

Finding Solutions from Natural Pattern for Future Transportation Network

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Abstract

The topic deals with the traffic problem in an urban scenario. Through the sources, it can be seen how traffic is obstructing the growth and development of the city. Its utopian concept in the view that it will seek to attain an ideal city that will be planned and organic, irrespective than present scenario, and will be unique in its way.

The larger the city, the greater its complexity and the potential for disruptions, particularly when this complexity is not effectively managed. The most important transport problems are often related to urban areas and take place when transport systems, for a variety of reasons, cannot satisfy the numerous requirements of urban mobility.

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In the proposal the city can support transportation through 3 levels of transits. Depending upon the function and size of the population that will use the transit, transits have been categorized. It will be a boon for the upcoming trend of transportation like POD cars, or intelligent transit, that will communicate with each other on their own and make the trip for us.

Keywords:

Natural Pattern, Intelligent transit, Future Transportation Network, transport systems, urban mobility

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Intent of the topic

The paper will seek to achieve following goals

- Elimination of stopping at red signals.
- Stopping of burning of fuel caused by stops at traffic.
- Saving time wastage at stoppings.
- Condemn unwanted halt in the way to work or travel
- Lessen accidents, road rages, traffic management problem in mega cities.
- Advocate seamless traffic flow, hassle free movement.

The main focus is to find the solution of the question

Can be these problem removed by following natural pattern?

What should be the ideal pattern of the city so that it would be hassle free in traffic network?

Introduction

Cities are locations having a high level of accumulation and concentration of economic activities and are complex spatial structures that are supported by transport systems. The larger the city, the greater its complexity and the potential for disruptions, particularly when this complexity is not effectively managed. The most important transport problems are often related to urban areas and take place when transport systems, for a variety of reasons, cannot satisfy the numerous requirements of urban mobility. Urban

productivity is highly dependent on the efficiency of its transportation system to move labor, consumers and freight between multiple origins and destinations. The Texas Transportation Institute estimated that, in 2000, the 75 largest metropolitan areas experienced 3.6 billion vehicle-hours of delay, resulting in 5.7 billion U.S. gallons (21.6 billion litres) in wasted fuel and \$67.5 billion in lost productivity, or about 0.7% of the nation's GDP. It also estimated that the annual cost of congestion for each driver was approximately \$1,000 in very large cities and \$200 in small cities. Traffic congestion is increasing in major cities and delays are becoming more frequent in smaller cities and rural areas.

According to traffic analysis firm INRIX in 2011, the Top 10 Worst US Traffic Cities are:

1. Honolulu: Drivers waste 58 hours in traffic;
2. Los Angeles: Drivers waste 56 hours in traffic;
3. San Francisco: Drivers waste 48 hours in traffic;
4. New York: Drivers waste 57 hours in traffic;
5. Bridgeport, CT: Drivers waste 42 hours in traffic;
6. Washington, D.C.: Drivers waste 45 hours in traffic;
7. Seattle: Drivers waste 33 hours in traffic;

8. Austin: Drivers waste 30 hours in traffic;

9. Boston: Drivers waste 35 hours in traffic;

10. Chicago: Drivers waste 36 hours in traffic;

Additionally, important transport terminals such as ports, airports, and railroads are located within urban areas, contributing to a specific array of problems. Some problems are ancient, like congestion (which plagued cities such as Rome), while others are new like urban freight distribution or environmental impacts. Among the most notable urban transport problems are: Traffic congestion and parking difficulties, **longer commuting**, public transport inadequacy, difficulties for non-motorized transport, loss of public space, environmental impacts and energy consumption, accidents and safety.

One of the main reasons for the traffic problem is an unplanned way of urbanization or we can say unsustainable way of growth of cities that is incompatible with nature and the environment has led to these urban problems. Some people try to escape these problems by moving away from the city - a process called counter-urbanization. Long term, however, the solution must be to make cities more sustainable.

As more people move to the edge of towns and cities, traffic congestion may get worse. Many people will drive their cars into the city centre to get to work. It is compounded by people being brought into city on large roads or motorways. These roads, then link up with smaller, older,

narrower roads in the city center. This causes a bottleneck and congestion.

In August 2010, road construction designed to improve circulation on the outskirts of Beijing ended up causing a 62 mile-long crush of cars, trucks, and Lorries on the Beijing-Tibet Expressway. The jam lasted for more than 11 days, keeping some motorists in their cars for five days.

According to Xinhua, the traffic jam didn't have to be as bad as it was; even after days of vegetating in their cars, stubborn motorists refused to take detours because they didn't want to pay more for gas and tolls.

