CapaCity In the Sky

by

Dawood F. Rouben

Submitted to the Department of Architecture in partial fulfillment
of the requirements for the degree of

Bachelor of Science in Art and Design

at the Massachusetts Institute of Technology

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CapaCity In the Sky

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To whom I owe everything.

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Jason - you are a life-saver.

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Abstract

Manhattan, as a model of a city with little room for lateral growth, is a good example of one driven by verticality. But verticality has its drawbacks with little light penetrating the dense urban jungle, populated by its collection of iconic towers. The concerns are many, but the one most relevant to this thesis is that of connectivity or the lack thereof in a dense city. Skyscrapers at present, currently stands alone and separate; their floors disconnected from the rest of the city and though ever soaring have done little more than intensify the social and physical disconnect between the city and its inhabitants. The one unifying factor appears in the form of public space - where people gather and interact.

The purpose of this thesis is to explore the issue of connectivity via public space in its many forms through the following:

- The possibility for a new kind of public space/program through the creation of a new layer in the sky.

- A solution to the issues of Mass-Transit congestion to allow for ease of access to these prototypical architectural interventions. Effectively doubling the mass transit capacity through this new layer in the sky.

Though this thesis is largely theoretical, it does use/make reference to Manhattan as a case study from which to design. For its unique density, history and public spaces render it an ideal site for such experimentation.

Thesis Supervisor : **Dan Cheng Ta Chen**
Title: Lecturer, Architectural Design, School of Architecture and Planning, MIT

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Introduction

SOCIAL DEGENERATION

There are many issues that plague the cities of today. A number of these, have their roots in the skyscraper typology which although ever-evolving in its formal, technological and structural aspects has been inherently doomed to stagnate from the standpoint of promoting social activity and connectivity.

The tower, vertically-challenged, is by its very nature anti-social. For social activity from simple observation, predominantly occurs on and across a continuous horizontal plane.

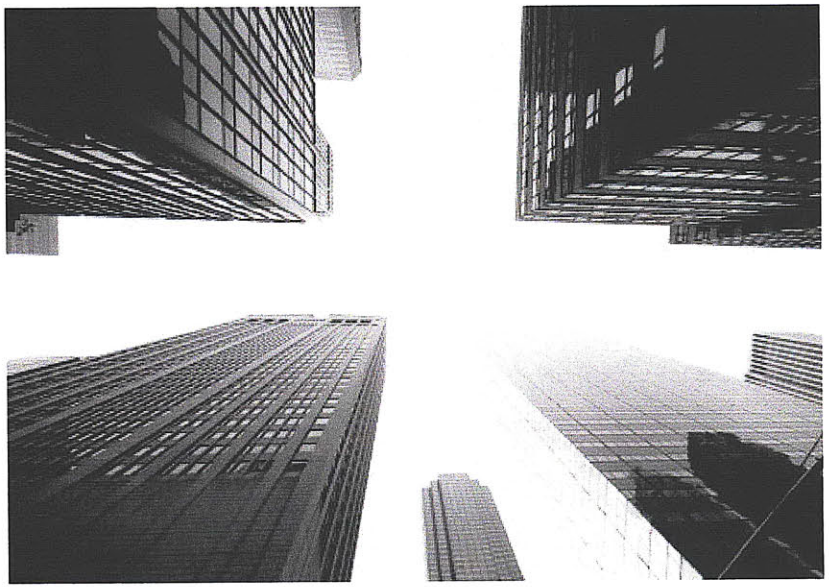
DISCONNECTED TOTALITY

The tabula-rasa condition blatantly exhibited in most skyscrapers today, creates disconnect between every level of tower. "There is no seepage of symbolism between floor" but rather a "systematic exploitation of the deliberate disconnection between stories." In turn, we are left with conditions ripe for 'Vertical Schism'.

In Rem Koolhaas's Delirious New York, he refers to both the storey-storey and interior-exterior disconnect under the recurring related themes which he terms the 'Vertical Schism' and 'Great Lobotomy'; where each skyscraper storey is effectively an island within an island "within a system of 2,028 solitudes".

PLAGUE

"By 1910 the process of territorial multiplication has become inexorable. The entire Wall Street area is on its way



to a grotesque saturation point of total extrusion where "eventually, the only space not occupied by enormous buildings in Lower Manhattan would be the streets..." There is no manifesto, no architectural debate, no doctrine, no law, no planning, no ideology, no theory; there is only - Skyscraper". - Delirious New York, Rem Koolhaas.

ICON, EGO AND ECONOMICS

'Skyscraper-Sprawl' is a phenomenon that has already overrun most large urban centres. Though some, such as Manhattan necessitate the use of Skyscrapers - it is only more recently that they have become driven by economics, concealing its rooted-ness in a freakish history.

In other instances however, it has become ever-apparent that the driving force is that of ego become manifest in the iconography that has surfaced and since evolved from the tower typology. Such is the case with Dubai and its soon to be completed 800+ meter monolith. Neither practical nor useful, it serves but as a measure of ignorance and ego.

Manhattan, as a model of a city with little room for lateral growth, is a good example of one driven by verticality. However, the story is not so simple and clear-cut. In 1927, the seeds were sown, when the true intentions of Raymond Hood; arguably the real mastermind behind Manhattan's evolution as a 'City of Towers' ; were to exploit and "enlist the natural greed of the developer - who invariably wanted to build the largest possible volume". This of course meant building the tallest tower on the smallest plot of land according to Koolhaas.

Coupled with the 'Culture of Congestion', it becomes diffi-

cult to believe in the well-intentioned if not objective nature of the skyscraper as existing purely out of necessity of managing density and maximizing returns/profitability.

ARCHITECTURAL WEED

Skyscrapers require large amounts of energy to function, not to mention build, maintain and if need be - take down. There is a degree of permanence to this architectural weed, that drains the landscape of its resources and its life in the form of social interaction and public activity. The streets are left in the shadows of these monoliths, the ground plane deprived of its light as each tower competes with the one adjacent for its prominence in the city skyline as their "success is measured by the destruction of [their] context". A clear historical instance is that of the Equitable building (1915), following which it became clear that "the time has come to subject this form of architectural aggression to regulation".

Soon enough, the skyscraper, once the object of desire becomes a necessary reality. As these icons attract the attention of those who wish to experience the city in earnest and so flock in its direction as the population influx into the cities are made to increase and with them in cyclic fashion the towers that contain them.

URBAN DILEMMA

The tower typology tears down any preconceived notions of scale, making it difficult for the majority of urbanites to become accustomed to such verticality. The architecture can be overwhelming. With increasing densities and proportional vertical growth, the sky is rendered barely visible and in some areas, it is only

through the reflective glimpses presented across the vertical modern curtain-wall surfaces that the public

A CHANGE IN PROBLEM : 16 & 61

In 1916, following the completion of the Equitable Building, it became apparent that new zoning laws had to exist and so the setback laws were born. In 1961 however, with improvements made in technology, structure and materials became 'lighter' and in turn, the architecture more transparent (or reflective). In exchange for added verticality as an incentive, developers were asked to provide public space in the form of plazas at the skyscrapers feet. The zoning provisions of '61 set out to improve the social conditions in and around skyscrapers but in doing so had only further accentuated the problem as most of these plazas became windswept and consequently barren.

1975: REACTION

In response to these failed plazas developed in conjunction with the 1961 zoning laws, William H. White was hired to improve them. In 1975, new guidelines were adopted which "stated specific requirements for public seating, vegetation, connection to the street and various amenities." - *Public Space,* Stephen Carr

Though Carr mentions that these specifications have promoted an increase in the intensity of activities occurring around these spaces, "New York developers have increasingly chosen to incorporate indoor atria and concourses, rather than outdoor spaces". Though there are examples of such atria that do perform as intended, such as "The Market" at the Citicorp Centre

others more often than not, fail to attract the public.

Other attempts have appeared in the form of sunken plazas.

PUBLIC Vs. PRIVATE

"There are more than 500 privately owned public spaces in the city, mainly concentrated in Midtown and Downtown Manhattan, where, since 1961, developers have been allowed to build taller buildings if they, in turn, agreed to have such spaces open to all."

"But in a recent eight-month study of 77 privately owned public spaces on the East Side, Mr. Keane (an urban planner) concluded that 30 of them, including the one at Caliente Cab Company, had obstacles to public access that included padlocked gates, piles of garbage and spikes on supposed seats."

"There are plenty to choose from," Mr. Keane said of the neighborhood's public plazas. "Whether or not you can use them when you get there is another story."

- NY Times Article : Gregory Beyer
  A New Study Faults Plazas as Public in Name, Private in Look
  May 25 '08

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Scenario

"Too often, architects apply sustainable concepts to the existing skyscraper typology, without *questioning* the typology itself."

- David Scott,
Structural Engineer, Arup, New York and current
Chair of the Council on Tall Buildings and Urban Habitat.

Scenario

C O N N E C T

With population influx to major cities increasing worldwide, there is a need for a new architectural model to help connect and in turn, revitalize the city. This 'revitalization' is to occur as part of a process that is aimed at contributing to the improvement of the 'city dynamic' in addition to the careful maintenance of its growth from both social and demographic standpoints. At present, most cities severely lack in bringing social and residential spaces in proximity to work and transportation. At the street level this only helps further undesirable congestion and a lack of inter-activity in the form of socio-cultural exchange. My aim is to create a *new prototype* for building vertically in a dense urban environment such as Manhattan that re-connects the city at multiple levels, through the introduction of various activities and programs that respond to particular site conditions.

A C T I V I T Y

Moreover, through increased capacitance of activities, each being introduced vertically at multiple levels with appropriate implementation of mixed use programs, and further architectural inter-connectivity of the city iconic i.e. skyscrapers, cities and their respective centers would not only retain their dynamism but also thrive - ultimately being revitalized in a sustainable fashion. If anything, skyscrapers are generally regarded upon as being 'architecture representative of

the individual' and are found to be lacking in their attention to social pursuits. Asocial and immobile, skyscrapers stand segregated from the rest of the city, rendering the city culturally sterile and repetitive.

G R O W T H

Urban centers, due to their high market value, find themselves under constant pressure from a demand to grow and thus increase in density. Can a new model for building vertically be created that will allow added manageable density to contribute to a healthy and sustainable urban lifestyle and avoid choking the qualities that have kept the heart of the city desirable in its mature stages?

- Thesis Preparation

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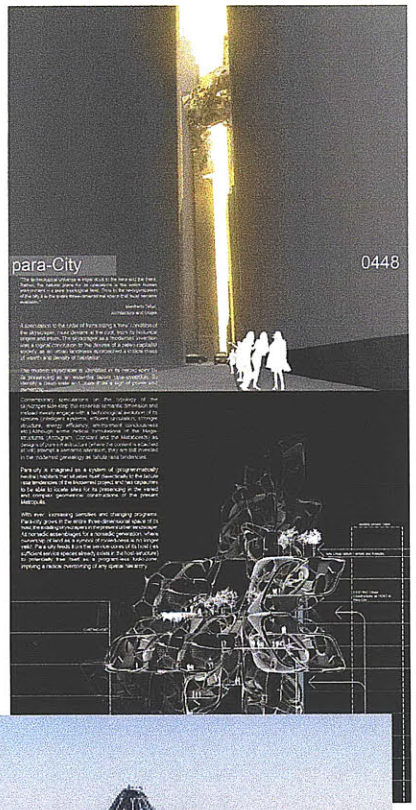
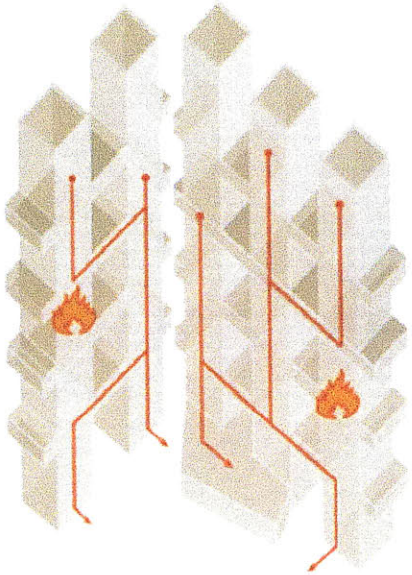
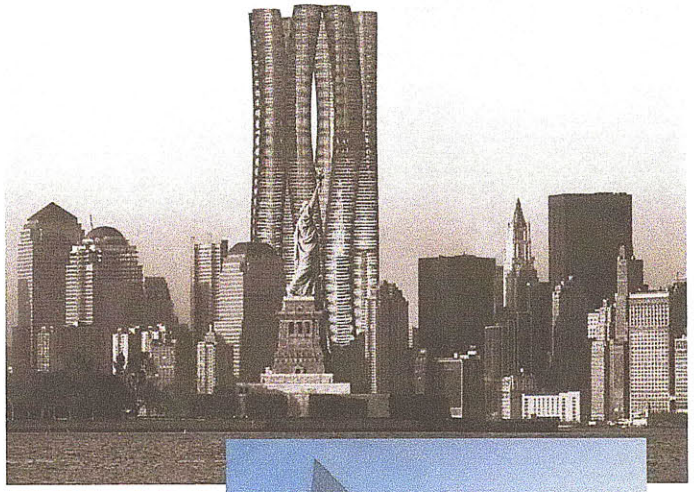
Precedence (Images)

"Enter the dazzle. We are awash in new skyscrapers, but the typology's reenergized career banks on one of two design strategies: go really tall or technologically dazzle."

