RICE UNIVERSITY

A PROPOSAL
FOR AN URBAN MOVEMENT SYSTEM

by

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Houston, Texas

May, 1967
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PREFACE:

MOBILITY, A RESULT OF TECHNOLOGY AND SCIENCE, HAS BECOME THE OUTSTANDING CHARACTERISTIC OF THIS AGE. PHYSICAL AND SOCIAL MOBILITY HAVE PROVIDED MAN WITH NEW FREEDOMS, ALTHOUGH, OFTEN HAVING ADVERSE AFFECTS ON MEN'S LIVES.

OUR CITIES, AS THEY EXIST TODAY, REPRESENT THE RESULTS OF THE COMBINED FORCES OF PAST AND PRESENT MOVEMENTS. OUR CITIES ARE COMPLEX AND DIVERSE: THEY ARE OUTGROWTHS OF TRANSITORY PERIODS IN WHICH CONFUSION AND LACK OF EMPHASIS OFTEN DOMINATED. TO DERIVE ORDER FOR OUR CITIES, IT IS NECESSARY THAT WE ACCEPT MOBILITY OR MOVEMENT AS A PRIMARY CHARACTERISTIC OF OUR AGE...UNDERSTAND IT, ITS IMPLICATIONS, ITS HIERARCHIES, AND BEGIN TO STRUCTURE IT AS A POSITIVE TOOL IN URBAN DESIGN.
ABSTRACT

A PROPOSAL FOR AN URBAN MOVEMENT SYSTEM

ROSCOE C. LAWLESS

AS A POSITIVE TOOL FOR STRUCTURING OUR URBAN ENVIRONMENT, URBAN MOVEMENT SYSTEMS MUST ZONE MOVEMENT BY TYPE AND VOLUME, ESTABLISH A COMPLETE MOVEMENT ACTIVITY HIERARCHY AND ESTABLISH A HIERARCHY OF RESULTING POINTS OF MOVEMENT EXCHANGE.

I. ZONING BY TYPE

A. MOVEMENT PURPOSE

B. MOVEMENT PROPERTIES

II. ZONING BY VOLUME

III. ESTABLISH A COMPLETE MOVEMENT-ACTIVITY HIERARCHY

IV. ESTABLISH POINTS OF MOVEMENT EXCHANGE

I WILL FIRST ESTABLISH THE NEED FOR MY PROPOSAL BY BRIEFLY SURVEYING THE MAJOR MOVEMENTS WHICH HAVE FORMED OUR CITIES. I WILL THEN SUPPORT MY PROPOSAL BY EXAMINING BASIC QUALITIES OF URBAN MOVEMENT AND SPECIFIC CHARACTERISTICS OF MOVEMENT TYPES, VOLUMES, MOVEMENT-ACTIVITY RELATIONSHIPS, AND POINTS OF MOVEMENT EXCHANGE.
HISTORY
Analysis

The history of this country is a history of mobility...of movement. After the initial settlement of the eastern sea coast, America's first continental movement began. This first migration resulted in the clearing and settling of the American continent. A following movement saw the flow from the countryside into factory towns. A third, represented a shift of people and resources from earlier industrial centers to financial centers. A fourth continental movement, which allowed movement away from centralized areas, has begun to lead to a fifth movement which accelerates decentralization in space while providing centralization in time. Each of these movements has had a primary social, economic, or political stimulus, as well as complimentary modes of transportation. Each, likewise, has had favorable and unfavorable results.¹

The first movement began about 1790 as people moved

westward in search of land and a better life. The land was settled but often at undue cost to the country's natural resources. The cities which resulted from this movement became first an economic and then a cultural spearhead into America's western wilderness.²

These cities became central trading hubs, dependent primarily upon foot and horsedrawn transportation for local movement, and was thus limited in size. A city generally developed at points where overland routes converged at river crossings. Thus, long range regional movement was either by horsedrawn wagons, by river flat boats, or, at a later time, by steamboats.³

The second continental movement began about 1830 as industrial production took hold of the country. The resulting city became a place of work and business opportunity...while individual needs were often forgotten.

The railroad, itself a result of industrial production, became a primary stimulus to the resulting centralization.

As railroads converged on cities, transportation centers evolved and the city took on a spider web form with points of development occurring at railroad stop points. Local movement was still primarily dependent upon foot or horsedrawn means as points of high density developed within walking distance of factories or train stops.