The possibility of a continuation of present trends of unsustainable economic growth, increased social fragmentation and environmental degradation is neither an acceptable nor sustainable option. Without change, human societies will find themselves having to survive in a polluted world where social relations are severely damaged and economies have collapsed. In many communities this is already the case. The adaptability of the city is unquestioned. It is the adaptability of its citizens, decision-makers and urban policy within that city that will be put to the test in the pursuit of sustainability. Urban planners need to come up with a new type of transportation network to cope up fast urbanization. Cities should planned such a way that it can live long and could be compatible with advancement in technology so that it can meet future generation needs to.

Some traffic engineers have attempted to apply the rules of fluid dynamics to traffic flow, likening it to the flow of a fluid in a pipe. Congestion simulations and real-time observations have shown that in heavy but free flowing traffic, jams can arise spontaneously, triggered by minor events ("butterfly effects"), such as an abrupt

steering manoeuvre by a single motorist. Traffic scientists liken such a situation to the sudden freezing of supercooled fluid. However, unlike a fluid, traffic flow is often affected by signals or other events at junctions that periodically affect the smooth flow of traffic. The traffic problem still seeks a better way to handle its constraints.

Relevant literature/theoretical framework

Why have cities not, long since, been identified, understood and treated as problems of organized complexity? If the people concerned with the life sciences were able to identify their difficult problems as problems of organized complexity, why have people professionally concerned with cities not identified the kind of problems they had? (Jacobs, 1961, p. 434.)

When Jane Jacobs posed her prescient question over 30 years ago, our understanding of cities was still dominated by the search for a visual order. As our immediate knowledge of the city is visual, it is perhaps explicable that urban problems which manifest themselves in cities are first associated with the destruction of visual order and harmony. The clear consequence of this has been the quest to solve, or at least alleviate, these problems by reimposing this order or developing it anew through city planning and design. Indeed, modern city planning still takes its inspiration from works such as Camillo Sitte's (1889, 1965) *City Planning, According to Artistic Principles*, which was published a little over 100 years ago. As long as man has sought to interpret

the city, this has been mainly through the visual arts and architecture, culminating in the present century in the ideologies of the Garden City, the City Beautiful, and the Modern Movement. This deeply ingrained view of the city has had a profound influence on less artistic, more humanistic and somewhat more explicitly scientific approaches which in turn have sought to see the city through the need to assert statistical order in terms of homogeneity of its structure and the suppression of 'undesirable' diversity. Indeed, since Jane Jacobs elaborated her thesis, our understanding now augmented by the realization that the city presents a kaleidoscope of complexity, has hardly changed; planning and design still seek to impose a simplistic order on situations which defy our proper understanding and which we can only perceive as disordered.

From ancient times, towns and cities have been classified into those which grow 'naturally' or 'organically' and those which are 'artificial' or 'planned'. In terms of the doctrine of visual and statistical order, organic towns when viewed in plan form resemble cell growth, weaving in and out of the landscape, closely following the terrain and other natural features, embodying the technology of movement through main transport routes, like spider webs or tree-like forms focussed on centers which usually contain the origin of growth.

In contrast, planned towns display a geometry of straight lines and smooth curves, built on a directness of movement which can only be imposed from above, embodying some sense of man's direct

control over nature through technology. Until this century, such planned developments were other parts of larger towns or very small complete towns, more on the scale of the village; although with the institutionalization of large scale urban planning in the last 80 years, much more grandiose plans for entire cities such as the British New Towns or capital cities such as Chandigarh and Brasilia have been attempted which embody a more perfect geometry.

In parallel, the idea that naturally growing cities are in fact more workable, more efficient and more equitable, indeed more democratic, has gained credence as we have begun to probe the complexity which composes the way cities evolve and function. (*Michael Baity and Paul Longley, p. 60*)

Cities are primarily vehicles for bringing people together to engage in the exchange of ideas and material goods, and city size depends upon the level at which the city exists in the entire hierarchy of size from the smallest hamlet to the most global city. But large cities grow from the tiniest seeds, and the nature of economic production and consumption, which are related to each other in the market is directly based on the level of population the market can support and vice versa. Perhaps incredibly, the way spatial markets are organized across the range of spatial scales is virtually identical. When

consumers purchase goods in retail outlets, the same structures and mechanisms are used at whatever level of the hierarchy such transactions take place. Such structures which repeat themselves at different levels of the hierarchy and which in turn are associated with different scales and sizes are said to be self-similar.

