratios plotted against cul and cell ratios. The plot shows the positions of configurations A, B, C and D.

fig. 8.2 The nodegram. Each point represents a network, according to its proportion of T-junctions and culs-de-sac, thereby giving a quantified graphical impression of the ‘morphological continuum.’
street intersection types

one approach

two approaches

three approaches

four approaches

five or more approaches

roundabout

dead end

straight

skewed L

L

t

skewed T

Y

X

oblique

oblique -2

offset

5 -leg

6 -leg -1

6 -leg -2

roundabout: rightangle
### INTERSECTION SPACE GUIDELINES

In most situations, only a minimum spacing is recommended. However, for streets in urban areas, maximum spacings are also recommended to enable a proper density of connecting street network. Frequently, intersection spacing is not a controllable element of intersection design, and the spacing is “given” as a fixed condition. In such circumstances, spacing guidelines are not applicable. However, in many situations, particularly involving areas of new development, intersection spacing is an important part of the context, and should be considered in light of the above guidelines.

Most intersections have three or four legs, but multi-leg intersections (five and even six-leg intersections) are not unusual. Examples of intersection configurations frequently encountered by the designer are shown in Exhibit 6-5. Ideally, streets in three-leg and four-leg intersections cross at right angles or nearly so. However, skewed approaches are a regular feature of intersection design. When skew angles are less than 60 degrees, the designer should evaluate intersection modifications to reduce the skew.
Perfect Fern, fractal iterative shapes also reveal tree-like structures, which can take on an infinite variety of formations.

CANTOR SET:
One very simple way to understand fractals and the meaning of “iteration” is to examine a simple recursive operation that produces a fractal pattern known as Cantor Set. You take a line of arbitrary length and remove the middle third. This is the first step or “iteration”, then take the remaining two lines and repeat the clipping procedure. Eventually after 5 or 10 iterations you have dozens of tiny lines which take up only as much room as the two original ones from the first step.
WHAT ARE FRACTAL PROPERTIES?

A mathematical fractal 1) has structure on all levels of scale, and 2) is self similar.

The first property 1) of a fractal is occurrence of structure on all scales. This property can also be identified in cities, which also have structure on all scales. Self-similarity 2) means that parts of a fractal are similar to other parts of a fractal. In particular, we find that parts (structure) repeated on different scales. Especially property 1 gives confidence that one can use elements of the fractal concept to increase the understanding of urban environments.

Living suburban environments have intrinsically fractal properties, in common with all living systems. To utilize the properties of fractal, it is necessary to understand several things in some detail: 1) what these fractal properties are; 2) the intricate connectivity of the living suburban fabric; 3) methods of connecting and repairing suburban space; 4) an effective way to overlay pedestrian, automotive, and public transports; and 5) how to integrate physical connections with electronic connections.
environment <e1>

<subdivisions>
subdivisions <e1(x)>:
~ 76.5 hectares

<rain_saturation>
(-33 to 36) factor slope & elevation
(-68 to 63) ground saturation factor
(-4 to 112) max & min elevation values

<drainage>
_drainage <e1(x)>:
~306 drop points
~1601 ft average water travel length

<contour>
_contour <e1(x)>:
~2" contour
~total elevation change 116'

<1>
_Lincoln, NE
_O st & S 84th
~1mi x 1 mi
Hex_Obtuse

- contour: zero response
- drainage: zero response
- rain saturation: zero response
- collector road: none stated
- subdivisions: ~76.5 hectares
- feeder road: zero response

- intersection type: three-way intersection
- 0 cul-de-sac
- 12 cells

- frequency of use: center of the system is highly used

- area of green space: 0.367 mi

- lot arrangement: 380 lots
- each lot: 60' x 150'

- pedestrian path: zero response

- road_grade: 1.15 to 4.36 degree
- 0 path above 5 degree

- cut and fill: zero response

- paved road: 3.827 mi

- _gh<settings>
- _circle packing <initialRad 700>, <count 341>, <rnd 0>
- _<remove road factor 0>
- _<min street length 300>
- _<street width from center 15>
- _<lot width 60>
- _<lot depth 140>
- _<side walk width 6>
Hex_Obuse <gH1>