The third movement, begun about 1870, saw the rise of financial empires in the hearts of our cities. The shift did in general, improve the status of the individual physically and intellectually.

The development of the streetcar and subway at this time permitted the city limited dispersal. High densities, formerly required by the lack of adequate movement means within the city, were no longer necessary.

City growth occurred along the street car lines as activities were developed within

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walking distance of street car exchange points.\textsuperscript{5}

The fourth movement began to take form about 1925 with technology and science as its base. Advancements in transportation and communication began to allow de-centralization.

The automobile, a primary stimulus of this movement, has generated today's horizontal city and its resulting low densities.\textsuperscript{6}

A fifth movement, which is becoming evident in our age, is again based upon science. This movement accelerates de-centralization in space while providing centralization in time. Points of activity may, then, be totally removed in space, yet may be extremely close in time.

\textsuperscript{5} Spreiregen, p. 159-161.
\textsuperscript{6} Spreiregen, p. 165.
A historical analysis of movement frequency between the activities of living, working, shopping, and recreating with regard to movement type and the association patterns resulting in urban form is here discussed.

"A town is by definition a specific pattern of association, a pattern unique for each person, in each location, at each time."  

I. First Migration c.1790

Legend
Available types of movement
Non-available types of movement

The following diagrams are schematic representations and not to be considered in exact quantitative terms.

II. Second Migration c.1830

Movement type

Railroad

Movement type

Horse

Walk

Frequency

World

Community Structure

City

Community Association

Frequency of Use

Associations

Neighbors
III. Third Migration c.1870

Movement Type

- Railroad
- Streetcar
- Horse
- Bike
- Walk
- World

Community Structure

- City

Community Association

- Neighborhood

Associations
IV. Fourth Migration c.1925

<table>
<thead>
<tr>
<th>Movement Type</th>
<th>Frequency of Use</th>
</tr>
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<tbody>
<tr>
<td>Jet Plane</td>
<td></td>
</tr>
<tr>
<td>Air Shuttle</td>
<td></td>
</tr>
<tr>
<td>Train</td>
<td></td>
</tr>
<tr>
<td>Auto</td>
<td></td>
</tr>
<tr>
<td>Commuter Rail</td>
<td></td>
</tr>
<tr>
<td>Rapid Transit</td>
<td></td>
</tr>
<tr>
<td>Bus</td>
<td></td>
</tr>
<tr>
<td>Scooter</td>
<td></td>
</tr>
<tr>
<td>Bike</td>
<td></td>
</tr>
<tr>
<td>Walk</td>
<td></td>
</tr>
</tbody>
</table>

World

- Community Structure
  - City

- Community Associations
  - Neighborhood Associations
HISTORY

Conclusion

In the past, American cities were compact, movement means were slow and people lived and worked close to one another. A large percentage of movement was on foot and interaction among people on a local scale resulted.8

The introduction of the railroad at the rise of an industrial era led to radial forms of city growth with concentrations of growth at railroad stop points. The introduction of street cars and sub-ways with the rise of a new financial era in general, improved the lot of city dwellers, providing a greater choice of movement types, as a spider web form evolved.

The introduction of the automobile, and its broad acceptance has stimulated de-centralization and low densities in American cities. Resulting cities, such as Los Angeles, are formless horizontal undifferentiated growths without focal centers or without particular reliefs in form.9

9Richards, p. 171.
City dwellers do enjoy a higher standard of living than ever before—yet, they are—by their limited choice of movement types—unable to achieve the diversity which their cities should offer.

The impact of the introduction of air and rocket travel, as well as, electrical impulse communication systems is yet to be fully realized. It is evident that these new modes of movement will have decisive effects upon American cities. It may well be possible to attain maximum physical dispersion in space and yet maximum concentration at the same time as high speed systems draw activities together in time. The actual impact of these systems must be be left to conjecture, however.

Our cities, as they exist today, represent the results of the combined forces of these past movements, and of the present movements. Our cities are complex and diverse: they are outgrowths of transitory periods in which confusion and lack of emphasis often dominated. Our cities now lack order of movement and activity. Streets have no hierarchy with respect to functions they serve. A rec-
talinear grid, resulting from the pre-motor age, allows in-discriminate movement of un-related systems of communication.

