Three Dimensional City Organization

by

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Dear Dean Anderson:

In partial fulfillment of the requirements for the degree of Master of Architecture, I hereby submit this thesis entitled "Three Dimensional City Organization."

Respectfully,

[Signature]
## LIST OF PLATES

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SCALE 3 PARK AND ROAD</td>
<td>26</td>
</tr>
<tr>
<td>2</td>
<td>DISTRIBUTION SYSTEM</td>
<td>26.5</td>
</tr>
<tr>
<td>3</td>
<td>CAPSULE NETWORK</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>PLAN OF EXISTING CONFIGURATION</td>
<td>31.1</td>
</tr>
<tr>
<td>5</td>
<td>PLAN OF DESIGN DEVELOPED</td>
<td>31.2</td>
</tr>
<tr>
<td>6</td>
<td>SCALE THREE SECTIONS: A, B + C.</td>
<td>31.4</td>
</tr>
<tr>
<td>7</td>
<td>SCALE THREE SECTIONS: D, E + F.</td>
<td>31.5</td>
</tr>
<tr>
<td>8</td>
<td>C.B.D. PLAN LEVEL 1</td>
<td>44</td>
</tr>
<tr>
<td>9</td>
<td>C.B.D. PLAN LEVEL 2</td>
<td>45</td>
</tr>
<tr>
<td>10</td>
<td>C.B.D. PLAN LEVEL 3</td>
<td>46</td>
</tr>
<tr>
<td>11</td>
<td>C.B.D. PLAN LEVEL 4</td>
<td>47</td>
</tr>
<tr>
<td>12</td>
<td>C.B.D. PLAN LEVEL 5</td>
<td>48</td>
</tr>
<tr>
<td>13</td>
<td>C.B.D. PLAN LEVEL 6</td>
<td>49</td>
</tr>
<tr>
<td>14</td>
<td>C.B.D. SECTIONS: A, B + C</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>EXISTING CONFIGURATION</td>
<td>51</td>
</tr>
<tr>
<td>16</td>
<td>DESIGN DEVELOPED (SOUTH VIEW)</td>
<td>52</td>
</tr>
<tr>
<td>17</td>
<td>DESIGN DEVELOPED (north view)</td>
<td>53</td>
</tr>
<tr>
<td>18</td>
<td>DESIGN DEVELOPED (east view)</td>
<td>54</td>
</tr>
<tr>
<td>19</td>
<td>VIEW FROM SOUTH</td>
<td>55</td>
</tr>
<tr>
<td>20</td>
<td>DESIGN DEVELOPED (south view)</td>
<td>56</td>
</tr>
</tbody>
</table>

(cont.)
(list of plates continued)

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>DESIGN DEVELOPED (north view)</td>
<td>57</td>
</tr>
<tr>
<td>22</td>
<td>EXISTING CENTRAL BUSINESS DISTRICT</td>
<td>58</td>
</tr>
<tr>
<td>23</td>
<td>PLAN: DEVELOPED C.B.D.</td>
<td>59</td>
</tr>
<tr>
<td>24</td>
<td>CLOSE-UP OF C.B.D. ENVIRONMENT</td>
<td>60</td>
</tr>
<tr>
<td>25</td>
<td>CLOSE-UP OF C.B.D. ENVIRONMENT</td>
<td>61</td>
</tr>
<tr>
<td>26</td>
<td>C.B.D. ENVIRONMENT</td>
<td>62</td>
</tr>
<tr>
<td>27</td>
<td>MULTI-LEVEL ACCESS AND USE</td>
<td>63</td>
</tr>
</tbody>
</table>
CONTENTS

1 Title Page
2 Abstract
3 Contents
4 List of Plates: Drawings and Photographs
5 Introduction
8 Part One: Aspects of Three-Dimensional Organization
18 Part Two: Core Organization
32 Part Three: C B D Organization
44 Bibliography
INTRODUCTION

The future form of the city is necessarily speculative, yet it is reasonable to say that it will take place within certain limits. A polarity of these limits could be said to be those of human values at one pole, and physical limitation at the other. These deal essentially with what we may want to do, and what we can do. Between these two determinants, the human environment may be shaped.