T-tree <gT1>

contour <e1(gH1,gT1)>
  _zero response

drainage <e1(gH1,gT1)>
  _cells merge base on drainage path

rain saturation <e1(gH1,gT1)>
  _zero response

collector road <e1(gH1,gT1)>
  _none stated

subdivisions <e1(gH1,gT1)>
  _76.5 hectares

feeder road <e1(gH1,gT1)>
  _zero response

intersection type <p(gH1,gT1)>
  _15 three-way intersection
  _1 culs-de-sac
  _8 cells

frequency of use <p(gH1,gT1)>
  _center of the system is highly used

average length between nodes <p(gH1,gT1)>
  _0.408 mi

area of green space <p(gH1,gT1)>
  _1,819,970 cubic feet

lot arrangement <p(gH1,gT1)>
  _406 lots
  _each lot `60'x150'

pedestrian path <p(gH1,gT1)>
  _zero response

road grade <p(gH1,gT1)>
  _1.157 to 4.36 degree
  _0 path above 5 degree
  _cut and fill <p(gH1)>
  _zero response

paved road <p(x)>
  _3.521 mi

circle packing <initialRad 700>, <count 341>, <rnd 0>
  _<remove road factor 76>
  _<min street length 300>
  _<street width from center 15>
  _<lot width 60>
  _<lot depth 140>
  _<side walk width 6>
T-tree: e1(gT1)
- zero response
- collector road respond to drainage path
- rain saturation: e1(gT1)
- zero response
- collector road: e1(gT1)
- path systems respond to collector road
- subdivisions: e1(gT1)
- ~ 76.5 hectares
- feeder road: e1(gT1)
- zero response

intersection type: p(gT1)
- 23 three-way intersections
- 26 culs-de-sac
- 0 cells
- frequency of use: p(gT1)
- 2 highly used branches
- average length between nodes: p(gT1)
- 0.419 mi
- area of green space: p(gT1)
- 165739 cubic feet
- lot arrangement: p(gT1)
- 403 lots
- each lot: 60'x150'
- pedestrian path: p(gT1)
- zero response
- road grade: p(gT1)
- 0.01 to 3.520 degree
- 0 path above 5 degree
- cut and fill: p(gT1)
- zero response
- paved road: p(x)
- 3.77 mi

gf<settings>
- circle packing <initialRad 400>, <dc 500>, <Rnd 0>
- <remove road factor 0>
- <min street length 300>
- <street width from center 150>
- <lot width 60>
- <lot depth 140>
- <side walk width 6>
- <prox>min 489, max 663>
In shaping our physical environment today we are influencing future attitudes and individually experienced needs. We are confronted with a problem of true planning and policy making. Svend Riemer, a sociologist explained, “if we provide well integrated neighborhoods in which the individual dwelling unit is supplemented by community facilities, the future citizen will be endowed with a different personality than if we focus attention upon the provision of specialized rooms within the family residence. “In response to Riemer, both spaces from community planning to individual room design needs to be studied further with recent change in technology, and both aspect of space from personal space to territorial space needs to be designed holistically when it comes to dwelling spaces.

With regards to designing dwelling spaces, architects are confronted with contradictory demands. Clients challenge for more privacy and an increasing number of specialized rooms are required, such as the study, the library, the guest room, the workshop and the recreation room. Yet, clients emphasize large living rooms and an easy flow of communications between kitchen, dining room and all other units located on the main floor. The creativity of the architect, thus, seems to be challenged by cross-purposes. As any architect knows, good design addresses scores of issues; focusing on one concern leads eventually to catastrophe. For example, assume that the client’s house faces south, directly onto a busy street. Where does the client install a solar room, a greenhouse, even a glass wall if they choose privacy above energy concerns? It is here that the architect supersedes the engineer, for the question involves knowing vastly more than purely technical information about sun patterns. It seems that, new ideas about functional architecture in magazines and architectural journals appear rather chaotic and whimsical to one outside of the discipline.
housing typology: A & B

Type A:
- 195 sq ft attic space
- 241 sq ft bedroom 1
- 173 sq ft bedroom 2
- 279 sq ft bedroom 3
- 386 sq ft bedroom 4
- 209 sq ft bedroom 5
- 3 bedrooms