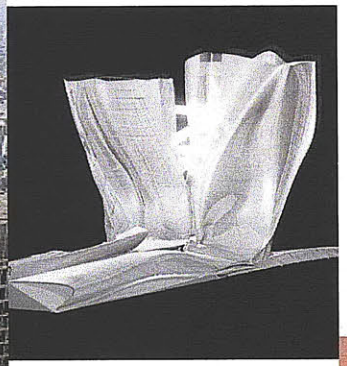
- Russell Fortmeyer
The Skyscraper: Still Soaring
Architectural Record







LIFE SAFETY DIAGRAM
MULTIPLE ESCAPE ROUTES



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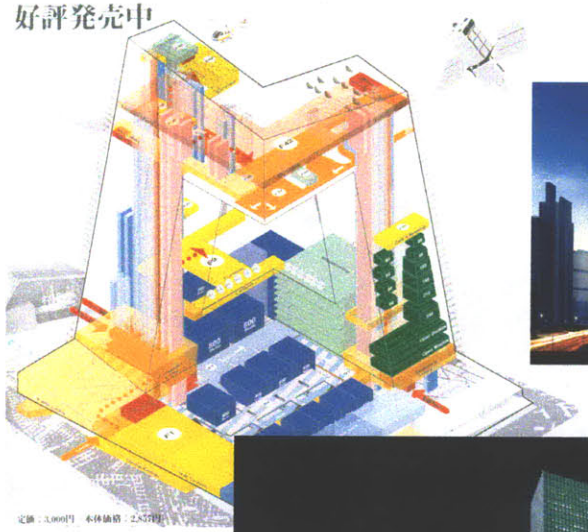

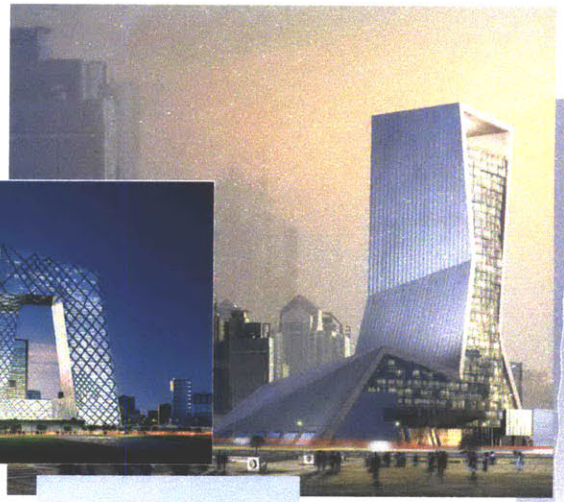

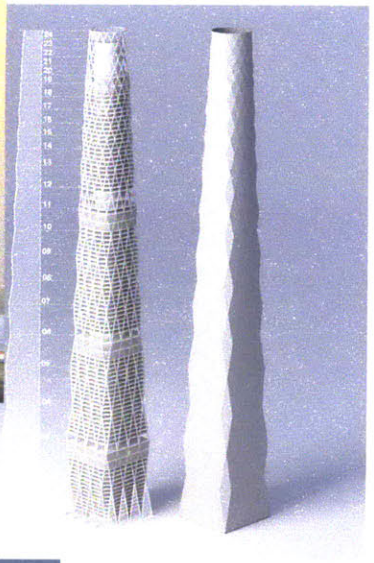

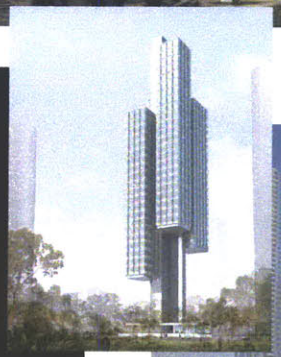

Projects looked into.

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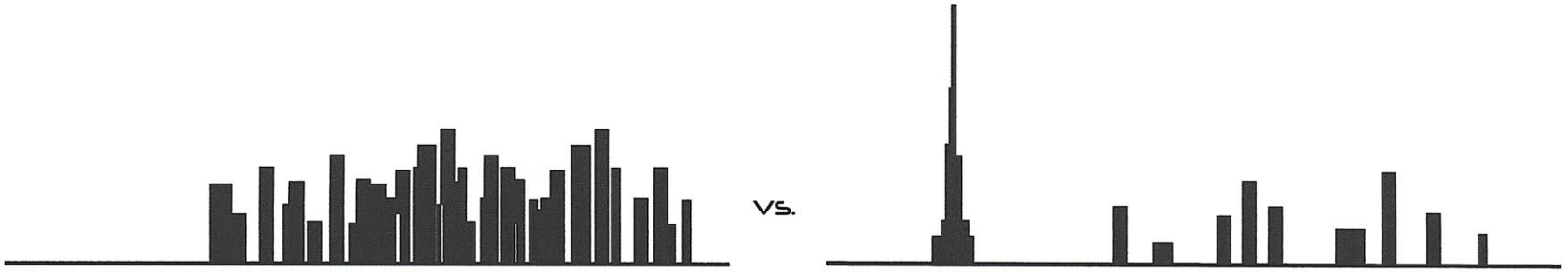
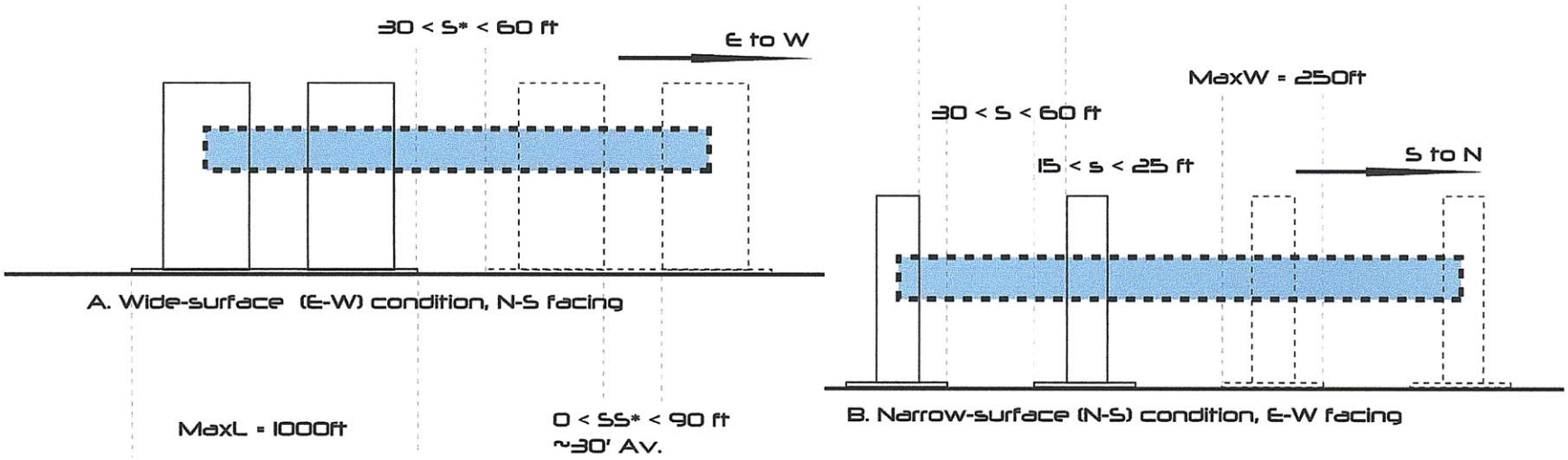
Concept, Analysis + Theory

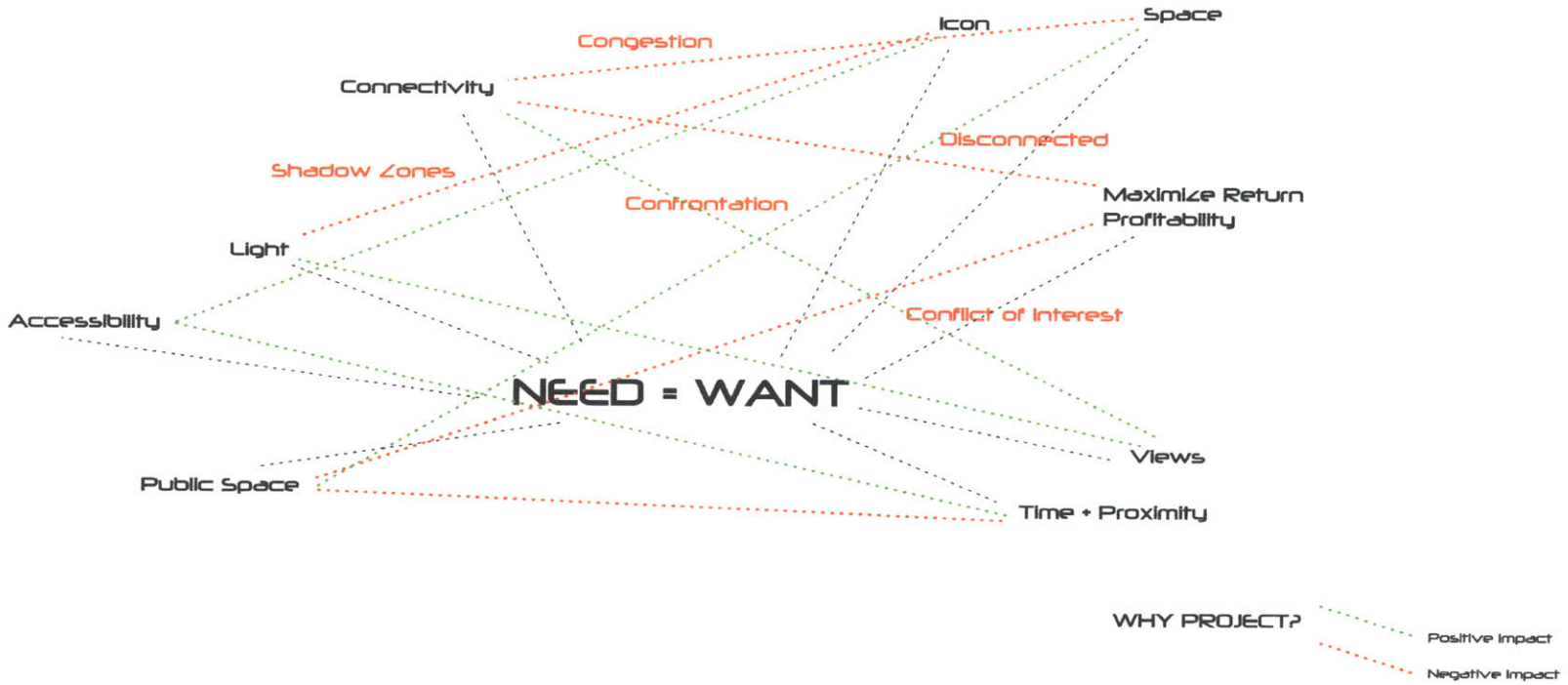


WHY MANHATTAN?

Manhattan's density is an appropriate one to use for an architectural intervention that involves the connecting of towers. When compared to the distances that need to be spanned between skyscrapers in a city such as Dubai, the connecting of skyscrapers and its potential for sustainability through manageable density appears to be a more realistic task to achieve in Manhattan - structurally speaking.

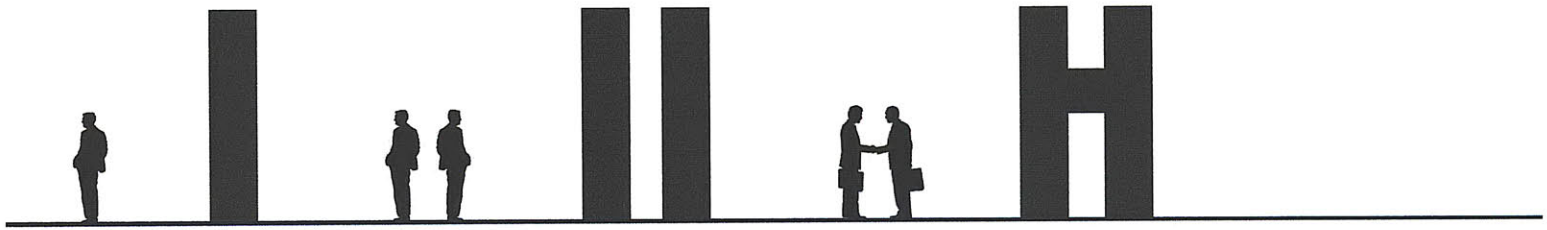
The spans from one adjacent block to another and one skyscraper to another across both the axes that define the streets and avenues ranges from the sum of 3 traffic lanes and 2 sidewalks (minimum average span across the streets-axis E-W) which adds up to approximately (10'x3)+(10'x2) = 50ft to a maximum average span across the avenues-axis (N-S) which adds up to approximately (10'x6) + (15'x2) = 90ft of traffic lanes + sidewalks - plazas not included.





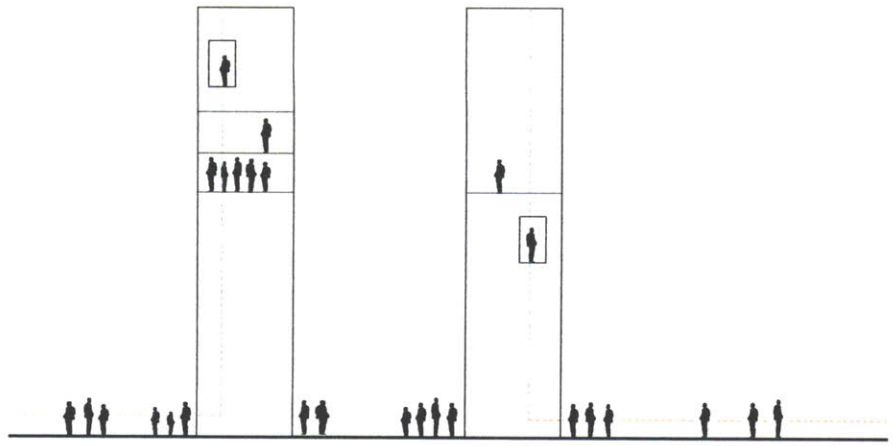
NEED Vs. WANT

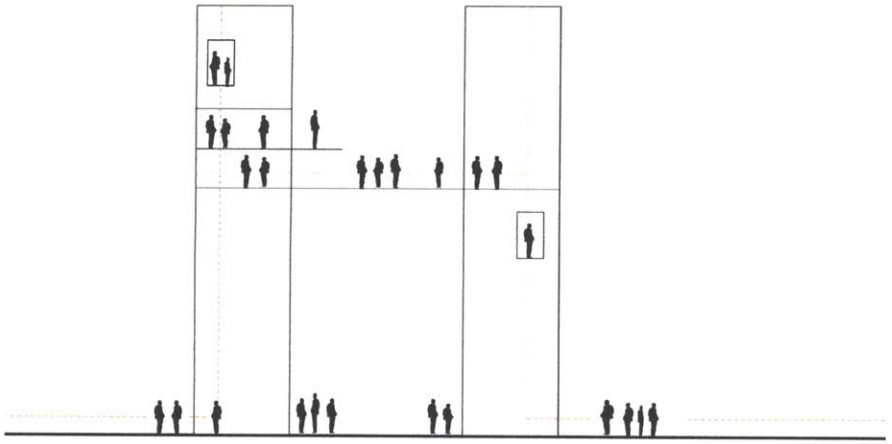
The issue is one of balance, where the factors in balance to be equated through my design proposal are the needs and wants of all those involved. The wants of the developer are clear - maximize returns and profitability but at what cost? At the cost of social disconnect and neglected public spaces. The narrow-minded methods by which these towers have been designed historically blurs the boundaries of need and want, making it difficult for the developer to distinguish between the two. Under the illusion that the most efficient, profitable and or beneficial architecture is the currently existing rigid tower typology, the developer has not any other options from which to choose - and so the result is design stagnation. This most likely explains why it is that a large and ever-increasing number of towers seem to have little-more than form-making or technological innovations about them. Other than this, not much in the way of evolution has taken place since the skyscraper species began.