The primary movement problems which our cities face today may be summarized as follows:
1. Streets often have no hierarchy with respect to the functions they serve.
2. Indiscriminate movement of unrelated systems of communication exists.
3. Limited choice of movement types exist.
4. Total reliance upon one movement type (high order flexible) produces congestion and inefficiency. 10

Recognizing these problems, the following compiled list of general movement system goals is suggested.

GENERAL MOVEMENT GOALS: A MOVEMENT SYSTEM SHOULD:
1. Permit equal distribution and accessibility.
2. Provide maximum freedom of choice of movement type.
3. Utilize each type of movement for its inherent advantages.

4. Be economically feasible.
5. Be able to adjust to meet the needs of changing social, economic, political, and cultural determinants.
6. Provide visual structure to the city.
7. Provide speed, comfort, safety, convenience, dependability and adaptability.
8. Be applicable to existing situations as well as ideal towns. 11

III. MOVEMENT FUNCTION
Analysis: Qualities of Urban Movement

Throughout history, types and scales of activities have been grouped in cities for various social, cultural, economic, and political reasons. All of these reasons may, however, be bound up in the need for communication...the physical movement of people, goods, and messages. This appears to be the fundamental thread which ties together various activities in all realms of city life. It is perhaps the most important of all physical city components, for the city depends upon the flow of goods and ideas for its life.

A study of movement systems in our present cities has revealed the following basic qualities of urban movement:

1. Movement is a servant function of activity.

"Traffic and roads are not ends in themselves, they are services only; the end is the environment for living and working."12

A. It may be a resultant of activity.\textsuperscript{13}

B. It may stimulate new activities.

"When aligned with other services and facilities, transportation helps generate powerful forces for influencing the long-run real estate market."\textsuperscript{14}

II. Movement paths are links between activities.\textsuperscript{15}

III. Movement paths may be boundaries.

"...a highway or other circulation route serves to separate laterally while joining longitudinally."\textsuperscript{16}

IV. Each type of movement has an optimum range of performance.\textsuperscript{17*}

V. Each type of movement has an optimum trip-distance between stopping points.\textsuperscript{18**}

\textsuperscript{13}Steering and Working Groups appointed by the Minister of Transport, pp. 33-34.

\textsuperscript{14}Seguin, p. 143.


\textsuperscript{16}Ibid.


\textsuperscript{18}Ibid.

\textsuperscript{*Optimum range of performance

\textsuperscript{**Optimum trip-distance: these refer to the most economic distance based upon the characteristics of each type of movement.
VI. Intersections of human movement paths generate social interaction.19

VII. Regularly occurring points of identity give cohesiveness to movement pattern.

"Just as our mental process needs fixed points...to enable it to classify and value transient information and thus remain clear and sane, so the city needs 'fixes', identifying points which have a long cycle of change by means of which things changing on a shorter cycle can be valued and identified."20

VIII. Movement paths can define districts; scales of movement can determine district size.21.

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20 Smithson, p. 584.
21 Steering and Working Groups appointed by the Minister of Transport, p. 42.
IV. ZONING BY TYPE
ZONING BY MOVEMENT TYPE

Analysis

"Circulation ways of different types are not alike in terms of safety and convenience...there is variation in the type of route which most efficiently moves the specific goods or people it is designed to serve." 22

In Fritsch's *City of the Future*, it was suggested that "...just as land use should be zoned, so should the characteristics of circulation ways reflect their use..." 23

An examination of the purposes of movement, and the specific properties of movement types in fulfilling those purposes, will support the proposal of zoning movement by type.

Movement is engaged in as a communication devise between activities. It may be for any of following purposes:

1. Movement of people—in bulk or individually
2. Movement of goods 24
3. Movement of messages
4. Movement of utilities.

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22 Reiner, p. 129.
23 Ibid.
24 Steering and Working Groups appointed by the Minister of Transport, p. 34.
In the fulfillment of each of these purposes, various movement types may be examined with respect to their individual properties.