Type B:
- 2364 sq ft attic space
- 147 sq ft bedroom 1
- 386 sq ft bedroom 2
- 386 sq ft bedroom 3
- 503 sq ft bedroom 4
- 246 sq ft bedroom 5
- 3 bathrooms

Type A:
- 2 door garage
- 378 sq ft kitchen
- 571 sq ft living room
- 34 ft front setback w/ sidewalk

Type B:
- 2 door garage
- 692 sq ft kitchen
- 1035 sq ft living room
- 45 ft front setback w/ sidewalk

Circulation
type A:  
on-useable attic space

type B:  
633 sq ft attic space

23 sq ft bedroom 1  53 sq ft bedroom 1
45 sq ft bedroom 2  303 sq ft bedroom 2
64 sq ft bedroom 3  240 sq ft bedroom 3
204 sq ft bedroom 4  3 bathrooms
204 sq ft bedroom 5
345 sq ft bedroom 6  4 bathrooms

circulation

2 door garage  1 door garage
318 sq ft kitchen  303 sq ft kitchen
206 sq ft living room  330 sq ft living room
25 ft front setback w/ sidewalk  7 ft front setback w/o sidewalk

48 ft

96 ft

91 ft

43 ft

housing typology: C & D
type A:
1066 sq ft attic space

type B:
1728 sq ft attic space

type A:
- 293 sq ft bedroom 1
- 192 sq ft bedroom 2
- 153 sq ft bedroom 3
- 255 sq ft bedroom 4
- 228 sq ft bedroom 5

bathrooms

type B:
- 225 sq ft bedroom 1
- 195 sq ft bedroom 2
- 385 sq ft bedroom 3
- 176 sq ft bedroom 4
- 228 sq ft bedroom 5

bathrooms

circulation

type A:
- 1 door garage
- 384 sq ft kitchen
- 414 sq ft living room
- 15 ft front setback w/ sidewalk

type B:
- 1 door garage
- 630 sq ft kitchen
- 480 sq ft living room
- 7 ft front setback w/ sidewalk

type E

44 ft

93 ft

type F

46 ft

107 ft

housing typology: E & F
type A:
- 1085 sq ft attic space

type B:
- 1344 sq ft attic space

type A:
- 258 sq ft bedroom 1
- 284 sq ft bedroom 2
- 407 sq ft bedroom 3
- 369 sq ft bedroom 3
- 252 sq ft bedroom 5
- 170 sq ft bedroom 6
- 4 bathrooms

type B:
- 218 sq ft bedroom 1
- 230 sq ft bedroom 2
- 288 sq ft bedroom 3
- 3 bathrooms

circulation

type A:
- 1 door garage
- 416 sq ft kitchen
- 264 sq ft living room
- 25 ft front setback w/ sidewalk

type B:
- 2 door garage
- 506 sq ft kitchen
- 506 sq ft living room
- 21 ft front setback w/ sidewalk

housing typology: G & H
street prototype: B

- building footprint
- LOT outline
- green zone
- sidewalk
- paved road
- house type: B
- subdivisions: ~76.5 hectares
- total lot count: 481
street prototype: A

- Building footprint / lot outline
- Green zone
- Sidewalk
- Paved road

Subdivisions: ~76.5 hectares
Total lot count: 447
A st & S 84th st
(tissue pattern 1)
A st & S 84th st
(tissue pattern 1)

Street Layout
(linear ft)
71,496
(linear miles)
13.5
Linear ft/Person
7.74
Sidewalk Layout
(linear ft)
178,670
(linear mi)
33.8

Lot Count
3,079
Density
9,237
(per sector)
Lot Size
5,329
(average sq ft)

House Size
(average sq ft)
1,448
Front Setback
(average ft)
25
Height
(average ft)
35

Park Land Area
(sq ft)
6,220,903
(acre)
143

3- way
96
4- way
1
cul-de-sac
90
The findings from earlier tissue pattern studies can inform future iteration design guidance, by plugging directly into those parts of guidance addressing street type and layout structure. Street pattern is just one area of urban design concern, but sets the spatial framework or other aspects of urban design. In particular, the affinity between street types and patterns or topology has been demonstrated. A number of specific interpretations of desired properties for street layout has been suggested, including interpretations of connective networks, clear hierarchy as well as other properties such as legibility and coherence.