UNITED SKYSCRAPERS OF AMERICA

This is in part due to the limitations of a program whose nature exists in a vertical format in addition to the iconic individuality that each skyscraper possesses. If architecture has historically been a representation of its people, then skyscrapers represent the zenith of individualism. An important concept that I would like to express in this thesis is that of architecture as a representation of its people. The towers as Rem describes them, stand alone, disconnected, and in competition with one another - not only for light and place but also for attention and focus: as centres in the decentralized grid that is Manhattan. So what if these towers were to unite?





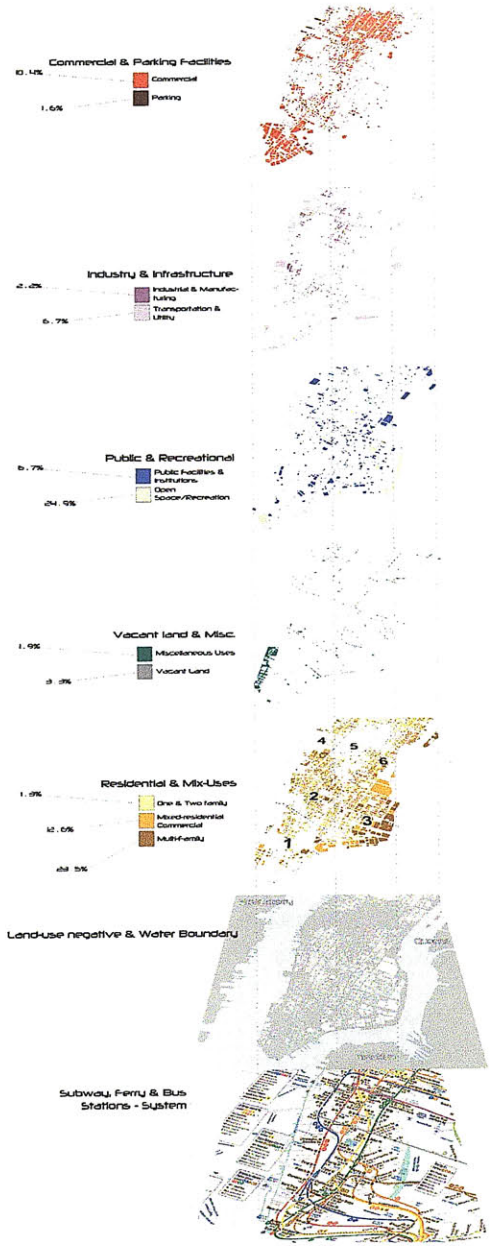
A NEW LAYER

The diagrams on the left are meant to demonstrate the hypothetical effects of creating a new strata on which the public are free to interact and gather in comparison to presently existing conditions.

In Manhattan, at the corners of skyscrapers' sidewalks (usually the region at which the streets and avenues intersect) are usually the closest zones of accessible public space. These can more often than not become uncomfortably confrontational and congested, rendering them unattractive for the purpose of gathering or socializing. Moreover, a substantial number of these so-called public spaces in fact, happen to be privately owned, effectively reducing the number of spaces on which it is possible to gather and freely interact.

The addition of an aerial 'ground plane' would not only help to manageably decrease pedestrian traffic to a desirable level (effectively halving it), but also help promote social networking in the form of cross-interaction from one tower to the next. This would also help to further reduce vertical traffic in the form of elevator usage and waiting times, as this ground-plane shift would allow for tower denizens to seek refuge from their workplace without having to wait for the elevators to make it both to and from the ground plane.

Consequently, the capacitance of activity within skyscrapers increases, as do the degrees of interaction. Once limited to very two-dimensional planar interactions limited by the 'Great Lobotomy', this intervention seeks to re-connect the towers and blocks in this "system of 2,028 solitudes".

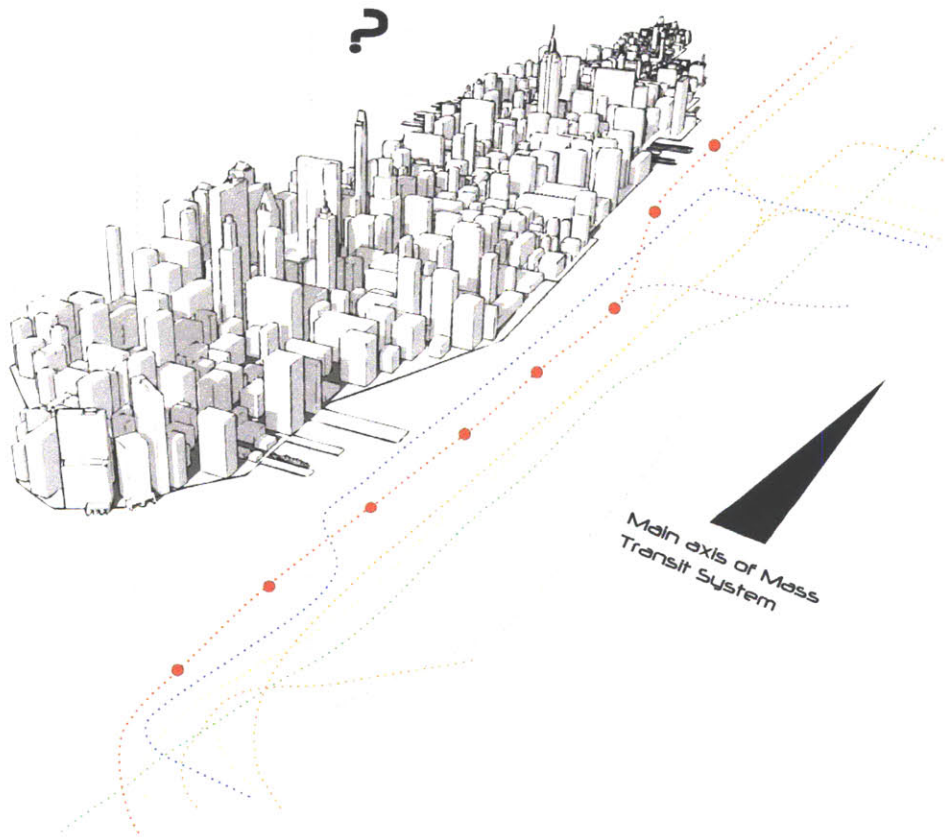


Furthermore, it would help to achieve a breakdown in both scale and hierarchy inherent/native to the tower typology. This breakdown in scale occurs through the newly introduced layer of activity that serves to moderate the sheer verticality of these towers, as the public's proximity to a clear view of the skies has effectively been improved - bringing more light to these new layers.

GOING UP : NEW PLACE FOR PUBLIC SPACE

The exploded diagram on the left is meant to help illustrate the lack of public space (light green) in Manhattan just under 59th Street which therefore excludes Central Park as the anomaly.

In addition, there is an evident lack of vacant land (grey) upon which to build making the issue of adequate, accessible and desirable public space in the city a crucial one to tackle. For, Manhattan by nature, is laterally bound by the water's edge and so the only place left to consider is - up.



MASS TRANSPORTATION : CULTURE OR CRISIS?

"Several subway lines have reached their operational limits in terms of train frequency and passengers," according to data released by the Transit Authority. All but one of the "A" Division Lines, and the E and L lines are at capacity" and "crowding on the Lexington Avenue trains exceeds design limits."

"Crowding on subway lines results in delays and if congestion-based pricing for automobile travel to Manhattan is implemented, subway crowding is predicted to worsen."

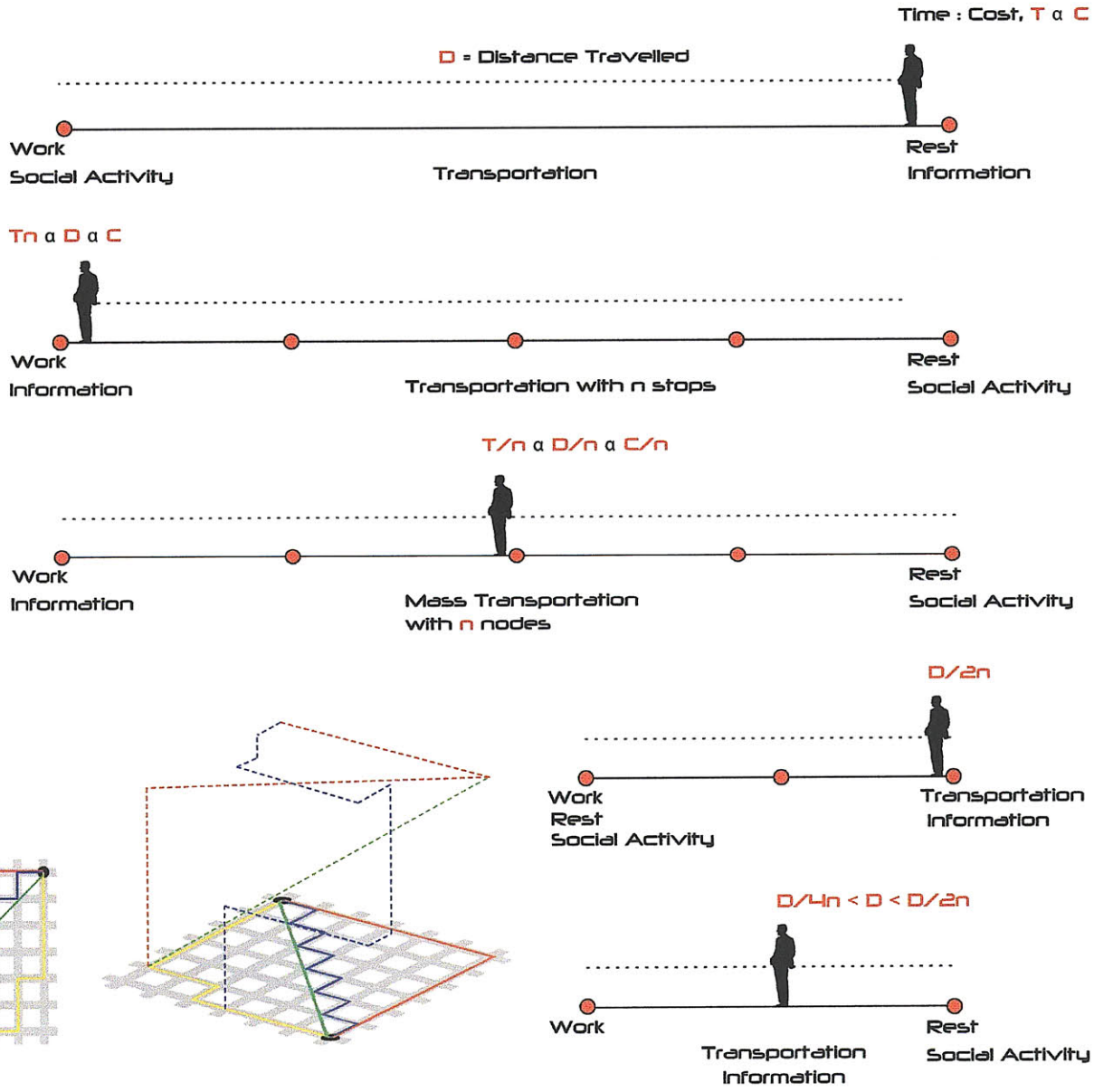
"The Second Avenue Subway will begin to relieve pressure on the Lexington Avenue line when its first segment begins operating in 2015, but no such relief is planned for other crowded lines. Because new subway construction can require years to plan and complete, the Transit Authority can only turn to increased bus service to manage demand in the short run."

- NY Times Article : William Neuman
Some Subways Found Packed Past Capacity
June 26 '07

New York City has, by far, the highest rate of public transportation use of any American city, with 54.2% of workers commuting to work by this means in 2006.

New York City also has the longest mean travel time for commuters (39 minutes) among major U.S. cities.

- U.S. Census Bureau, American
Community Survey 2006, Table S0802

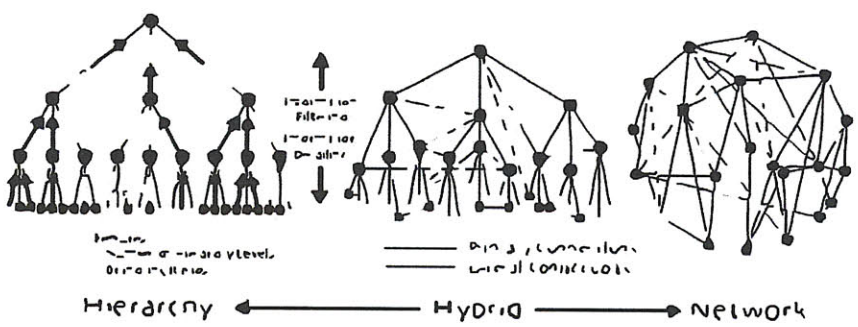

Time : Cost, T α C
D = Distance Travelled
Work
Social Activity
Transportation
Rest
Information
Tn α D α C
Work
Information
Transportation with n stops
Rest
Social Activity
T/n α D/n α C/n
Work
Information
Mass Transportation
with n nodes
Rest
Social Activity
D/2n
Work
Rest
Social Activity
Transportation
Information
D/4n < D < D/2n
Work
Transportation
Information
Rest
Social Activity

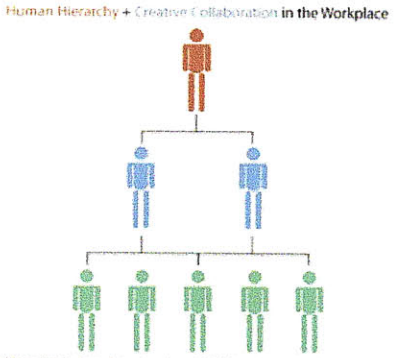
MORE THAN AN ISSUE OF GEOMETRY

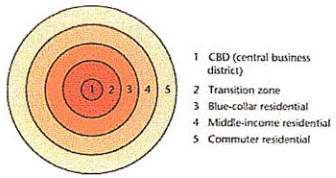
Manhattan traffic is bi-axial. The pedestrians walk the streets (E-W) and the subway system runs approximately parallel to its length in the N-S direction - in accordance with the avenues. This is largely due to the grid but also the proportionality of the land. It is easier to walk shorter distances and so since Manhattan is longer/taller than it is wide the streets are appropriately oriented to allow for pedestrian traffic and lesser vehicular traffic (mostly 3-lane-wide) along the shorter axis, whilst the trains and 6-lane-wide automobile lanes run the longer span. This in fact happens to be fairly efficient on many levels.