A likely development of future city form deals with the notion of three dimensional organization. It appears likely, in that it may be a way in which the environment may be humanized. There are, however, major organizational differences between the three dimensionally organized city and the present day two dimensional order.

Three dimensional organization means that there is physical three dimensional displacement of the city's access systems and functional uses. Where the present city is spread across the ground horizontally, the three dimensional city has access and uses organized vertically as well as horizontally. What appears to be three dimensional in the present city are elements of architecture.
Therefore, three dimensional organization affects the scale of the city block and larger areas.

If physical and experiential organization is to take place at a large scale, it could result in major changes in way of life. What might be expected is that a higher level of technology may be needed, which would mean a change in the allocation of the physical and conceptual resources, a different aesthetic which might result in a different tone of life lived there. And different social relations, due to new physical relationships of activities may result in a different world view over a period of time. These changes presumably would result from the fact that a change in the physical relationships of an environment would not only change the physical being of that body of people and place, but what people are exposed to in that place, consequently affecting the things they think of.

Such changes, which affect our physical and experiential reality need to be investigated for possible effects before they take place. This opens the opportunity of choice as to whether these changes are warranted, and if we can make them or not. In addition, speculative investigation of possible future events allows one to better prepare for the future.
In light of this, the following thesis is a design investigation which encounters some of the characteristics of three dimensional organization which possibly could take place. The emphasis is on physical organization rather than on experiential life styles that might occur there. A complete design would deal with both human values and the physical environment, yet the outline that the physical design brings affords many experiential settings to be read in.
PART ONE: ASPECTS OF
THREE DIMENSIONAL ORGANIZATION

There are many differences between two dimensional organization and three dimensional organization in relationship to the city and its workings. However, the most outstanding from a design point of view deals with the physical organizational differences brought about by three-dimensionality itself.

Essentially, three dimensionality allows a greater number of relations to be made between objects, effectively resulting in a larger design palette. This larger design palette can bring about functional and experiential relations not previously attained between various modes of circulation, buildings, and spaces. Yet this larger palette also produces a physical complexity calling for new organizational concepts to bring order.

By three dimensional organization, buildings can be arranged so that they have a variety of access connections, giving appropriate spaces to that particular access mode. Pedestrians may have their environment separated from that of the service truck.

Two dimensionally organized cities, on the other hand,
have their functional connections and pedestrian amenities as well as the support of buildings all on the same plane. One can visualize new relations, for instance, if one takes a two dimensionally organized configuration and starts separating functions which are incompatible. A basic separation may be the extraction of pedestrian oriented facilities from vehicular oriented facilities, thereby producing two distinct organizations. The two may then be interrelated in a new way. This is more complex in terms of physical relations but this kind of separating and rearranging may be warranted in that the present street setting in our city cores has become "saturated" with activity. Furthermore, the general "mix" of pedestrian interests with vehicular interests has produced experiential and functional conflict due to this saturation.

The situation could be summarized by saying that the activity has out-grown its form. Where there was unity and cohesion, the limits of such functional and experiential interrelation within the form of the present street situations have been passed. There has been an evolution of design in terms of separations in urban organization. At one time, the circulatory function of the street was as
the place for vehicles, pedestrians, and waste. With the advent of plumbing and horizontal separation of pedestrian and vehicular traffic, the basic "street" of our present two-dimensional city was developed. The next step in evolution, as it appears, is to remove these intersections by vertical separation. Each of the past forms had its kind of activity producing a kind of functional and experiential unity. In making new environmental forms, functional as well as experiential interrelations must be considered as part of the design.

For instance, in the present urban street in the central business district, the setting is supposed to be highly active. The specific reason is difficult to state but it has something to do with sensing of the "wheels of progress" in a production oriented environment. The activity level is produced by both pedestrian and vehicular circulation, interacting within this street. According to present criteria, if these two modes are separated, a possible inappropriate setting may result. Then again, the separation producing the new form may support a new criteria of appropriateness. This situation, however, is representative of the many form and activity relations that
have to be considered in the design of new environments. The problem of producing an active environment may not be so great. It can be solved by the proximity of separated modes. The movement channels do not have to impose on one another physically, but they can still impose experientially if they are within perceivable range. In terms of physical design, this involves circulation alignment and vertical relation. This brings up the point of differences of organization, the alignment of circulation, and massing of architecture at a larger scale, the scale of the city block.