As well as addressing suburban patterns, the research suggests design processes, in the form of the constitutional approach. This suggests the possibility of generic coding for structure, as an alternative to desired pattern templates. It suggests the possibility of an approach that is both rational and organic.

The next steps would be to work towards combining different types of street with different kinds of spatial composition and built form: a more detailed typology of open green networks, wider range of programs, etc.; design codes for building types, and planning codes for frontage use, in a single system of design guidance. This could be developed for different cities and countries.
84th & A st
(tissue pattern 2)
84th & A st
(tissue pattern 2)

- Single family home
- Sport field
- Elementary school
- Open green space
- Private green space
- Mixed-use
- Multi family housing
- Commercial zoning
84th & A St

(tissue pattern 2)
84th & A St
(tissue pattern 2)
84 th & A st
(tissue pattern 2)
84th & A st
(tissue pattern 2)
84th & A St
(tissue pattern 2)
<table>
<thead>
<tr>
<th>Lot Count</th>
<th>2,563</th>
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<tbody>
<tr>
<td>Density (per sector)</td>
<td>7,689</td>
</tr>
<tr>
<td>Lot Size (average sq ft)</td>
<td>5,435</td>
</tr>
<tr>
<td>House Size (average sq ft)</td>
<td>1,497</td>
</tr>
<tr>
<td>Front Setback</td>
<td>25</td>
</tr>
<tr>
<td>Height</td>
<td>35</td>
</tr>
<tr>
<td>3-way</td>
<td>74</td>
</tr>
<tr>
<td>4-way</td>
<td>16</td>
</tr>
<tr>
<td>cul-de-sac</td>
<td>61</td>
</tr>
</tbody>
</table>

**Street Layout**

- **Linear ft**: 79,818
- **Linear mi**: 15
- **Linear ft/Person**: 10.38

**Sidewalk Layout**

- **Linear ft**: 183,584
- **Linear mi**: 34.8

**Park Land Area**

- **sq ft**: 7,995,618
- **acre**: 184
<table>
<thead>
<tr>
<th>Classification &amp; General description</th>
<th>Location Criteria</th>
<th>Size Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mini-Park</strong></td>
<td>Less than a 1/4 mile distance in residential setting</td>
<td>Between 2500 sq. ft. and one acre in size</td>
</tr>
<tr>
<td><strong>Neighborhood Park</strong></td>
<td>1/4 to 1/2 mile distance and uninterrupted by non-residential roads and other physical barriers</td>
<td>5 acres is considered minimum size. 5 to 10 acres is optimal.</td>
</tr>
<tr>
<td><strong>School-Park</strong></td>
<td>Determined by the location of school district property</td>
<td>Variable</td>
</tr>
<tr>
<td><strong>Community Park</strong></td>
<td>Determined by the quality and suitability of the site. Usually serves two or more neighborhoods and 1/2 to 3 mile distance</td>
<td>As needed to accommodate desired uses. Usually a minimum of 50 acres, with 75 or more acres being optimal</td>
</tr>
<tr>
<td><strong>Large Urban Park</strong></td>
<td>Determined by the quality and suitability of the site. Usually serves the entire community</td>
<td>As needed to accommodate desired uses. Usually between 30 and 50 acres.</td>
</tr>
<tr>
<td><strong>Natural Resource Areas</strong></td>
<td>Resource availability and opportunity</td>
<td>Variable</td>
</tr>
<tr>
<td><strong>Greenways</strong></td>
<td>Resource availability and opportunity</td>
<td>Variable</td>
</tr>
<tr>
<td><strong>Sports Complex</strong></td>
<td>Strategic use of community-wide facilities</td>
<td>Determined by projected demand. Usually a minimum of 25 acres, with 40 to 60 acres being optimal</td>
</tr>
<tr>
<td><strong>Special Use</strong></td>
<td>variable-dependent on specific use.</td>
<td>Variable</td>
</tr>
<tr>
<td><strong>Private Park/Recreation Facility</strong></td>
<td>variable-dependent on specific use.</td>
<td>Variable</td>
</tr>
</tbody>
</table>