CLASSIFICATION OF URBAN MOVEMENT TYPES:

I. Movement of people:
   A. Walking
      1. degree of flexibility: low order, flexible
      2. optimum speed:
         2.5 mph
      3. optimum trip distance: 0 - ±.66 miles
   B. Bicycle
      1. degree of flexibility: low order, flexible
      2. optimum speed:
         3 - 12 mph
      3. optimum trip distance: ±.05 miles - ±2.5 miles
   C. Motor cart or Motor scooter or Mini-car
      1. degree of flexibility: low order, flexible
      2. optimum speed:
         15 - 25 mph
      3. optimum trip distance: ±.20 miles - ±3.0 miles

*Flexible: movement made of variable speed, volume, and trip distance. Usually privately provided.
D. Local Bus
1. degree of flexibility: low order, inflexible
2. optimum speed: 15 - 30 mph
3. optimum trip distance: ±30 miles - ±3.75 miles

E. Rapid Transit
1. degree of flexibility: high order, inflexible
2. optimum speed: 40 - 60 mph
3. optimum trip distance: ±1 mile - ±12.5 miles

F. Commuter Train
1. degree of flexibility: high order, inflexible
2. optimum speed: 40 - 70 mph
3. optimum trip distance: ±1.5 miles - 25 miles

G. Automobile
1. degree of flexibility: high order, flexible
2. optimum speed: 15 - 75 mph
3. optimum trip distance: ±15 miles - ±310 miles

H. Airplane
1. degree of flexibility: high order, inflexible
2. optimum speed: 200 - 300 mph
3. optimum trip distance: ±250 miles - ±2,000 miles

I. Vertical transportation
1. degree of flexibility: inflexible
2. optimum speed: 100 - 300 fpm
3. optimum trip distance: variable

II. Movement of Goods:
A. By hand
1. degree of flexibility: low order, flexible
2. optimum speed: 2.5 mph
3. optimum trip distance: varies with goods

B. Light Truck
1. degree of flexibility: low order, flexible
2. optimum speed: 15 - 45 mph
3. optimum trip distance: ±3 miles - ±15 miles
C. Heavy Truck
1. degree of flexibility: high order, flexible
2. optimum speed: 20 - 60 mph
3. optimum trip distance: +15 miles - +310 miles

D. Train
1. degree of flexibility: high order, inflexible
2. optimum speed: 40 - 70 mph
3. optimum trip distance: variable

E. Airplane
1. degree of flexibility: high order, inflexible
2. optimum speed: 200 - 500 mph
3. optimum trip distance: +250 miles - +2,000 miles

III. Movement of Messages:
A. Wire
B. Wireless

IV. Movement of Utilities
A. Electricity
B. Water
C. Sewage

D. Drainage Sewers

25 The above limited list of movement types was chosen for purposes of examination only. For an examination of new types of movement, many of which do not appear here, see:


   The figures quoted above were compiled from the following two sources:


ZONING BY MOVEMENT TYPE

Conclusion: Principles derived

1. Separation by movement purpose will ensure maximum service advantages of each movement purpose and thus aid in the achievement of movement organization clarity.

2. Separation by movement type properties of flexibility, speed optimum, and trip distance optimum will ensure maximum service advantage of each type of movement and thus aid in the achievement of movement organization clarity.
V. ZONING BY VOLUME
ZONING BY MOVEMENT VOLUMES

Analysis

Classification of urban movement volumes:

Volume is a resultant of the demands placed upon a movement system by each movement type in the fulfillment of each movement purpose. It is a function of speed and use frequency recorded by persons moved per time unit.

Louis Kahn proposed a graduated use and speed scale for vehicular movement in his plan for Philadelphia in 1953...which, in affect, was a proposal for zoning movement by volume.

"Expressways are like rivers. These rivers have harbors. These harbors are the municipal parking towers. From the harbors branch a system of canals that serve the interior. The canals are the go streets. From the canals branch cul-de-sac docks. The docks serve as entrances to buildings."\(^{26}\)

"A city's expressways would be tied to its network of slower speed arterials. These in turn would tie into a still slower speed network of stop and go streets."\(^{27}\)

\(^{26}\)Kahn, p. 383.

\(^{27}\)Sprürengen, p. 85.
Le Corbusier, in his plan for Chandigarh, proposed a series of seven types of routes— from high speed, high volume inter-urban ways down to pedestrian paths.  

28 Springen, p. 35.
ZONING BY VOLUME VOLUMES

Conclusion

Differing volumes should be separated into the following orders within each movement type to ensure the satisfaction of variable demands of each movement type and the functions they serve.

Volume Orders
Primary Conductors: highest level
Secondary Conductors:
Major Arteries:
Minor Arteries:
Collectors:
Local Distributors:
Local Terminals: lowest level

Terminology for the above volume orders is based primarily upon the following sources:
Steering and Working Groups appointed by the Minister of Transport, p. 42.