The basic relation of walk–street–building, considered at the scale of the block is presently the organizational and environmental constant of urban space in cities. The block size can change, buildings of different height may be shaped, etc., or an occasional open space may change the character of urban spaces. However, the basic urban space organization in present cities is remarkably limited and the same holds true for the vantage point given the pedestrian.

The real impact of three dimensional organization is that it deals with developing a new set of relations
at the city block scale, allowing a greater number and variety of relations. Essentially, we are dealing with the placement of circulation networks and their related facilities (be they architectural or urban amenities, parks, etc.) in such a fashion as to create new environments. Once again, we can visualize the present horizontal circulation network enclosed and delineated by architectural elements. With the three-dimensional ordering there may be a number of such orders placed one above the other, some used primarily for service vehicles, or other kinds of vehicular circulation, and other levels and networks solely for pedestrian use. These different circulation modes, with their related architectural enclosures, create a number of environments which may receive their appropriate design treatment.

With this kind of organization of different circulation and use environments, one over the other, the general activity fabric may be woven. Two basic design opportunities are available: the ability to separate and the ability to expose one environment to the other.

Essentially, a greater degree of continuity of the environment as a whole may be developed through these design capabilities. This mainly deals with pedestrian
environment, vehicular circulation being fixed to its system. With the ability to separate, one could, for example, connect residential environments together in such a way that they were continuous through many areas, even though these many areas were composed of a number of different uses. This may result in a kind of "constant." On the other hand, a continuous change of use and environmental form use may be followed by a person on a different route.

Therefore, in overlapping various uses and circulation modes which, in a given area, are separate, yet connected over a number of areas, various forms of continuity may be provided. This points up one of the more significant aspects of three-dimensional organization, and that is "choice." Such organizations become "choice-matrices" where one may compose one's route from one place to another without really going out of one's way. One can be exposed to different use settings from various vantage points and distances and generally choose the tone and encounter of one's trip.

With this design capability one overcomes one of the major faults of two-dimensional urban environment: the
tendency for closed environments to occur and dominate an area. For example, financial districts tend to drive out wholesale districts, and retail tends to drive out residential until a "mono-use" areas are developed, blocking one area from another. There is also the danger that these one-use environments become "half-alive," as seen in the financial district after five o'clock. Many urban cores are mere shells in the evening and often dangerous as well. In the daytime, a lack of use variation becomes monotonous and even narrow in terms of exposure.

Here again the three-dimensionally organized environment with various uses mixed and overlapped may serve as a general introduction to a fuller pattern of life. Research laboratories and artist studios juxtaposed and overlapped with residential and retail areas may revitalize what is now a closed and resistant setting. One might even expect a certain amount of increased social interaction to occur as a result of such widening of exposures and life encounters.

Traditionally, the urban core has been a place of
vital interaction. Once again it may be an economic, institutional, production, and cultural center, as well as a good place to live. Three dimensional organization can overcome the effects of saturation, as well as those of one-use ground dominance and restrictive flow. This scale of design, however, needs a structure to accept it. At present the ground is the structure which accepts the two dimensional organization. If there are to be various circulation modes and uses, one above the other, there must be a structure to hold and relate them. So a fundamental need of three dimensional organization is the need of a three dimensional structural terrain. Depending on the density developed, the environment in some ways would begin to have the qualities of architecture. If buildings were able to unite with the terrain and unite with other buildings, architecture would begin to have the qualities of environment. This effectively would make the environment a little more like a building and buildings a little more like environment. This tendency is mainly due to the higher degree of functional interrelation and structural interdependence, as well as the factor that through time small buildings would be joined to make bigger buildings.
In terms of developing a structural terrain to receive the buildings there are two main methods: one is the initial construction of an actual physical terrain that holds and receives buildings and to which they would conform. This represents the "mega-structure" concept. The other way is to develop a set of agreements to which individual buildings would conform. Then, through their own growth, these buildings would be developing the actual structure. This second method is based on the idea that cities evolve over a long period of time and their growth patterns are generally unpredictable. The second is more responsive to changing structural methods and aesthetic emphases which evolve.