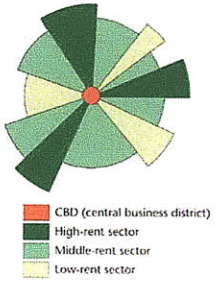
From an article by Minkowski, a theoretical physicist on New York Taxi Cab Geometries, he pointed out that the shortest distance (and hence the best route to take - if only it could be taken) between two locations of the grid happens to be traversing the diagonal. However, due to the regular geometry of the grid, any other path taken from the first to second point on the grid (without recursion) is equal in distance to that of any other path taken from the same start and end points. Of course, this model did not account for time and was a simplified two-dimensional planar model.

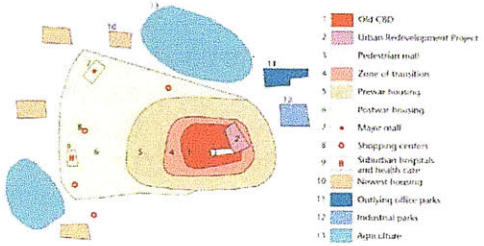
From this I began questioning the possibilities of a three-dimensional model, that could help facilitate movement across and in multiple planes, effectively doubling the existing pedestrian and NYC MTA's traffic capacity as a possible solution to existing constraints and congestion. For if there were multiple circulatory paths made available on different levels then much in the same way as a parallel circuit operates in comparison to one whose component configuration is in series - the flux is multiplied and thus congestion relieved.











CONCEPTUAL CONCLUSION

In an essay titled Complexity Rising, by Yaneer Bar-Yam, the author draws analogies between social networks and control structures. From this start, I then went on a step further to draw analogies between the social theories presented and the urban morphologies that currently exist, such as the Burgess, Hoyt and Nucleated models, eventually equating these to the Hierarchical, Hybrid and Network-ed structures respectively. From there, I then went on to ask the question of 'why is there not an architecture that has the characteristics of a network-ed structure?'. Essentially what the question suggested was the anti-icon: the formless.

THEORETICAL FOOTPRINT : 10 x 10^6 m

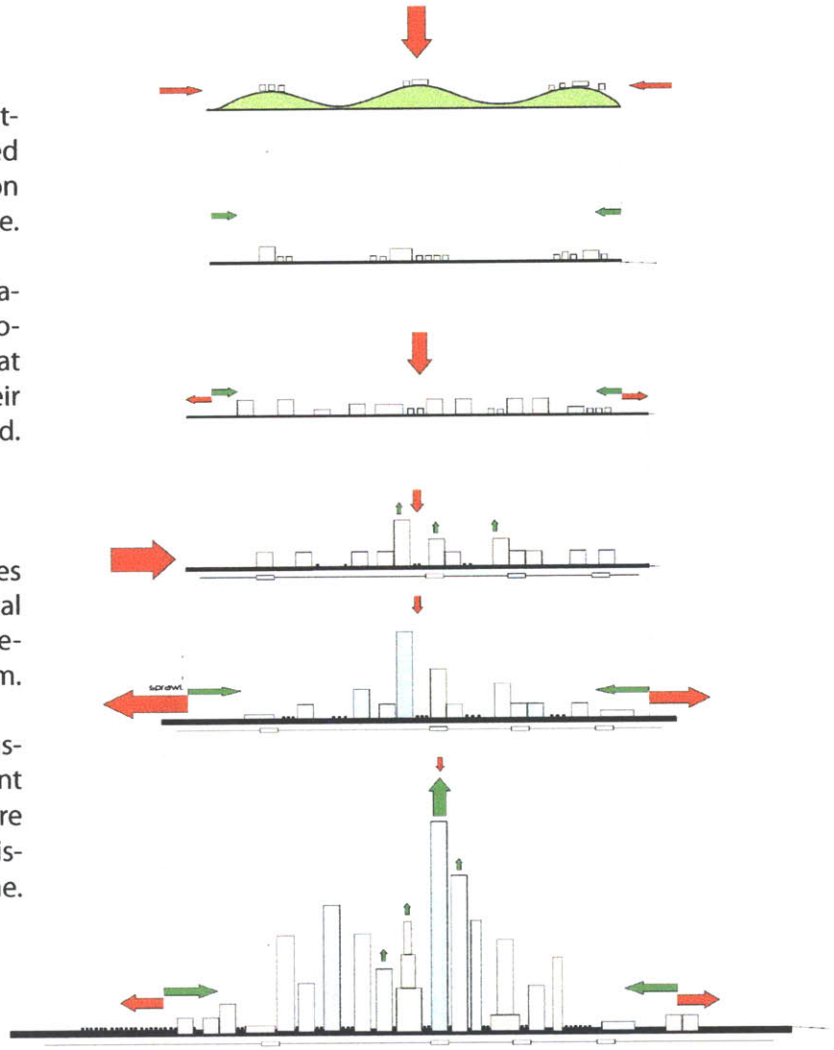
Treating the historical growth of cities as a pressure system helped me understand the demands on the city for its expansion over time.

From the constant effects of urbanization and migrant flux, to those of 'auto-architecture', it has become apparent that cities must grow. The manner of their growth however, should be questioned.

Urban Sprawl or Verticality?

Both have their drawbacks. What makes New York so unique is its small ecological footprint attributed to a good and widespread public transportation system.

Such infrastructure promotes sustainable growth, as the amount of fossil fuels being consumed are greatly reduced, as are commuting distances - the issue here is one of time.



Timeline

City Zero

Tabula Rasa

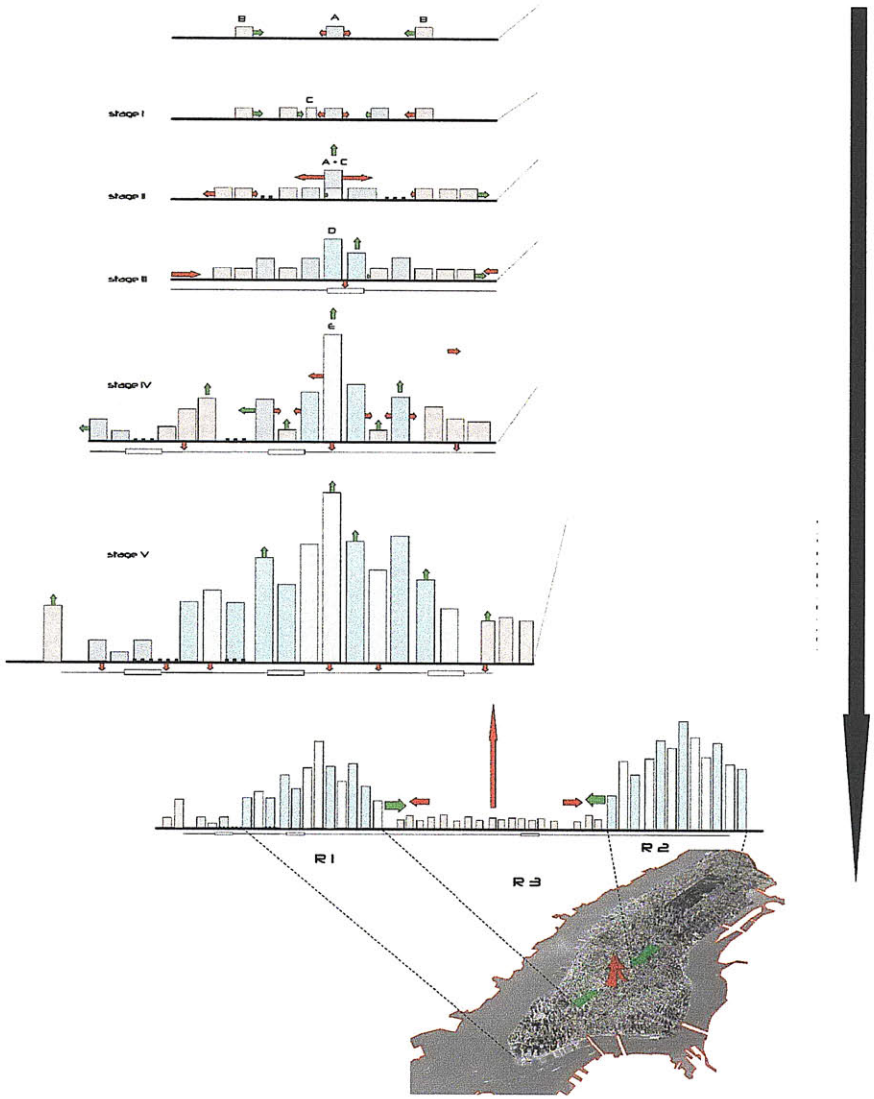
Competition

Culture of Congestion
+ Great Lobotomy

City of Towers

Manhattanism
+ Mega-Cities

land decr.
pop ^
prices ^
trav. dist ^
traffic ^
density ^
disparity ^
skyscrapers ^



THEORETICAL FOOTPRINT : 10 x 10^3 m

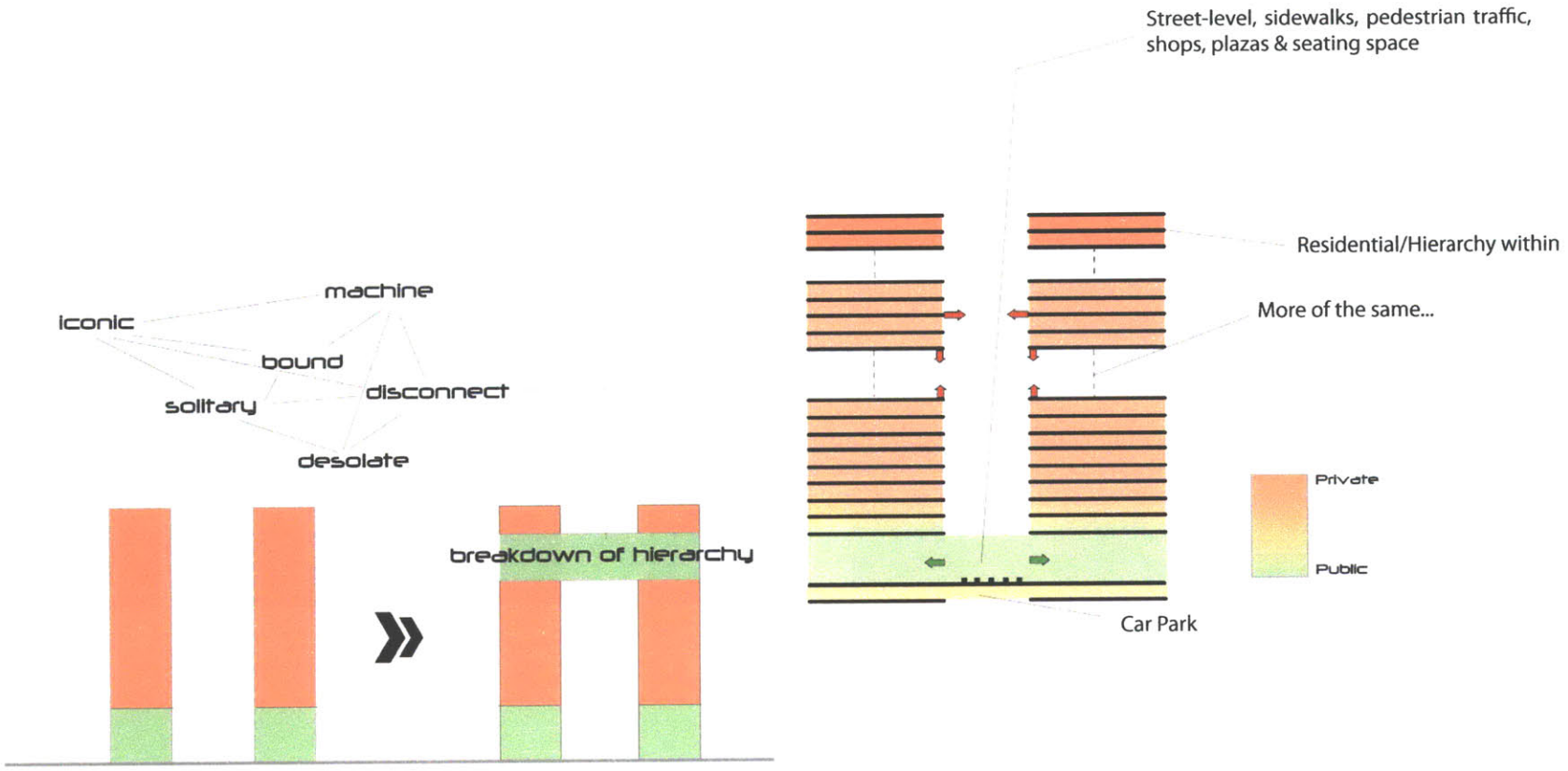
Zooming in on the city block, we begin to observe much of the same, with vertical growth dictating if not influencing neighboring architecture.

Following major migrant worker influx into the cities, there is constant pressure inflicted on near-by buildings from one another to build taller.

Interestingly enough in Manhattan, the NYU, So Ho area seems to be battling it out with both commercial zones in Midtown and Downtown. The political forces in favour of preservation seem to have an effect on the prevention of skyscraper-sprawl between these two zones.

But for how long?