Cities with their manifest self-similarity of the market area and repeating orders of centers and neighborhoods show the same kind of irregularity at many scales have been called fractals (from the Latin adjective fractus meaning 'broken')

Fractal exists in nature as a basic rule to decide the pattern in nature. We can see that in the tree that consists of an identical motif (a bunch of leaf) repeating itself on an ever-reduced scale. (*Michael Baity and Paul Longley, p. 59-60*)

The best example of a tree which fills the plane is provided by the H-tree which is shown in Figure 2.13 (a). This tree is symmetric, it is self avoiding in that its branch angles are chosen to be 90° and the rate at which both its branches contract is 0.707. This gives a fractal dimension of 2 which bears out our intuition. A slight variation of this contraction ratio down to 0.7 and a slight decrease in the branch angles from 90° to 85° produces a slightly more realistic structure with a dimension of 1.943, but this remains strictly self-similar. This is also shown as Figure 2.13 (b).

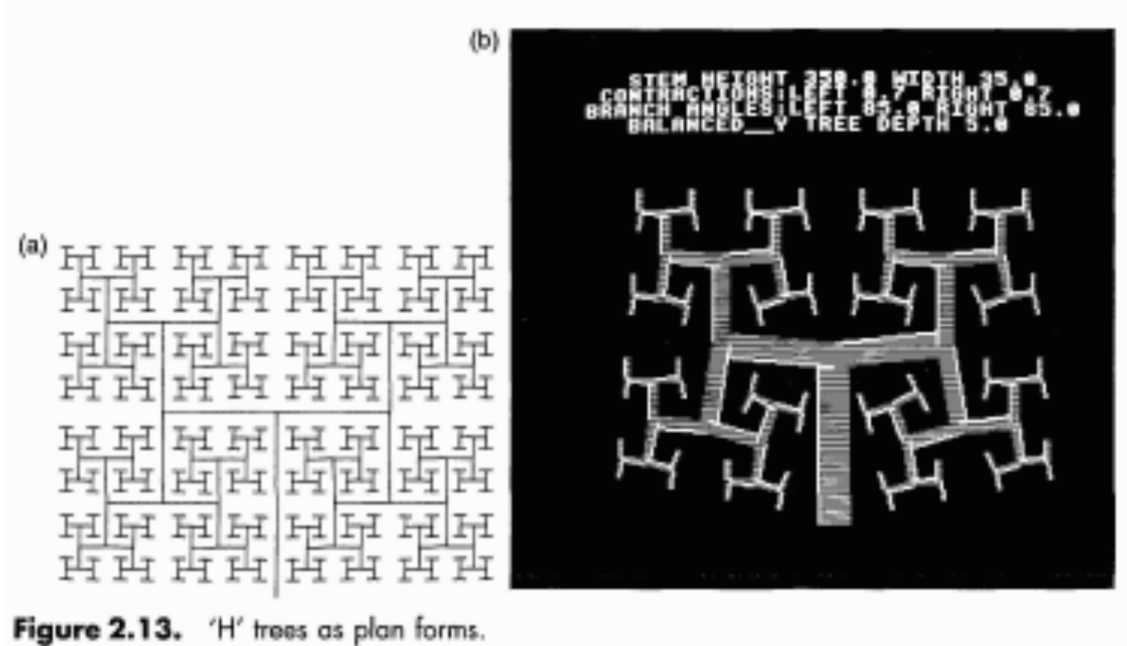


Figure 2.13. 'H' trees as plan forms.

These forms are 'H' trees as plan forms a classic space-filling curves. They are reminiscent of traffic systems in residential areas of towns. In fact, one of the features of these binary trees which is brought out by this analogy is that it is possible to visit every branch of the tree without crossing any other branch. This form of layout plan was suggested by Clarence Stein as being an ideal layout for a residential housing area in that its residents could walk around the layout without crossing any of the roads. This was adopted quite widely as a model for pedestrian segregation of vehicular traffic and it was widely implemented in the design of residential areas in the British New Towns.

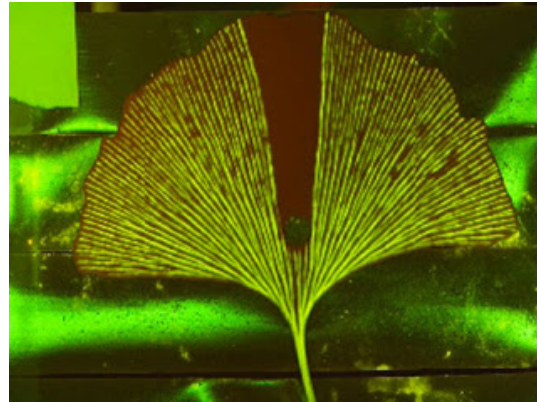
A team of biophysicists at Rockefeller University recently published a paper in Physical Review Letters about a new way to design distribution networks based on

the veins that carry water and nutrients in most tree leaves. This is a great example of biomimicry! Evolution by natural selection maybe be blind, but it has had billions of years of trial-and-error to figure out efficient and robust ways to do things. The interconnecting vein loops in leaves are a good example of that, and we can learn from them.