- **Neighborhood park**: remains the basic unit of the park system and serves as the recreational and social focus of the neighborhood. Focus is on informal active and passive recreation.
- **School-Park**: Depending on circumstances, combining parks with school site can fulfill the space requirements for other classes of parks, such as neighborhood, community, sports complex, and special use.
- **Community Park**: Serves broader purpose than neighborhood park. Focus is on meeting community-based recreation needs, as well as preserving unique landscapes and open space.
- **Large Urban Park**: Large urban parks serve a broader purpose than community parks and are used when community and neighborhood parks are not adequate to serve the needs of the community. Focus is on meeting community-based recreational needs, as well as preserving unique landscapes and open spaces.
- **Natural Resource Areas**: Lands set aside for preservation of significant natural resources, remnant landscapes, open space, and visual aesthetics/buffering.
- **Greenways**: Effectively tie park system components together to form a continuous park environment.
84th & A st
(tissue pattern 2)
27th & Old Cheney Rd

- **Street Layout**
  - (linear ft): 70,921
  - (linear miles): 13.4

- **Linear ft/Person**
  - 20.85

- **Sidewalk Layout**
  - (linear ft): 156,288
  - (linear mi): 29.6

- **Lot Count**
  - 1,134

- **Density**
  - (per sector): 3,402

- **Lot Size**
  - (average sq ft): 12,773

- **House Size**
  - (average sq ft): 2,454

- **Front Setback**
  - (average ft): 35

- **Height**
  - (average ft): 35

- **3-way**
  - 95

- **4-way**
  - 2

- **cul-de-sac**
  - 33

- **Park Land Area**
  - (sq ft): 407,634
  - (acre): 9
branching tissue pattern 2

84th & A st

Park Land Area
- (sq ft): 7,995,618
- (acre): 184

House Size
- (average sq ft): 1,497

Lot Count
- 2,563

Lot Size
- (average sq ft): 5,435

Density
- (per sector): 7,689

Front Setback
- (average ft): 25

Height
- (average ft): 35

Street Layout
- Linear ft: 79,818
- Linear mi: 15

Linear ft/Person
- 10.38

Sidewalk Layout
- Linear ft: 183,584
- Linear mi: 34.8

3-way
- 74

4-way
- 16
cul-de-sac
- 61
CONCLUSION
This system will not solve all problems, but it points a way forward for tackling several issues, not least problems created by existing practices and conventions of typology, hierarchy and planning. Unlike urban problems such as congestion pollution, poverty, disease or danger, the raft of engineering and planning regulation and zoning practices, typologies and hierarchies are all rational human constructs, put there expressly to serve human purposes. We should tailor them so that they are not part of the problem, but part of the solution.

Planning, and to an extent any form of design, are in a sense an exercise in futurism. A potential problem with futuristic visions comes if too narrow a frame of reference is envisaged. We are tempted to extrapolate a single variable, such as traffic growth or city size, without considering the circumstances in which overall scenarios would develop or evolve. This can limit the ability to visualize solutions. For example, it is difficult to imagine the car-free city of tomorrow, if we simply try to imagine the city of today without the cars. So, while it is easy to imagine cities of tomorrow, it is not easy to imagine viable ones or the path to get from here to there.

The research has demonstrated uncustomary permutations of existing things, exiting modes, street types, hierarchical structures. These may now be used to anticipate possible developments for the city of the future, at least in terms of streets and patterns, transport and suburban design. The city of the future envisaged here is not so much a projection of trends into the future, but just a glimpse of different permutations of existing forms.
REFERENCE


acknowledgements

thesis mentor: Steve Hardy
thesis critics: Tim Hemsath and Janghwan Cheon

Thanks to all my friends and colleagues at the University of Nebraska, College of Architecture, whose company I have enjoyed for many years, and particularly to my mentor, Steve Hardy, whose passion and commitment is a continual source of inspiration.

To Jordan Lake, Pat Heermann, Tara Lea Meador, Jason Culbertson and Darin Russell for helping me throughout my research. Due to their help, the research was able to reach resolution that would not have been achieved by myself alone. Thank you to my peers, without whose distraction the long nights in the attic would have been unbearable.

And finally, to Lindsay Groshans who has been supportive of me throughout the days and nights, and even at my worst. I thank you for everything that you have given me, for all of the help that you have provided, and for all of the support that you have given.

To summarize my experience, I would like to quote Gob from Arrested Development, “I’ve Made A Huge Mistake.”