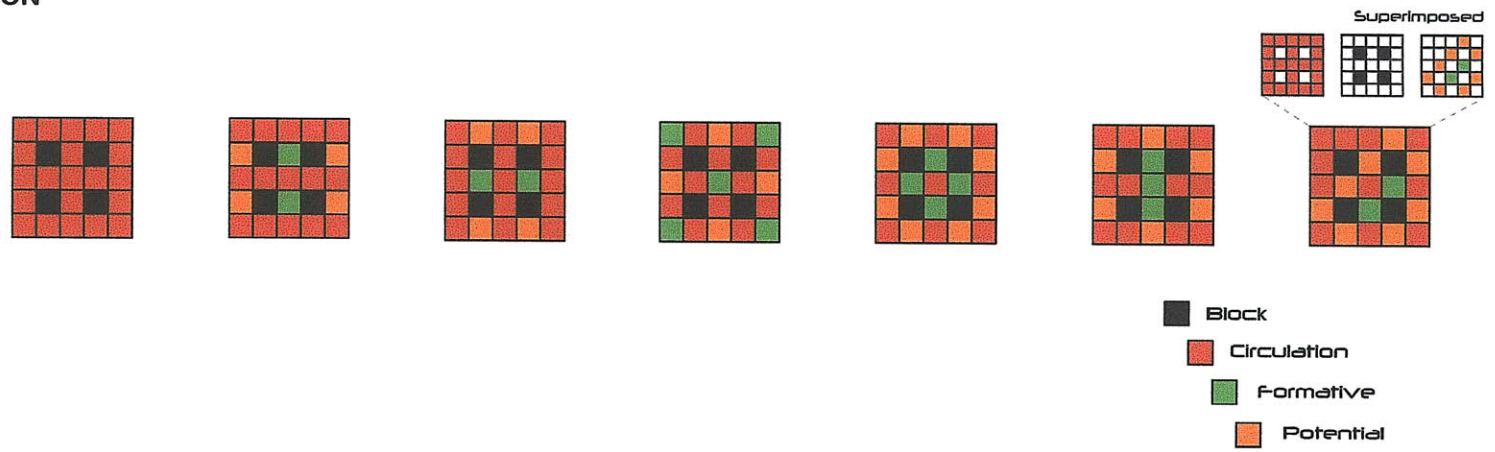
Manhattan with its 1,634,795 residents, population influx of 2,000,000+ on a daily basis and projected growth by 100,000 residents per annum, all spread over a little under 23 sq. mi (59.5 km2), makes it the most densely populated county in the United States.

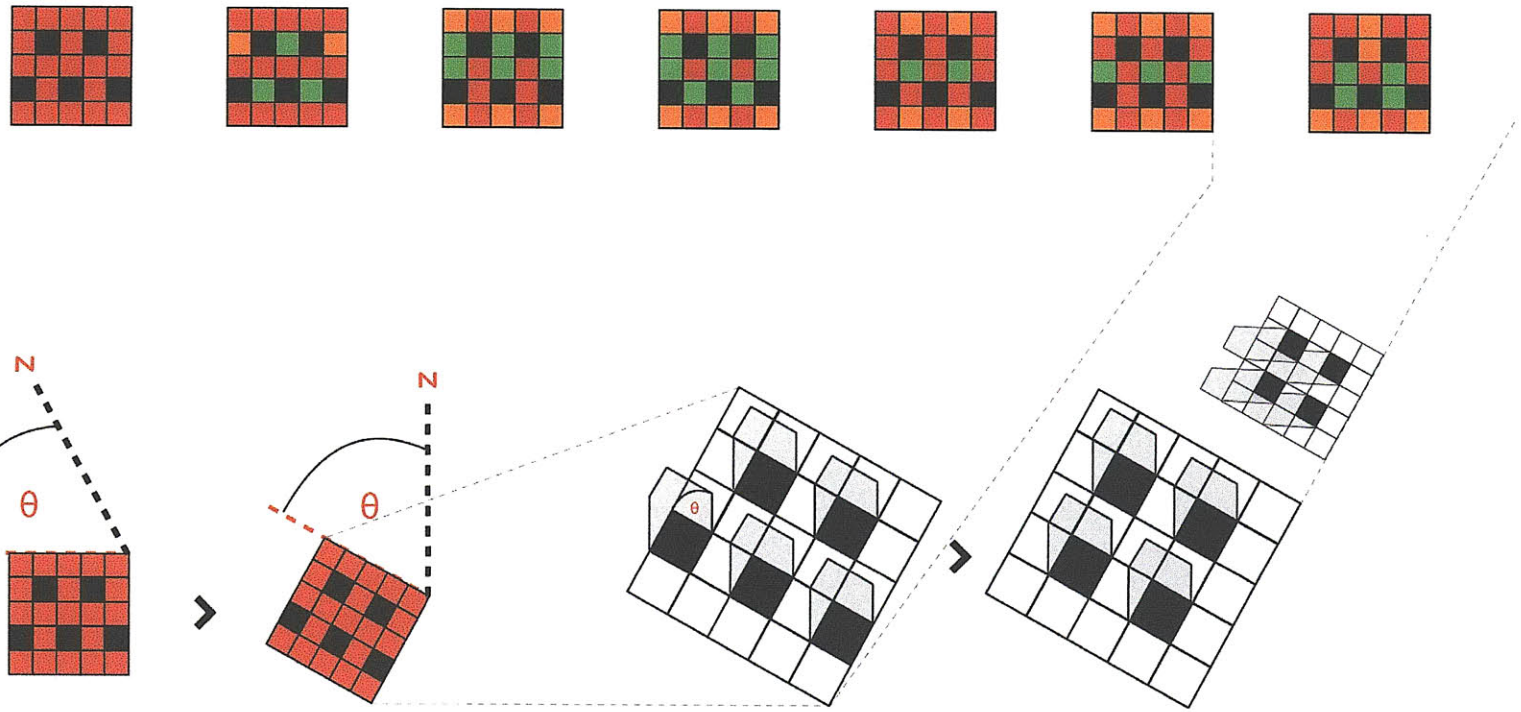


THEORETICAL FOOTPRINT : 10 x 10^1 x n (vertically)

At the level of skyscraper, there is a clearly existing hierarchy, with a public gradient that diminishes with increased verticality. By re-defining public space, the hierarchy within these towers can be broken down too and perhaps Alison and Peter Smithson's 'streets in the air' or neighborhoods in the sky can become a physical and social reality.

GRID ABSTRACTION

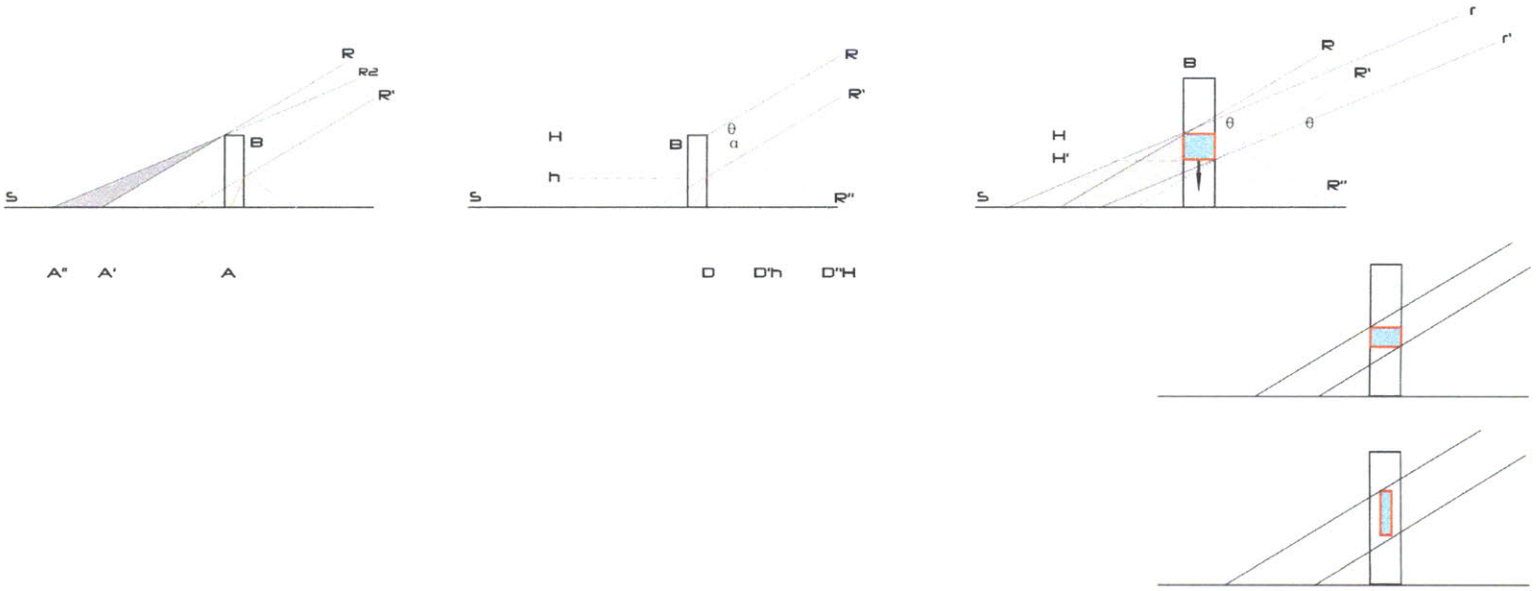


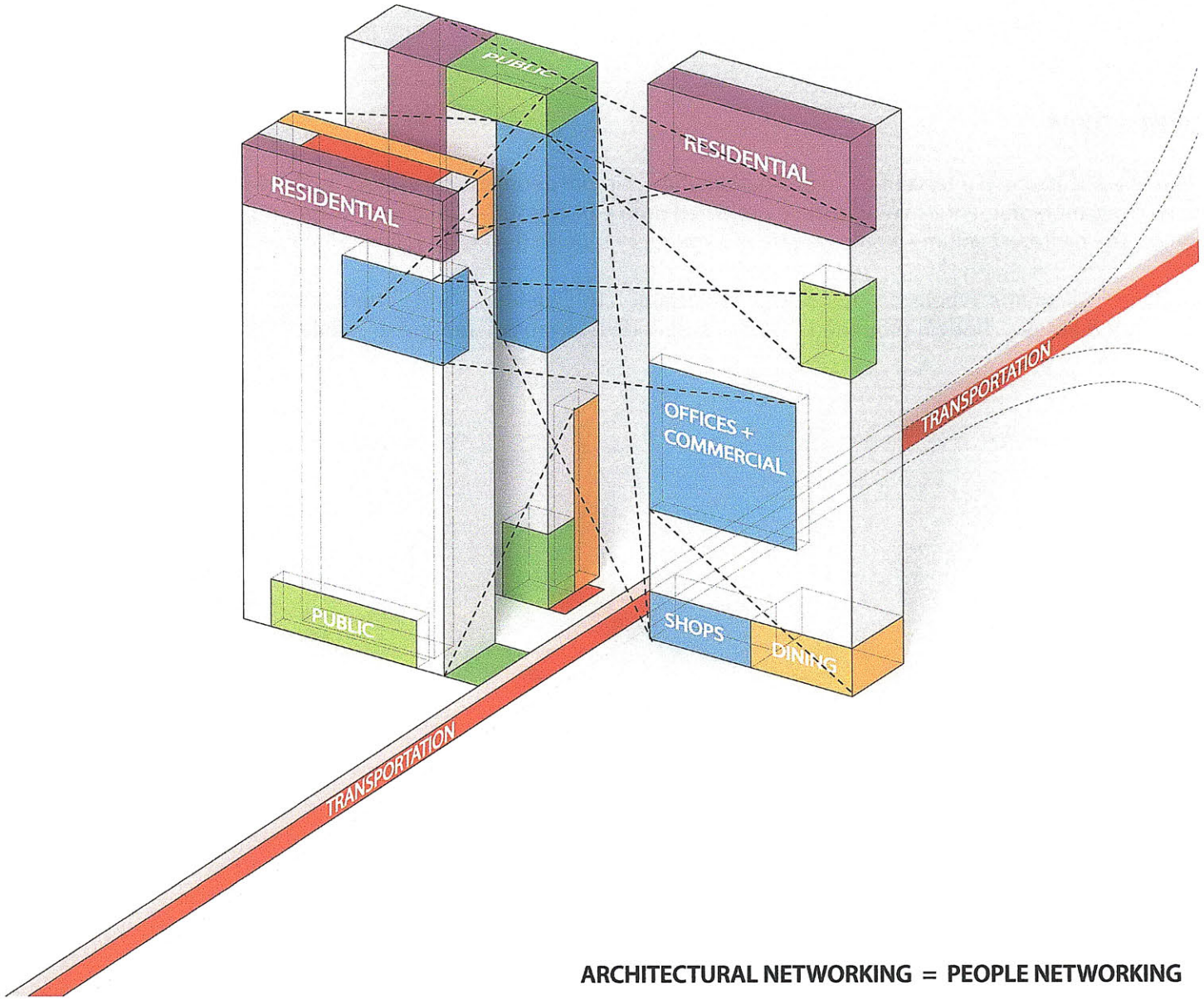


LIGHT + FORM

Were the architectural intervention to be floating, the optimum geometry for casting minimal shadows would be a sphere due to its constant radius. For its volume once projected onto a planar surface such as the ground, would be limited to a constant radius. The next-best volume would be that of a cylinder - though the radius is limited to two axes (a plane) unlike the sphere.