So the method which is advocated is building by increments which then form "whole" networks. This method refers primarily to the scale of individual buildings to which other buildings are added. Pedestrian circulation may generate larger networks by increment in addition, as well. Vehicular systems, on the other hand, are in need of continuity and would have to go in complete initially. This especially refers to mechanical systems. The expectation is that present land owners would agree to a method of dev-
elping the area above them and through a system of air-rights, which includes legal, structural, and functional relation, do so. For example, an existing wholesale area may become a platform for a residential community. It may be adjacent to a ground transportation facility (railroad) which again becomes a platform, or as we have mentioned, where a structural terrain may develop and support a school or possibly a shopping center. Vertical structural relations, function connections, the time of placement, as well as what are to be the permanent or non-permanent features of the organization are some of the relations that would have to be worked out.
PART TWO:
CORE ORGANIZATION

This portion of the thesis starts to describe the design that was developed. General assumptions are dealt with first, and then I move to specific treatments. The urban core chosen was that of the city of Boston. The configuration of Boston was used as a general form and event context, and is to be taken as a representative of the existing city. It is to be kept in mind, however, that the design developed here is in no way a formal design proposal such as might be prepared by a renewal agency. The design has been "exploratory," giving emphasis to concept development. The Boston configuration adds a "reality-reference" and helps in the shaping of design limits. Possibly a city based on a grid would have been more representative of a "typical" American city. But the two main reasons for choosing Boston rather than some other city are 1) it contains a number of varied geographical and land use conditions in proximity to each other (which allows the development of various prototype use organizations and their connection) and 2) there is readily accessible data. So the choice of Boston was made in light of these considerations in addition to the hope that the in-
herent form of three-dimensional organization may stand a greater opportunity to develop in a relatively unstructured setting.

A general projected growth was made, working with the assumption that where there is change, there is growth. This is not essentially necessary, for a three-dimensional organization could be made with the present density. However, three-dimensional organization implies density. Another reason for working with a projected growth was the desire to find out what a dense three-dimensional environment might be like. The projection essentially triples the density of floor use and of intown residents of the area chosen. Some assumptions were made about the likely state of circulation and of architecture which have affected the design. It is best that these be brought out before the explanation of the design begins.

**Truck Service:** Truck service will still be in use in that it is a basic land oriented distribution system that unites in-and out-of-town areas.

**A New Kind of Automobile:** The automobile as we know it today will be phased out of the urban centers. The automobile will evolve from the heavy self-powered and self-
driven, "system-powered" vehicle, the power being in the road bed. It may be possible to supply these vehicles with many attachments to enable the basic capsule to work on or off the powered system or on land, water, or air. The reason for the transition to this kind of vehicle is to allow greater capacities of movement to occur in smaller volumes, and at lower speeds. In that the vehicle is light, it can be manipulated three-dimensionally and integrated into the urban environments without imposing heavily on the design of that environment. This effectively results in raised "auto-capsule" circulation systems.

Open, Light, and Adaptable Architecture: Architecture will become more open in terms of interrelating with other buildings structurally and functionally in order to create mutual spaces between each other and in general to develop the three dimensional terrain of mass. A building may be thought of more in terms of a part of a whole. This will tend to make architecture a thing which is responsive to change. Lighter structural materials and building components which are manipulable to various
degrees may be a part of this trend.

**Similar Density Distribution:** The distribution of density will be somewhat the same, being a general gradation away from urban cores. This refers to both residential (people per acre) and other than residential use (commercial, institutional, etc.). There are two reasons for this expectation of similar density distribution:

1) Since a pedestrian environment is once again achievable, "proximity" to a greater number of amenities that develop through social cooperation will still have a centralizing effect. 

2) Three dimensional organization of use and circulation modes would be expected to originate in existing dense patterns and, in turn, reinforce that tendency.

There is also, of course, the basic reason that the urban core can once again be the "good place" by supporting a general development of cohesive human values and the pursuit of such.