Operations researchers have long believed that the best distribution networks for many scenarios look like trees, with a succession of branches stemming from a central stalk and then branches from those branches and so on, to the desired destinations. But this kind of network is vulnerable: If it is severed at any place, the network is cut in two and cargo will fail to reach any point downstream of the break. (Marcelo O. Magnasco, e048704)



LEMON LEAF WITH INTERCONNECTED
LOOPS with



LEAF with PARALLEL VENATION
RETICULATED VENATION

A good example of that can be seen on the two pictures in this post. The big dots are damage to the network. In the pic on top, you can see that the flow isn't stopped, and can go everywhere in the network. In the second pic, the flow is stopped everywhere downstream of the damage point.

Operations researchers have appreciated that these redundancies are an effective hedge against damage. What's most surprising in the new research is that the complex network also does a better job of handling fluctuating loads according to shifts in demand from different parts of the system -- a common real-world need within dynamic distribution networks. This kind of network full of loops can also be found in the blood vessels of the retina, the architecture of some corals, and the structural veins of insect wings. (Marcelo O. Magnasco, e048704)

Leaf with the fractal shape of veins which helps the leaf is a special way of transportation of food and water from the root of the plant or tree to the leaf. The special pattern in leaf has been derived from the thousand times of trials and error and finally got the fractal shape that helps

in sustaining the plant lifelong. Similarly the complexity of transportation in cities can be reduced by inspiration from nature. The fractal unit of leaf i.e. Y- shaped, unit is special because after joining in natural series, they create spiral form of network. They have evolved the simple and economical way of transporting food and water through the veins of a leaf.

Recommendations and solutions

The city is divided into sectors. Different sectors would have three types of transit.

1. 1st Tier transit—It will run along the sector border for the Intercity Commuters
2. 2nd Tier transit---It will run inside the sector for the Inter sector Commuters
3. 3rd Tier transit---It will run inside the sector, but will connect the Commercial center of the sector only and will be for business executives.

In every city, either it is newly born or old, we have seen that transit line are laid down as a straight line passing through the city or across the city boundary. The main

reason for this type of linear shape would be Grid-Iron pattern, or the ease of laying down the transit line. Some great thinkers in city planning also advocated the same shape for laying down a network in a straight line, but it was definitely on the basis of other factors than the transportation solution of a populated and churned city with urban conurbation because the time when they gave up the idea of Concentric planning or Central place theory, the city never had urban traffic scenario as like we are facing today. Or we have to move up from the old theory to something new.

Bio-mimicry can find a solution for new levels of settlement to absorb the unplanned growth in the city. Unplanned, because we can never control or restrict the organic growth of the human population. In other words, we cannot control the sprawl of the city completely, unless and until we impose restriction by laws.

Everything in nature grows organically. Trees, animals, Human beings, almost all biotic communities follow nature rules. Number, energy flow, and mass of biotic community are bound by the rule of balance of the nature in the biosphere.

Similarly, if we would not grow systematically i.e. organically so that the human growth abide by rules set by Mother Nature, we could bring up the chaos in the human community. And we cannot reside on earth well enough to survive in a healthy environment. Every

subsystem in the ecosystem is dependent on the other subsystem. One unbalanced subsystem can initially bring up change in another subsystem and finally could turn earth into one alienated and unhealthy place, a place where nature no more capable of healing her wounds of imbalance. And the present way of inorganic growth is bringing up the nightmarish fact into reality.

We can live organically we can grow as an intelligent species on earth. We can control the earth phenomenon up to much extent too. Analogous to nature, we should find a way to develop our physical infrastructure so that we can utilize our resources judiciously and sustainable, with utmost care to natural variables.

Conclusion

It will definitely be the compact development just like nature did it in making leaf and its various components. The idea is not new since Walter Chirstaller had also deduced that the city sector should be the hexagonal shape for better planning with respect to size, shape demand, and order of settlement.

In the proposal the city can support transportation through 3 levels of transits. Depending upon the function and size of the population that will use the transit, transits have been categorized. It will be a boon for the upcoming trend of transportation like POD cars, or intelligent transit, that will communicate with each other on their own and make the trip for us.

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