In the diagrams below, it was important to define and understand how it is that different geometries, both grounded and suspended would react to light to help minimize shadows

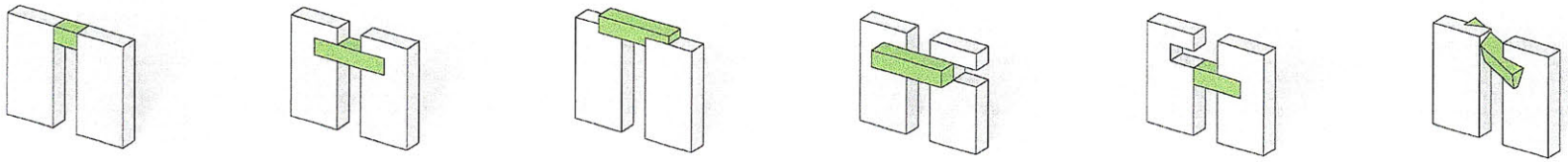




ARCHITECTURAL NETWORKING = PEOPLE NETWORKING

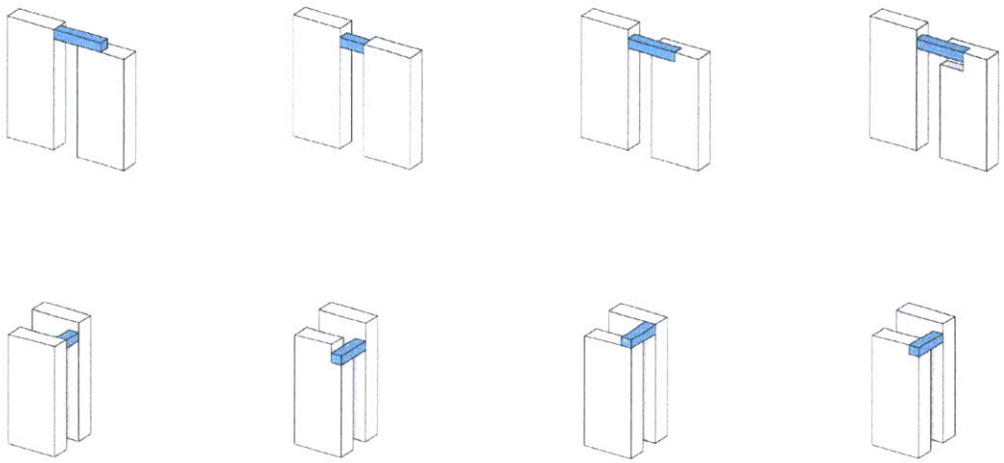
CapaCity In the Sky

Street AXIS

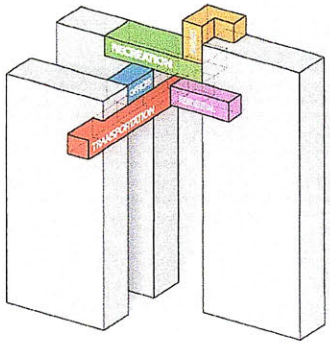


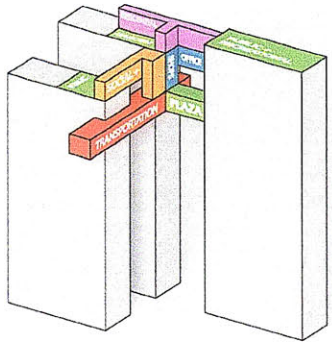
Avenue AXIS

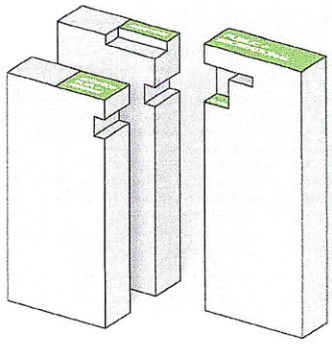
Spatial relationships above for similarly tall towers (in green) are meant to illustrate the variations in massing possibilities across both axes. Along these, exists a particular program determined by the interior workings of each of the individual towers. For instance, most shops at the ground level occur along the longer skyscraper facade which runs parallel to the streets. Taking this into consideration, we then observe the different spatial relationships along that axis.



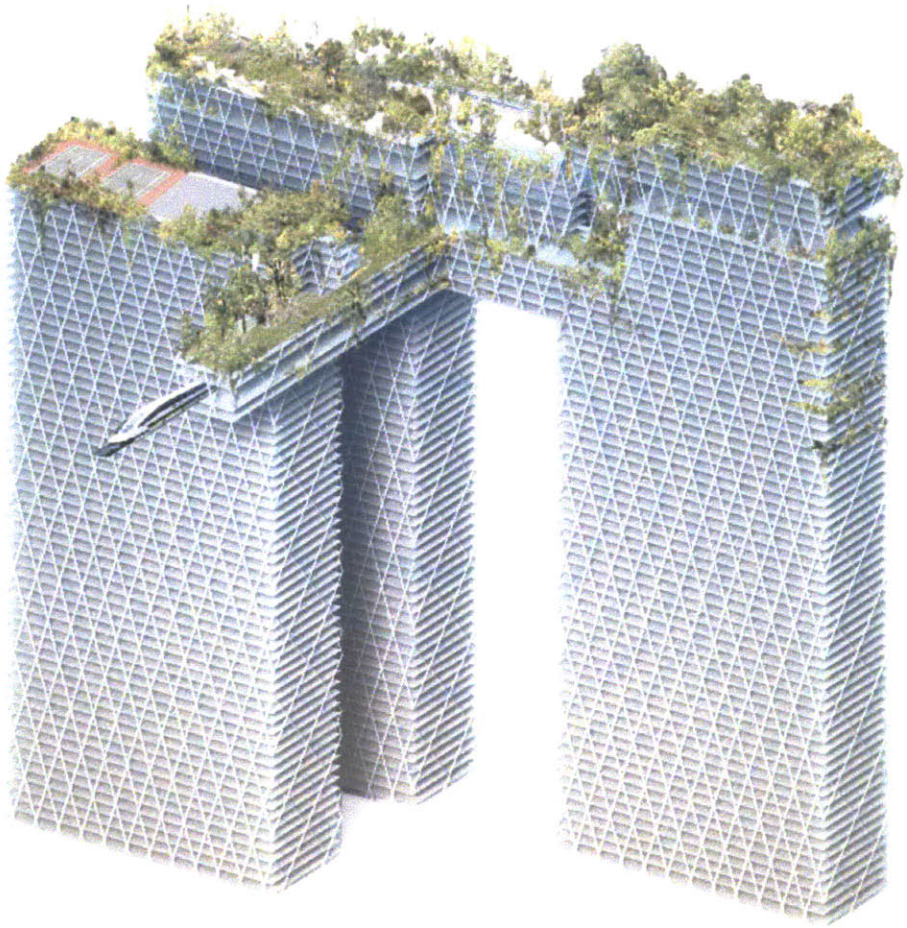
These relationships are provided greater flexibility with varying tower heights as shown in the diagrams above (bridging in blue). For the purposes of this thesis, I decided upon a three tower configuration with variations in their heights and so that I could demonstrate through design, the different programmatic opportunities that exist across both axes, used as a matter of convention in this thesis.







Above, are two iterations of the program massing, using similar simple cuboid-like volumes and text to represent the program in mind. Decisions were made based on the two axes and the skyscrapers' relationships to the street in addition to their interior relationships with one another were their programs to spill out into each other. Lighting and internal programmatic elements and their organizations were also taken into consideration to create a logical and very scientific program arragement. Furthermore, the axis that is to serve the aerial transportation network was maintained in accordance to/conjunction with the North-South direction currently the predominant orientation of the existing mass transit system in Manhattan.



This is a conceptual rendering of what the structure and exterior program(s) would look like were the form to remain as crude as in the massing diagrams. The idea was a piece of Central Park to take over the roofs of these towers, providing a sky surface. With improving green-roof structural technologies, this is now becoming a possibility. The air-way system shown would most likely not have its engine attached to it - effectively minimizing active loads on each tower. However, since all three towers are working together structurally, it should render the task of supporting the addition much easier and possibly provide them with added lateral stability.

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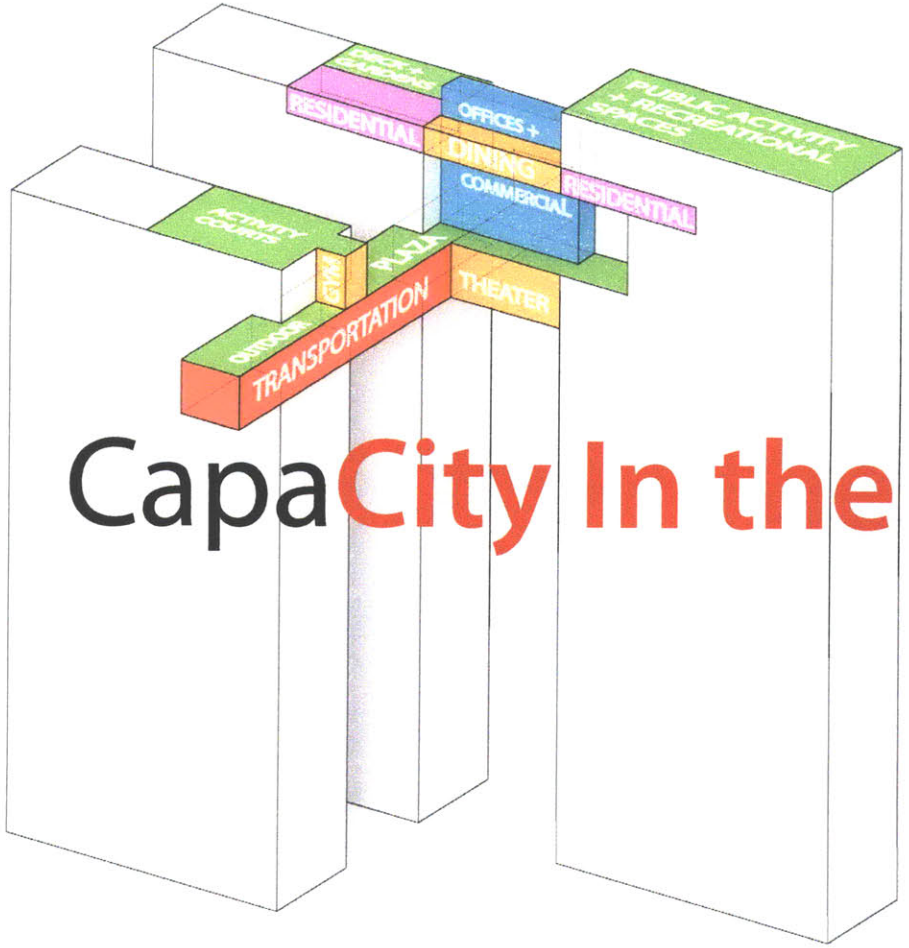

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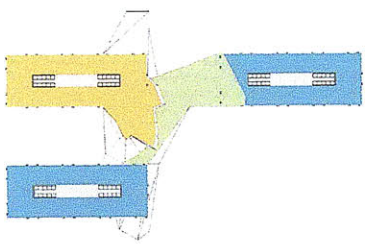
Plan Drawings



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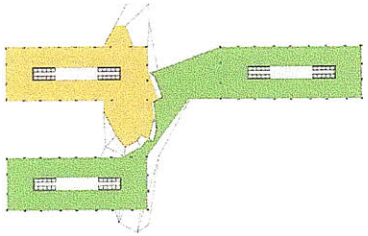

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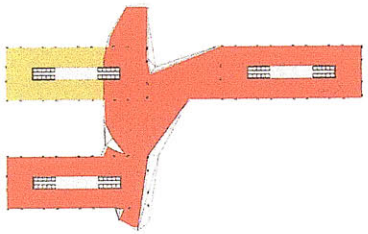

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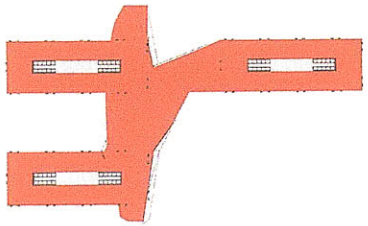

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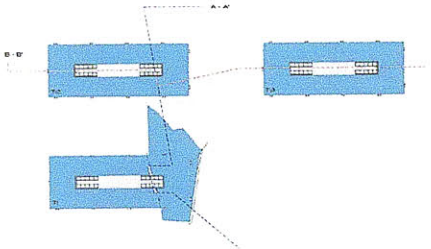
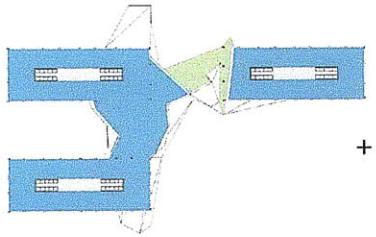


Block Perimeter

+ 540′



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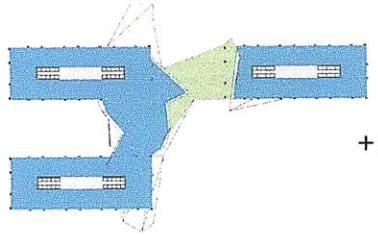

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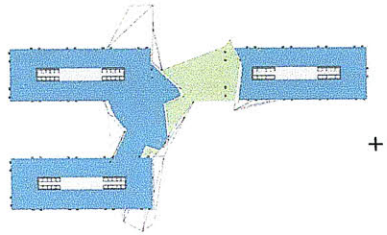

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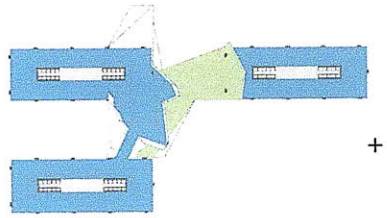

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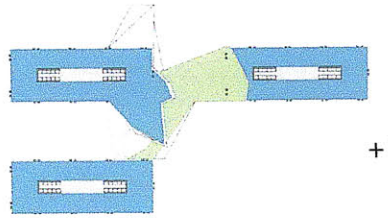

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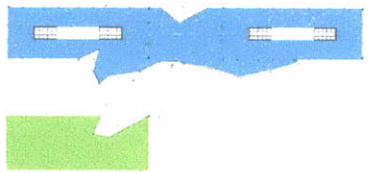

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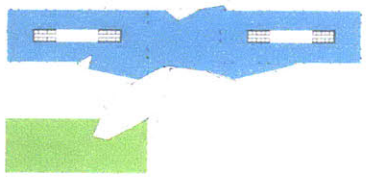

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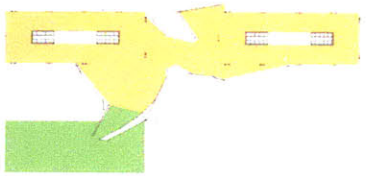

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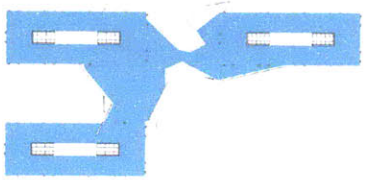

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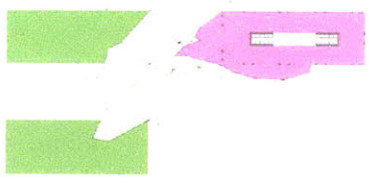

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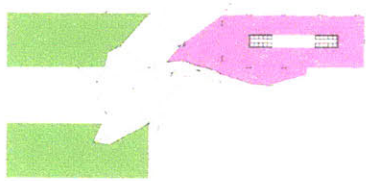