In order that the many parts of the urban design may be identified, scale designations have been made. The following chart serves to illustrate what is meant.
Identity of Scales:

<table>
<thead>
<tr>
<th>Scale</th>
<th>Solid</th>
<th>Void</th>
<th>Circulation</th>
<th>Approx. Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&quot;geography&quot; of land and buildings, a city</td>
<td>The space between and above</td>
<td>state highway, express</td>
<td>5 miles</td>
</tr>
<tr>
<td>2</td>
<td>urban core, town, suburb, etc.</td>
<td>&quot;</td>
<td>arterial</td>
<td>1-5 Miles</td>
</tr>
<tr>
<td>3</td>
<td>major area defined by use or form, several city blocks</td>
<td>&quot;</td>
<td>boulevard</td>
<td>( \frac{1}{2} - 1 ) mile</td>
</tr>
<tr>
<td>4</td>
<td>major group, a city block</td>
<td>space defined by that group</td>
<td>street</td>
<td>200'-( \frac{1}{2} ) mile</td>
</tr>
<tr>
<td>5</td>
<td>minor group, a number of buildings</td>
<td>&quot;</td>
<td>mall, alley, walk, etc.</td>
<td>20'-200'</td>
</tr>
<tr>
<td>6</td>
<td>a building</td>
<td>spatial envelope defined by such</td>
<td>corridors, elevators, etc.</td>
<td>6'+</td>
</tr>
</tbody>
</table>

The design developed here deals with scales 2 through 5.
The following explanation begins with scale two considerations.
Scale Two:

Three dimensional organization affects this scale by altering basic access modes of the core and by developing different kinds of three-dimensionally organized use areas. By using the existing use context as a base from which to grow, a number of areas were developed. This growth resulted in a mixture of dense residential and commercial areas juxtaposed with open space and generally interwoven with a continuous pedestrian park system. Within this area, there are approximately 2,000 acres having approximately 40,000 dwellings and 130,000 residents. Within this area there would be approximately 160 million square feet of floor use, not including residential use. There is approximately four times as much floor use and three times as many residents as compared to the existing condition.

Since the distribution of use at this scale was mainly influenced by the idea of growing from present use areas, the main change in organization was in terms of circulation modes. The circulation theory used to lay out the various networks dealt with the aspects of conceptual as well as physical continuity. The attempt was to give conceptual attributes which would be derived from
the basic placement of these paths. Hopefully, this would result in giving one "mental pictures" of where one wanted to be.

**Service Traffic (truck):** In order to reduce the traffic concentrating effects of the radial pattern, circulation routes have been turned back in an arc-like fashion. This would tend to relieve central traffic congestion and discourage through traffic. Through truck traffic would be handled by the inner belt express-loop. Raised service roads have been introduced in order to gain free pedestrian movement in certain locations. Service lines have also been raised to serve air-right groupings which occur in densely built areas in order not to restrict surface traffic conditions. One of the major circulation spines is developed by the connection of the areas to the north and to the south of the core. The path is essentially that of the upper portion of the inner belt. The inner belt which is now depressed is a truck service line, having grade service traffic passing over it, and above that the raised north-south connection occurs.

**Raised Auto-Capsule Networks:** The raised auto-capsule networks are developed out of the use of "loop" and "line"
configurations. The "loops" are essentially related to scales three and four, whereas the "lines" overlap sides of loops and become scale two-three. This describes a basic street (loop) and boulevard (line) system. Drawings describing scale two circulation occur on the next two pages.
LEGEND

SCALE THREE, PARK AND ROAD

1. North-south major service distribution connection.
2. Scale 3 on grade roads
3. Scale 3 above grade roads
4. Scale 3 below grade roads

Fine texture indicates grade level park system. / Arrows indicate that the pedestrian system continues, although changes level.
SCALE 3 PARK & ROAD
LEGEND

SCALE 2-4 DISTRIBUTION SYSTEM (goods and service)

1. Scale 2 express, under scale 3 north-south connection
2. Scale 2 express
3. Scale 3 on grade road
4. Scale 3 above grade road
5. Scale 4 on grade road
6. Scale 4 above grade road
7. Scale 4 tunnel
8. Scale 5 on grade road
DISTRIBUTION SYSTEM
LEGEND
CAPSULE NETWORK
1. Capsule express
2. Capsule boulevard
3. Capsule loop
CAPSULE NETWORKS
Scale Three:

Within this scale of organization the effects of three dimensional organization can be more readily seen. There are a number of different residential areas developed having various use relations and mixtures of use. Different geometrics develop due to site conditions. In addition, various vertical relations with the ground are made. These areas with their particular solid, void, and circulation arrangements develop emphasis and may be called prototypical.