29
Today congestion is caused, at least in part, by an incomplete choice of movement types.

As Mr. Dyckman, author of "Transportation in Cities", suggests our cities' major movement problems today are the overloading of existing facilities, overlong trips, irregularity of public provided facilities and lack of adequate parking. These problems combine to produce congestion.

In order to provide freedom of choice and maximum diversity and thus ease congestion, an urban movement system must provide a wide range of movement-type choices...giving full consideration to the purpose, properties and volumes of each movement type.

Architect, Van Lych states: "As long as cities exclude particular kinds of motion that belong inseparably to urban life, their validity---they have no other---will remain partial. The time has come to orchestrate all the motions that make a city. It is somehow in the nature of

cities in general and of traffic in particular to suppress certain kinds of motion which, if less insistent, are certainly no less fundamental to the idea of city.

Cities today demonstrate an appallingly limited range of movement. Their rhythm is as vehement as it is monotonous.

A city, if it really is a city, has a very compound rhythm based on many kinds of movement, human, mechanical and natural. The first is paradoxically suppressed; the second tyrannically emphasized; and, the third inadequately expressed."^31

In the consideration of all manners of urban movement, it is necessary to pull apart each movement purpose by type and establish particular systems which will best fulfill that purpose.

"In general, national, inter-city, inter-sector, and local (low speed car; pedestrian) traffic should each have separate systems... all movement must proceed through each stage of the hierarchy--and the town-building should respond to this hierarchy of movement."^32

^31 Smithson, p. 575.
^32 Smithson, p. 579.
It is necessary, however, to consider the whole while considering the component parts. Maximum choice of movement type must always be provided. The relationships of system to system, where these systems overlap—where they are compatible and where they are incompatible—becomes of utmost concern in the establishment of a balanced, workable, movement hierarchy.

A movement hierarchy, then, may be derived through the consideration of the general purposes, properties and volumes of all types of urban movement and the consideration of how the resulting systems work together.
Establishment of a Complete Movement-Activity Hierarchy

Conclusion

An urban movement system should provide a range of movement type choices in order to alleviate the congestion, chaos and lack of freedom which results from an over emphasis on one type of movement. A hierarchy of movement types, each working within its optimum ranges of performance, and each serving an appropriately scaled function should be established. Overlapping ranges of performance will provide choice.
ESTABLISHMENT OF MOVEMENT EXCHANGE POINTS

Analysis

"Urban transportation has to do not only with moving people and goods into, out of and through the city, but also with the spatial organization of all human activities within it."\(^{33}\)

Realizing the importance of achieving movement clarity as a tool to achieving spatial organization of human activities within a city, it is necessary to consider, as much as possible, all purposes of movement; movement properties and movement volumes. It is, likewise, necessary to study the relationships of different systems and emphasize the points of movement exchange which result at points of over-lapping performance.

"...that place where many movement systems (subway, express bus, micro-bus, taxi) join and form an exchange with each other. This concentration forms the potential to generate many further kinds of forms of activity. It becomes a place where people can share their mutual

\(^{33}\)Dyckman, p. 163.
excitement and anxiety with other fellow citizens.\(^\text{34}\)

These points of importance may "...occur where two routes connect—the pedestrian routes with the secondary network, and where the secondary roads link on to the primary network. They tend to be places where there is a local concentration of functions—a bus stop, a public house, a garage, some shops....At these points, which will be points of social contact, a concentration of building...can create a local landmark."\(^\text{35}\)

Exchange points are directly related to economic stopping points of various movement types. The most economical distance between these stop points, based upon maximum optimum trip distance, speed, and characteristics of the movement type, is shown in the following chart.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>WALK</td>
<td>AS REQUIRED</td>
</tr>
<tr>
<td>BIKE</td>
<td>AS REQUIRED</td>
</tr>
<tr>
<td>MINI-Car</td>
<td>INTERCHANGE-1 MILK</td>
</tr>
<tr>
<td>LOCAL BUS</td>
<td>1 MILK</td>
</tr>
<tr>
<td>RAPID TRANSIT</td>
<td>2 MILLS</td>
</tr>
<tr>
<td>COMMUTER RAIL</td>
<td>4 MILES</td>
</tr>
<tr>
<td>AUTOMOBILE</td>
<td>15 MILES</td>
</tr>
<tr>
<td>REGIONAL RAIL</td>
<td>16 MILES</td>
</tr>
<tr>
<td>HELICOPTER</td>
<td>20 MILES</td>
</tr>
</tbody>
</table>

Establishment of Movement Exchange Points

Conclusion

Exchange points are the result of over-lapping ranges of performance of various movement types, and directly reflects the hierarchy of the intersecting systems.