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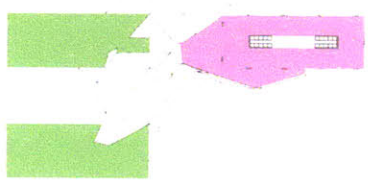

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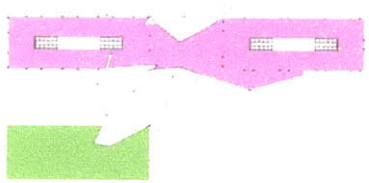

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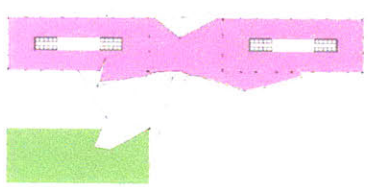

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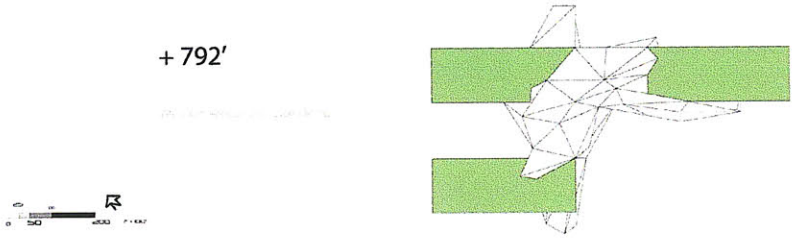

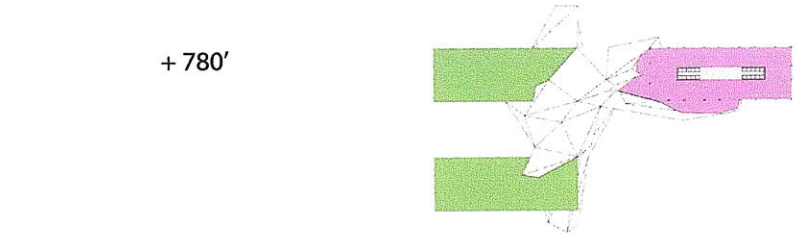

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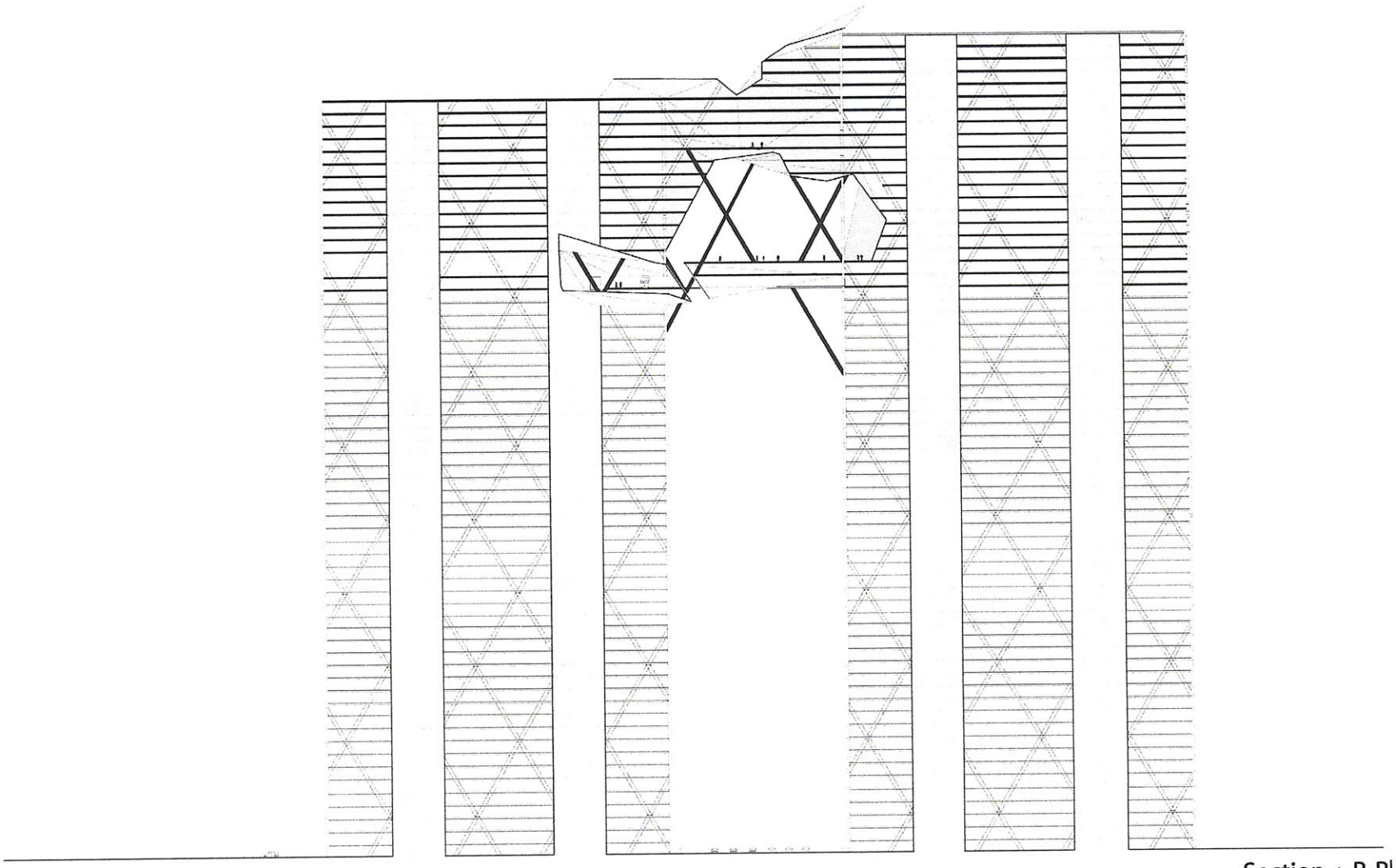

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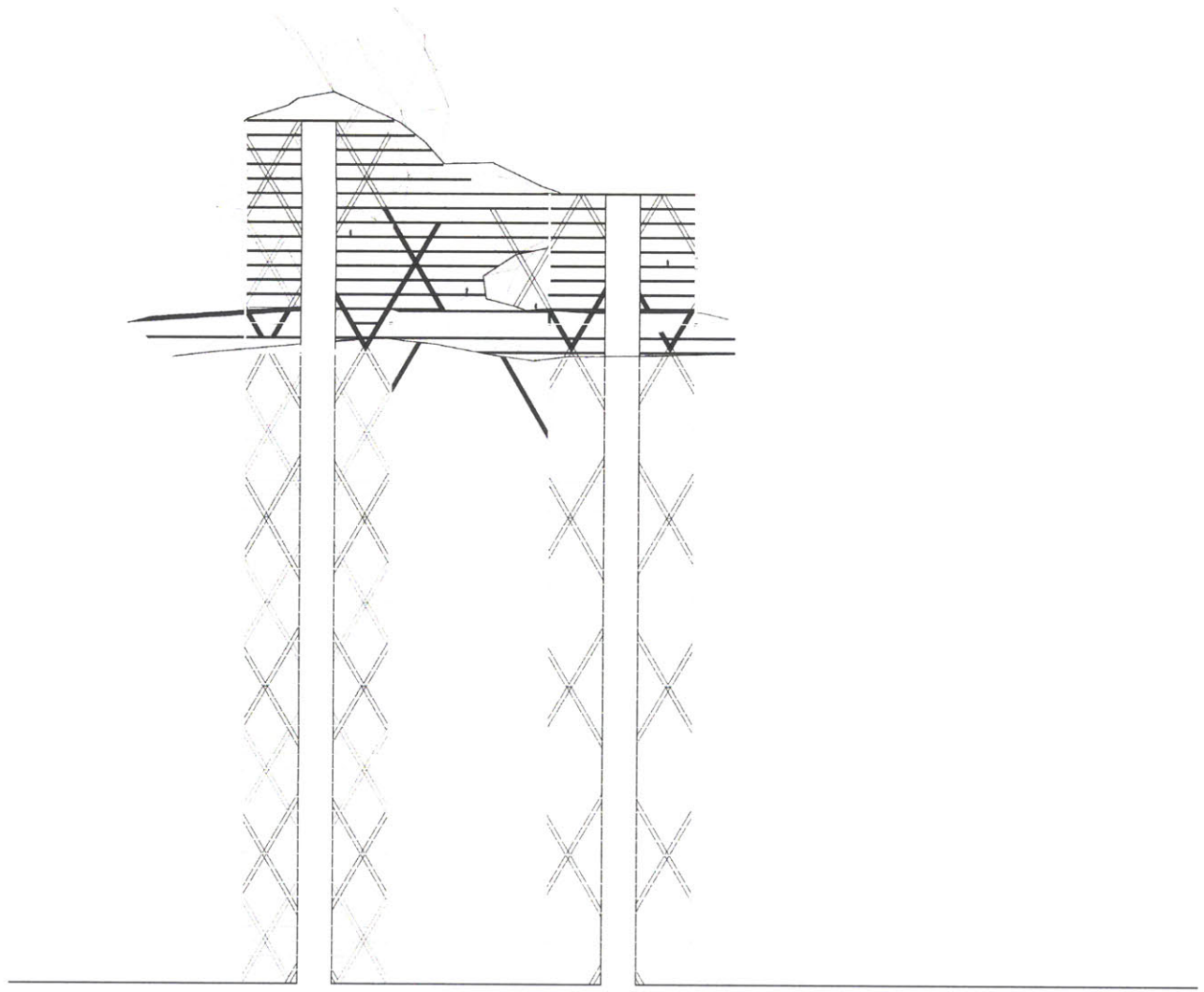

Section : A-A'

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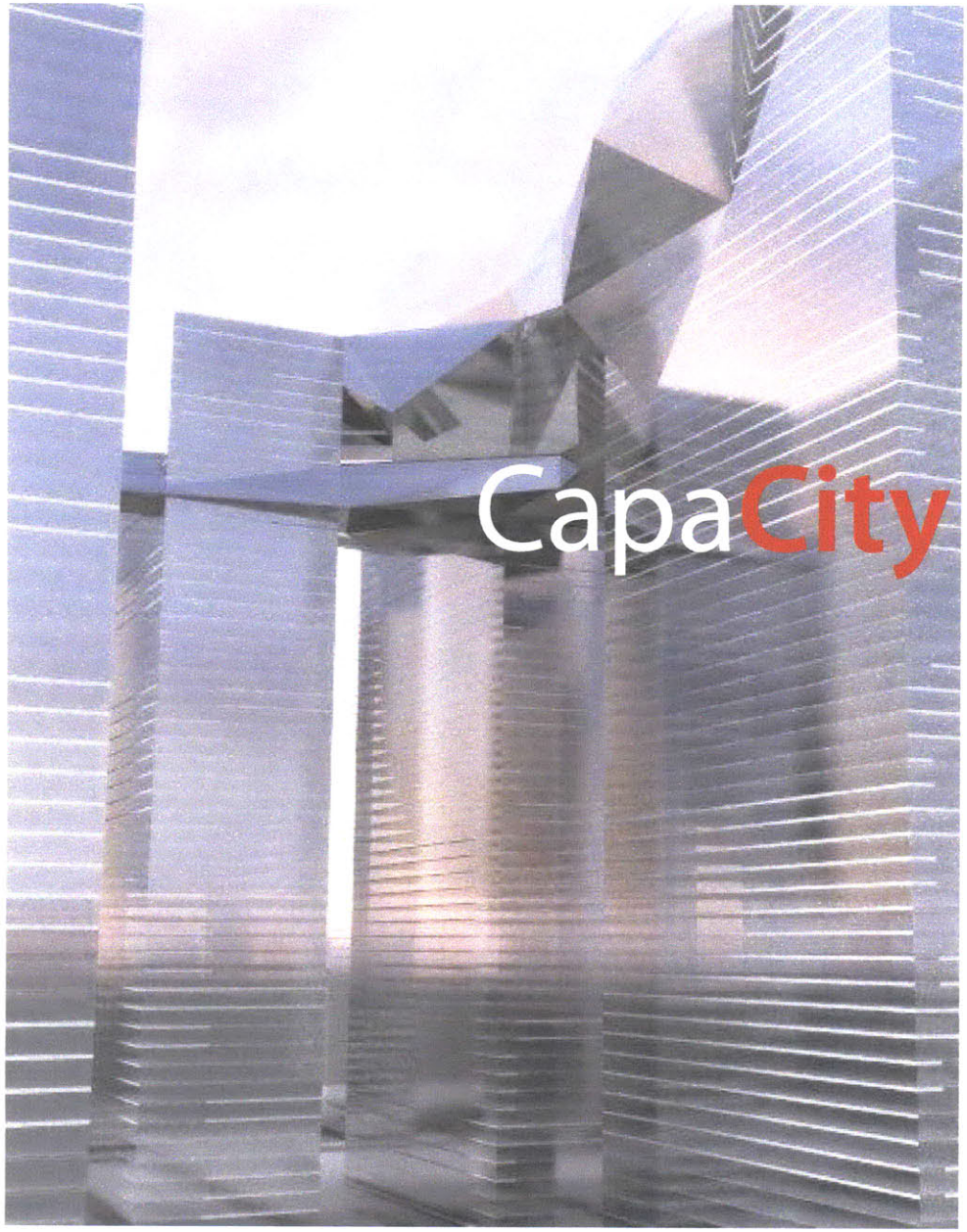