There are basically two kinds of commercial three dimensional organizations and these have mainly a geometrical basis. One is linear and the second covers an area. Linear commercial organizations appear above the north-south raised service street, through the south end residential area and through the Back Bay area.

Commercial Organization:

1) The north-south connection becomes an air-right "edge" of the CBD (central business district) and extends further along this service artery. As mentioned previously, its spine is a raised service road above which is a pedestrian mall. This edge moves over the depressed service express,
over part of the CBD surface distribution network, as well as over the two bodies of water that define the peninsula of Boston, and enters commercial areas on the other side in each case. A similar commercial development, but with less magnitude and occurring around a raised service road, enters the south-end. Above and below this commercial spine are different conditions. Below is a pedestrian oriented "green place." Above would be a residential area. The Back Bay commercial line rests on a surface distribution network which presently exists. Raised pedestrian malls are developed, as well as raised auto-capable networks, which serve to circulate people. The CBD will be discussed in part three of the thesis.

Residential Organization:
The Back Bay organization develops on the existing grid of surface streets now being used for service. The area is connected by raised pedestrian malls, public continuous malls at 25 feet above the ground, and semi-public discontinuous pedestrian streets occurring above that within the residential groups. This becomes a kind of town-house residential development in that outside spaces are minimal. Courts would exist at ground level and community facilities
ranging from personal services to retail, schools, and libraries would exist at the 25-foot-plus pedestrian mall.

The south-end development becomes quite a different organization in that the ground level is essentially a continuous park service being raised. The geometry of this is more open yet tends to thicken about service connections and community facilities which are also raised. The architectural character is more open in that the residential clumps would tend to have raised "yards" by way of roof decks. Community facilities would also tend to create outside raised platforms as part of their basic character.

The north-end uses the existing "village" on the ground as an outside space and for community facilities such as schools, shopping, etc. Two residential clusters surround "the village" and rest on surface service facilities with raised pedestrian malls occurring above them.

The waterfront residential community is raised over the public water-edge, keeping the two separate yet connected. An upper pedestrian level, semi-enclosed for protection against the elements, spans from the raised
mall and commercial-community facilities, across the water to a community boat marina.

The four point channel becomes an elevated residential community. The use mix of the area would probably be one third light industry, research and development, one third wholesale-retail-commercial, and one third residential, occurring above these and having community spaces on the roofs of commercial structures as well as on the ground below.

The following plans and sections depict these scale three organizations.
LEGEND:

▲ Level change in pedestrian circulation

Service road envelope

DESCRIPTION:

SECTION A

1. Raised pedestrian mall
2. Existing (north-end) village
3. Raised mail
4. Part of park (public) system
5. Elevated community and circulation
6. Community marina

SECTION B

1. Village (north-end)
2. Mall above north-south service connection
3. Governmental plaza
4. Northern portion of park

SECTION C

1. Southern portion of park
2. Raised mail
3. Raised circulation
4. Raised circulation in south-end
   Depressed service express
LEGEND:

▲ Level change in pedestrian circulation

▌ Service road envelope

DESCRIPTION:

SECTION D

1. River basin and park
2. Raised residential community
3. Raised commercial district

SECTION E

1. Raised mall
2. School or community facility
3. Continuous park system
4. Commercial and residential with raised circ.

SECTION F

1. Commercial district
2. Residential community
3. Storage and exchange center
4. Residential area and dock
5. Raised residential community
6. Residential community
PART THREE:
C B D
ORGANIZATION

The central business district is the area that has been given a closer inspection in terms of what it might be and how it might be developed. The major organizational influences other than the setting itself are circulation networks, an additive-evolutionary growth process, sun orientations, structure, the general motion "upwards" and relations with surrounding areas.

To begin with, the existing geometry has had an effect on organization due to the fact that this is the seed from which growth occurs. The ground organization of the government center and the Commons have been retained as pedestrian places. The general ground organization of the surface streets have received adjustments concerned with the straightening and aligning of street patterns. These adjustments which are due to the demands of the elements above, would occur over a period of time, so a complete new geometrical pattern is not attempted. The theory is that the surface level needs a certain amount of continuity because this level becomes a basic service platform from which the buildings receive their materials
through vertical construction spaces above the surface streets. Another reason for the new geometry (besides circulation continuity) has been the recognition of form compatibility and efficiency of space achieved by rectilinear geometry.