The systematic treatment of such points could provide references in the cities' visual structures while reinforcing points of social interaction.
SUMMARY AND CONCLUSIONS

As stated in the conclusion of the historical review of this paper, the movement problems facing our cities today are:

1. Streets often have no hierarchy with respect to the functions they serve.
2. Indiscriminate movement of unrelated systems of communication exists.
3. Limited choice of movement types exists.
4. Total reliance upon one movement type has produced congestion and inefficiency.

If movement systems are to become positive tools in urban design, they must overcome these existing problems. To overcome these problems, urban movement systems must zone movement by type and volume, establish a complete movement-activity hierarchy, and establish a hierarchy of resulting points of movement exchange.

I. Zone by Type

A. Separation by purpose to ensure maximum service advantages of each movement purpose and, thus, aid in the achievement of movement organization clarity.
B. Separation by properties of flexibility, speed optimum and trip distance optimum to ensure maximum service advantage of each type of movement and thus aid in the achievement of movement organization clarity.

II. Zone by Volume
Differing volumes should be separated into the following orders within each movement type to ensure satisfaction of variable demands of each movement type and the functions they serve; primary conductors, secondary conductors, major arteries, minor arteries, collectos, local distributors, local terminals.

III. Establishment of movement-activity hierarchy
An urban movement system should provide a range of movement type choices in order to alleviate the congestion, chaos, and lack of freedom which results from an over emphasis on one type of movement. A hierarchy of movement types, each working within its optimum ranges of performance, and each serving an appropriately scal-
ed function should be established. Overlapping ranges of performance will provide choice.

IV. Establishment of movement exchange points

Exchange points are the result of overlapping ranges of performance of various movement types, and directly reflects the hierarchy of the intersecting systems. The systematic treatment of such points could provide references in the cities' visual structures while reinforcing points of social interaction.

As a positive tool in urban design, then, urban movement systems must take on the aforementioned as design criteria. This criteria may well be represented graphically in the following diagrams.

The legend at the right refers to the numerical representations found in these diagrams.

Legend:
1. Walk
2. Bicycle
3. Mini-car
4. Local Bus
5. Rapid Transit
6. Commuter Rail
7. Automobile
8. Regional Train
9. Helicopter
10. Air Shuddle
11. Jet Plane
12. Rocket
MOVEMENT HIERARCHY
PROGRAM FOR APPLICATION

Analysis

The program for application is based upon the criteria outlined in the proceeding chapter and will assume the following available movement types:

I. Movement of People
   A. Elevators
   B. Walk
   C. Bike
   D. Mini-car
   E. Local bus
   F. Rapid transit
   G. Commuter rail
   H. Automobile
   I. Regional train
   J. Helicopter
   K. Air Shuddle

II. Movement of Goods
   A. Elevators
   B. Hand
   C. Light trucks
   D. Heavy trucks
   E. Railroad
   F. Air shuddle

III. Movement of Messages
   A. Wire
   B. Wireless

IV. Movement of Utilities
   A. Electricity
   B. Water
   C. Sewage
   D. Drainage

Statement of Study

Each movement type will be considered with respect to its specific characteristics and volumes.

Each movement type will be considered in a general "service" study.

The various utilities and wire lay-outs will be considered only generally with respect to primary lines of movement.
MOVEMENT HIERARCHIES
MAY BE STRUCTURED AS:

TREE:

GRID:

LINEAR:
Parallel lines of movement are assumed for purposes of demonstration.
EXCHANGE
SECTOR STUDY
SCALE: 1 in. = 1 mi.

I. WALK
2. BICYCLE
4. LOCAL BUS
5. RAPID TRANSIT
LIST OF WORKS CONSULTED


Dyckman, B. "Transportation in Cities," Scientific America, (September 1965), 163.


Sert, Jose L. *Can Our Cities Survive?* Massachusetts, 1944.


White, Morton. "Two Stages in the Critique of the American City," *The Historian and the City*. (Handlin and Burchard), Massachusetts, 1963. 54-94.