The additive-evolutionary process mentioned previously emphasizes the fact that the environment evolves through many stages and dispositions of experiential and physical character. The evolutionary part of the term refers more to the growth of architectural elements than it does to circulation networks in that architecture becomes the primary increment of change. It is expected that architectural elements would change their structural character and degree of openness through new interrelations with other buildings as they group together. On the other hand, the "additive" portion of the term refers to the circulation networks, especially to elevated auto-capsule systems which are added by level as the density builds up. The third and fourth pedestrian levels (see plans) are representative of this process. Each of these levels is formed as a part of a linear pedestrian arrival station network. The third level is part of the auto-capsule
street and boulevard network, and the fourth level is part of the capsule express network. The linear stations in each of these cases serve to develop an inter-station distribution system for the feeding and retrieving of auto-capsules from parking structures as well as continuing the passenger arrival platforms. These pedestrian levels in combination with the linear station network would be added to the environment as part of their respective systems (third pedestrian level: boulevard-street system; fourth pedestrian level: express system). The second level, which is the first raised level, is a deviation from the additive process. It would be built by increments since it is mainly constructed from the use of roof tops and connections spanning between buildings.

The fifth level is similar to the second in that it would be built by increments (as buildings were joined), yet the pedestrian-reinforced movement systems which would come after the level is established, would be constructed at one time. Where the additive process of adding separate pedestrian networks explains the layering effect, the horizontal placement deals with the capsule loop and line patterns that have been chosen. Basically,
the boulevards follow the north-south flow directions, navigating around the bodies of water that border the CBD. The loops are for scale three to four distribution. The linear stations become scale four and five distribution and are tied to areas in such a way to reinforce the geometry or simply blend with it.

Related to the geometrical layout of the capsule systems are factors which deal with operational aspects of these systems. It would be appropriate to mention these at this point. The capsule system would have two decision ranges of operation; a self decision level of operation which is a level of system operation where the individual riders may make route decisions, and secondly, a computer decision range where once the trip has been established, a computer would handle all decisions in terms of system transfers and station arrivals. These kinds of operations deal with the aspect of the capacity of the system and what percentage of that capacity is in operation. This has to do with how much time and space there is on the networks to allow a capsule to go from one loop to another, or from line to loop, etc. The meshing of a capsule from one network with the capsules of another
may not occur unless the space for it is available. When a low percentage of the capacity is involved, a driver may go from one network to another as such inclination occurs. (This would be a self decision trip.) On the other hand, when higher percentages of the system are in operation, such manoeuvres would have to be checked and accounted for by the computer in charge of operating the various trips. Knowledge of all the capsules on the system and their destinations would be necessary for handling them. This is because of the short distance between vehicles and their relatively constant speeds, resulting in meshing difficulty. It would seem that these two ranges are needed in order to have the benefits from both of these operational characters. The self-decisive trip is essentially a pleasure oriented operational level, whereas the computer decision is the work-operation level.

These ranges exist on the boulevard and street networks, whereas the capsule express system would more than likely work on a computer-decision-trip basis. This is due to the efficiency that is called for by the express system to the boulevard-street system in the CBD. This is in order to avoid the decision complexity that would result at peak operation levels.
The massing of the area (solid-void relations) is affected not only by circulation network spacing and existing street geometry, but by considerations given to sun orientation as well. In plan the circulation patterns were considered as hands of a clock which are oriented to sun angles during the day. North-west to south-east align with morning sun rays, and north-east to south-west with afternoon. These have been specifically adjusted to meet the requirements of Boston's latitude situation. The mass corresponds to sun angles in section essentially by following the equinox pattern of sun angles. The attempt was to keep level three relatively sunlit in that this is to be an open plaza network of pedestrian circulation. This brings about a triangular shaped north-south section (diagram a) where the north side of the triangle followed the 48 degree (with ground) slope (generally, not strictly).
This means mass has a tendency to follow the equinox sun angle (diagram b) thus casting less shadow.

The basic reason for considering sun as a form determinant is that the density of the environment is such that it would be very easy to have all urban spaces in shadow. So the decision was made to respect man's tendency to have his "place in the sun" and to have circulation and mass correspond to that desire.

**Architectural Coupling and Structure:**

Following the additive-evolutionary process, architecture and structure respond to this. The word coupling is used to emphasize the aspect that buildings join together. Architecture is a scale six element by the classification system that has been devised. Architectural coupling refers to the idea of having a number of scale six increments to unite in such a way as to create scale five spaces and masses and so on. An example of this process is illustrated by the following diagram.
Initially, (diagram a) "one" and "two" share pedestrian circulation links. In diagram b "one" sells "three" structural supports and the space between receives a mutual elevator and a mutual glazed foyer. In diagram c, "one" and "three" sell "four" support conditions (next horizontal resolution). "Three" obtains right via "one." "Three" and "four" share (by development agreement) roof of three semi-private open space, etc.

These conditions of building growth, circulation connection and public, semi-public enclosures, are interrel-
ational and follow the basic need of providing enough outside space and circulation ways to accommodate the added number of people that accompany the added growth of the CBD. The amenities, both public and private, develop as a consequence of simply making the environment habitable. What is indicated in terms of structure is a basic interlacing of vertical and horizontal force resolution.

The thesis has mainly been oriented toward general organization aspects of a three-dimensionally organized environment and so has not met the difficult and involved problem of working out such structural interrelations. The notion which has allowed such form manipulations to progress without detailed verification is that a single structure could be built to resolve the form that has been indicated in the design. It then becomes a matter of timing as to who does what and how. But as it happens, first things first. It is necessary to establish what a three-dimensionally organized environment may involve in general before one finds out what it involves in particular. It is expected that this is one of the major areas that would need innovation. This would mean that new construc-
tion techniques, structural capabilities, as well as legal relations would have to be satisfied.

The basic notions which might explain the forms arrived at, however, are these: the environment breaks into approximately three structural zones or types: 1) full support at ground level, 2) horizontal buildings supported by other buildings or spanning other buildings on ground levels, cubic, approximately 50' to 200+', 3) buildings built above more than two layers of buildings (tower form) starting approximately 100+'.

In the attempt to develop structural concepts which would handle this scale of structure the basic issues of horizontal and vertical force resolution and compression versus tensions systems was encountered. These aspects were applied to the situation of resolving what essentially became a building thousands of feet in horizontal dimension, having "wings" of 400+ in height and the centers of which spaced 400' to 800' (and greater) apart.

The basic concepts arrived at on this issue were that vertical loads would be taken by each building itself and horizontal loads would be taken by a tension structure.
Since functional vertical connections would be in most instances to the ground for goods and to other levels for people, support and access vertically become "one" thus resolving our needs of vertical resolution. The type of rigid frame and surface shear development which may link several buildings together, resolving vertical and horizontal forces by mutual structural connections, would occur in the initial air-right growth in zones one and two. Yet this kind of force resolution would not be expected to venture into structural zone three conditions and urban scale three structurally. The condition of structural zone three is such that the majority of mass occurs at a high level as well as its surface area receiving horizontal forces from wind. What we have is a very top heavy building.

So in the light of this situation it was decided to develop a means of resolving horizontal forces by a network of tension cables which would be mutually shared by the buildings occurring at this level.

In terms of compression versus tension resolution, this tension system seemed more advantageous. Horizontal continuity by a compression system means that members would
have to span long distances involving great size of members and weights of materials. Horizontal continuity by tension meant that sizes of members would be considerably reduced.

The cable system itself would go then through a number of phases. The idea is to fix the building at its centroids (or with one of its axes). This should correspond to the general geometry pattern of the environment so as to relate to other buildings.
C.B.D. LEGEND:

△ PEDESTRIAN CIRCULATION UP

∧ PEDESTRIAN CIRCULATION DOWN

彭 PEDESTRIAN CIRCULATION

|^ BUILDING ENVELOPE

口 CONSTRUCTION SPACE

== CAPSULE SYSTEM

I CABLE NETWORK

+ MAJOR VERTICAL CABLE SUPPORT
VIEW FROM SOUTH BASIN- PARK AREA
CLOSE-UP OF C-B-D ENVIRONMENT
CLOSE-UP OF C-B-D ENVIRONMENT
MULTI-LEVEL ACCESS AND USE
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