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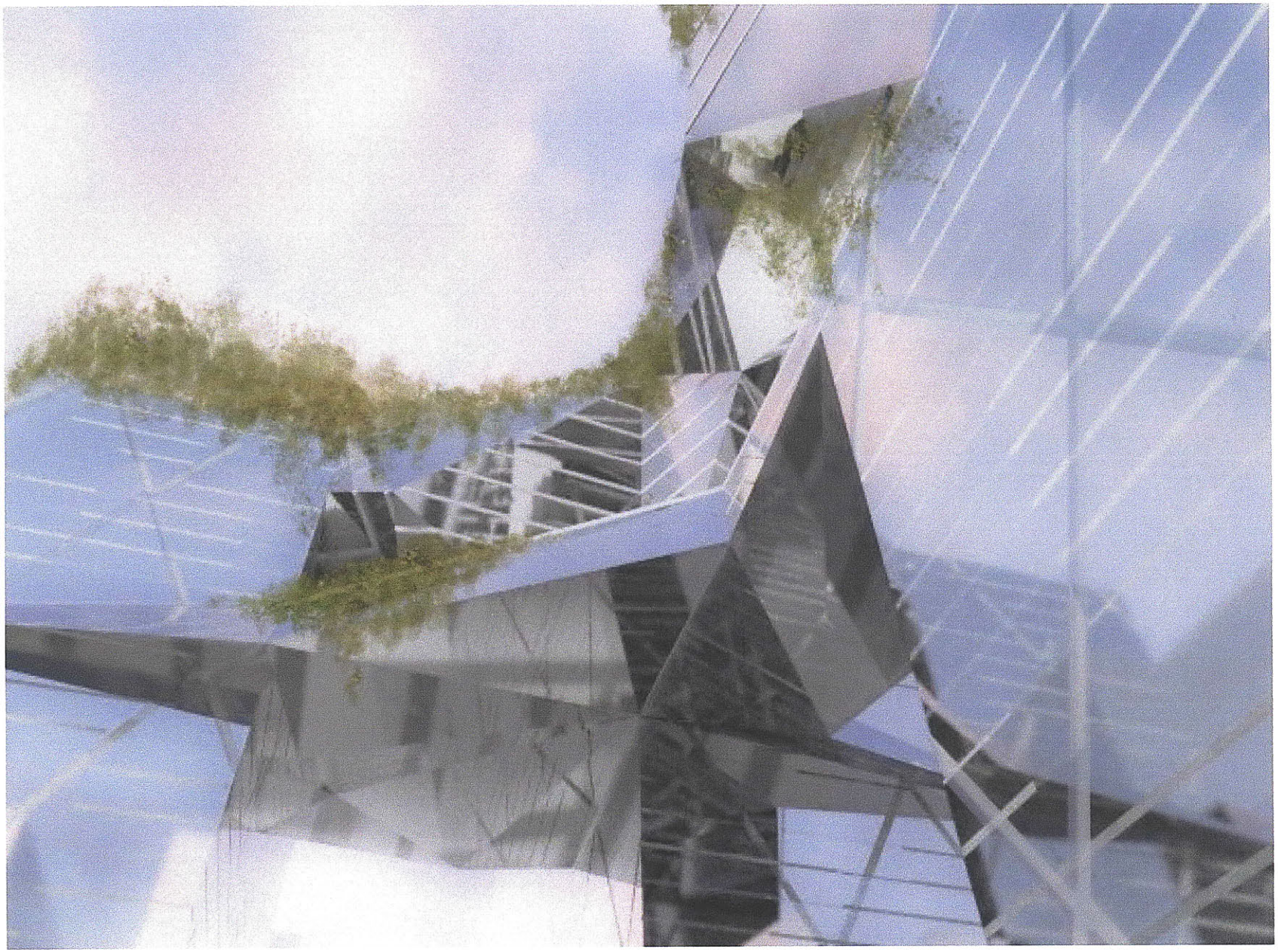
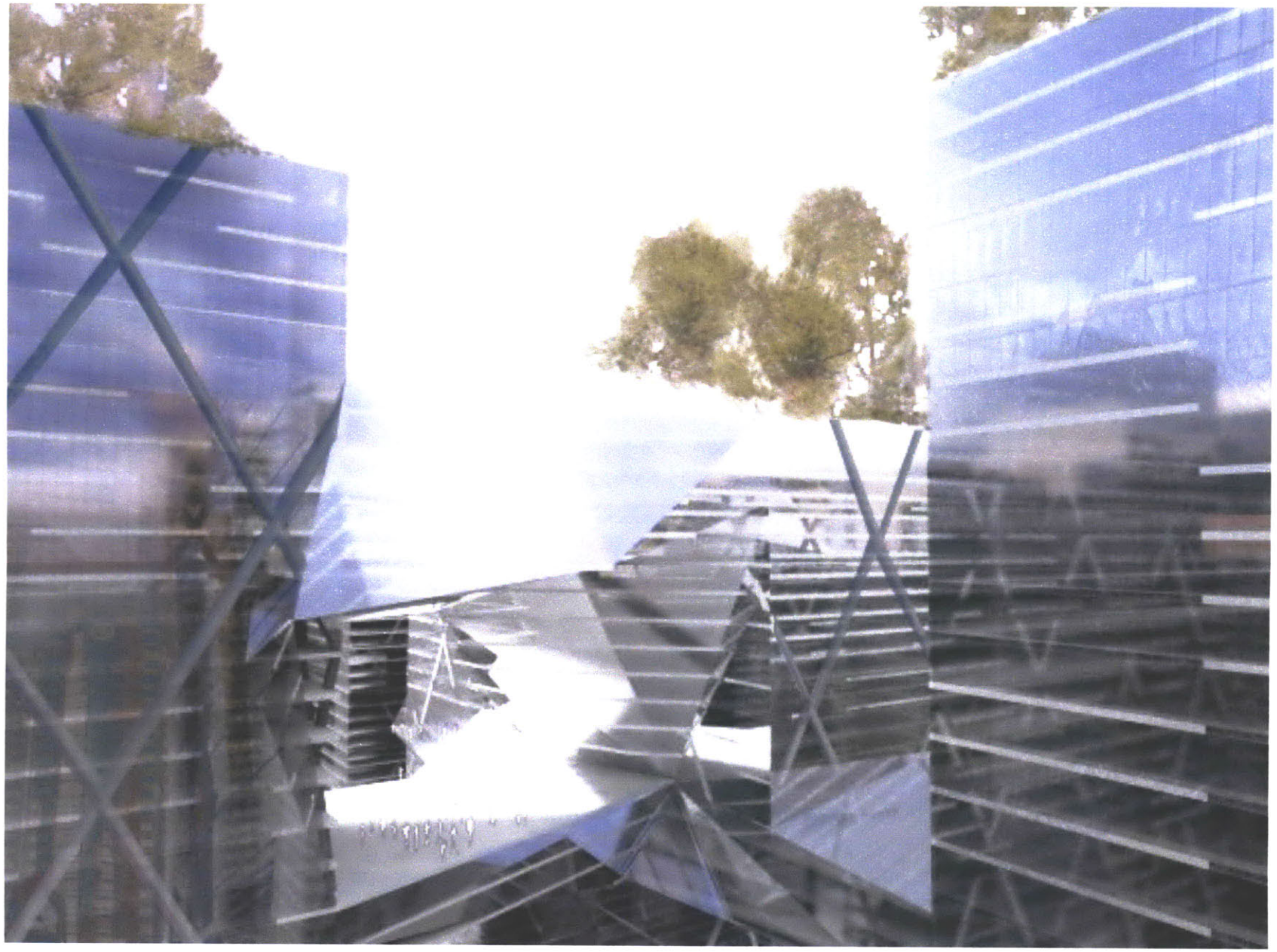
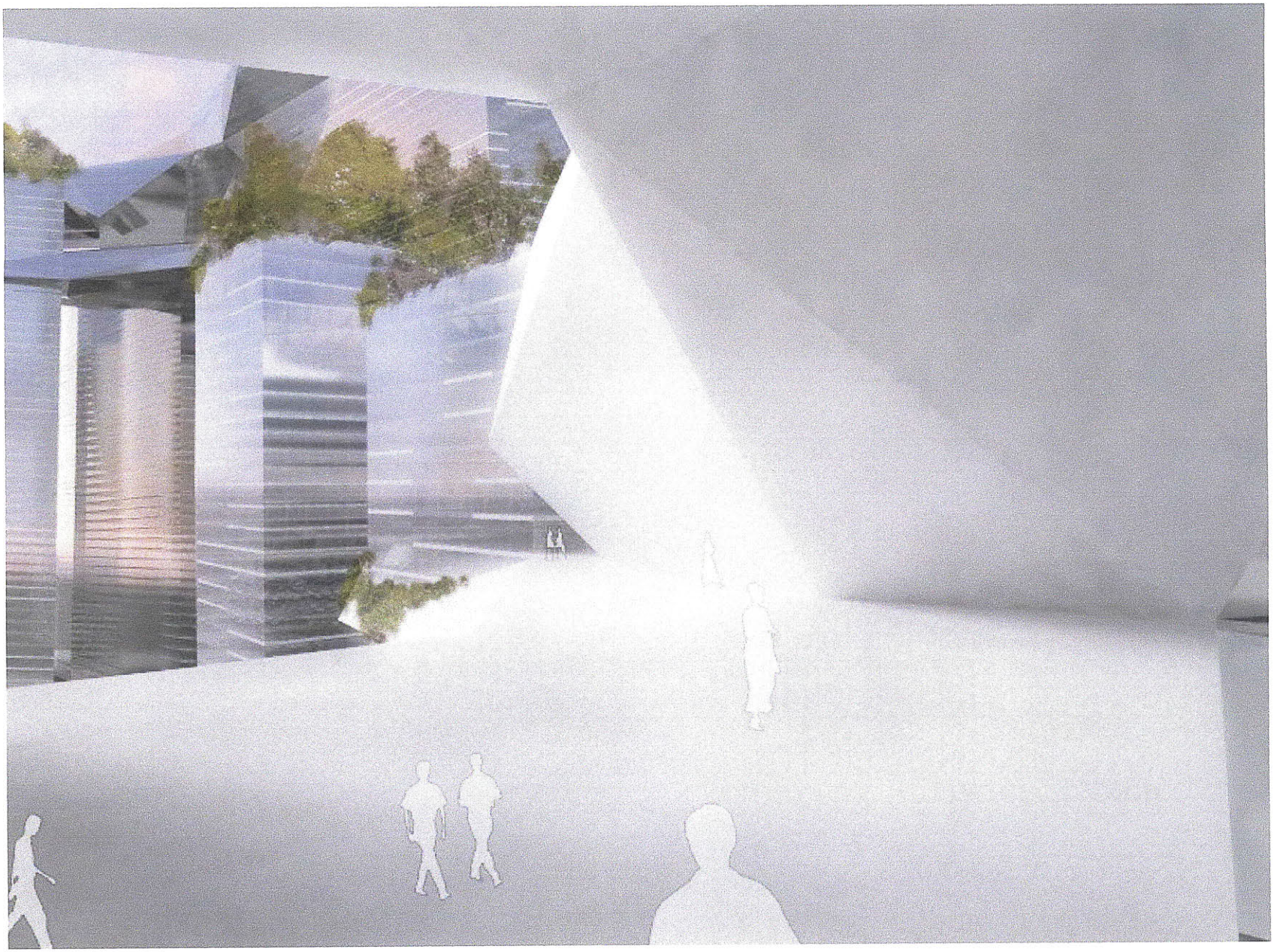
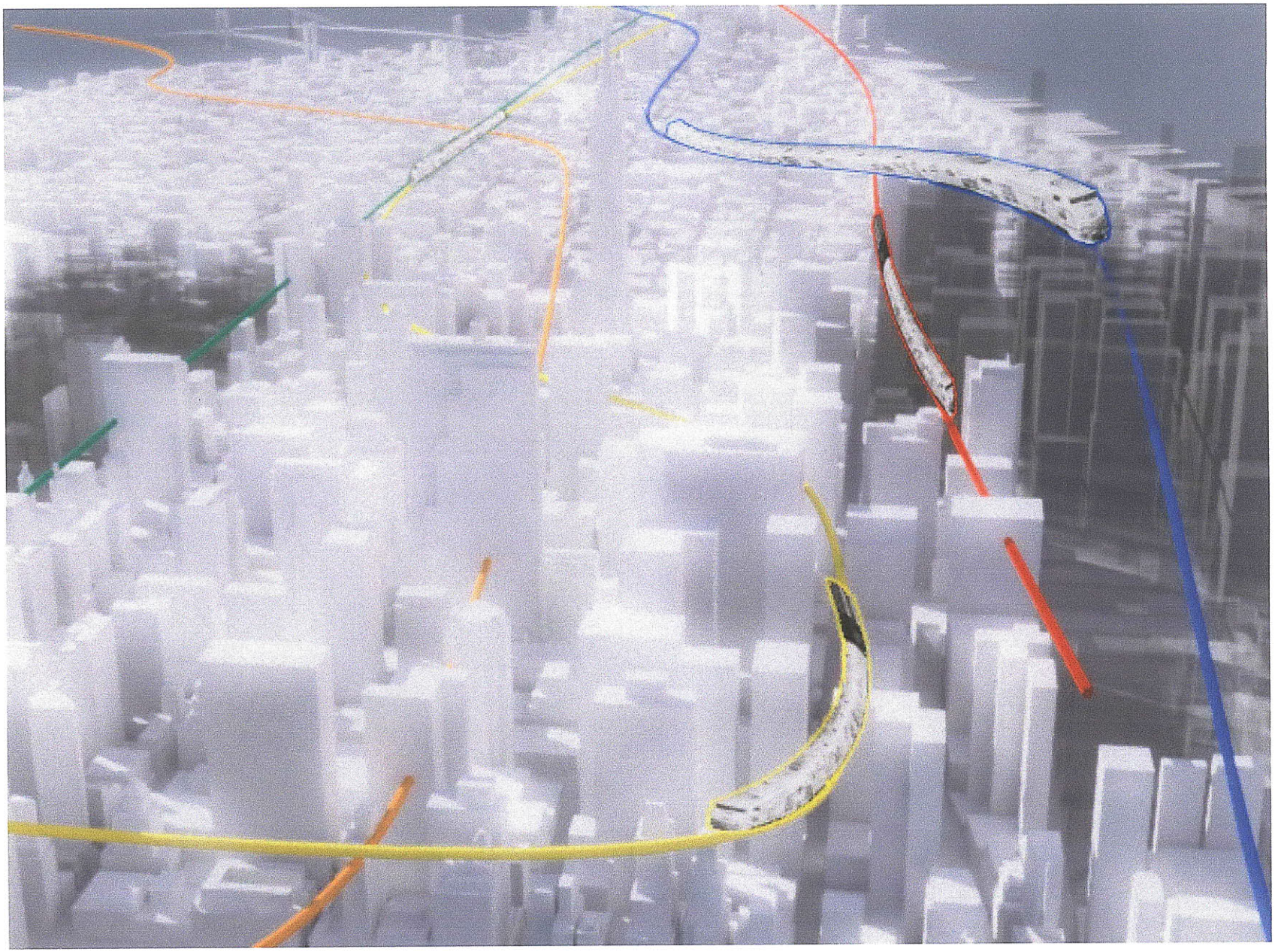


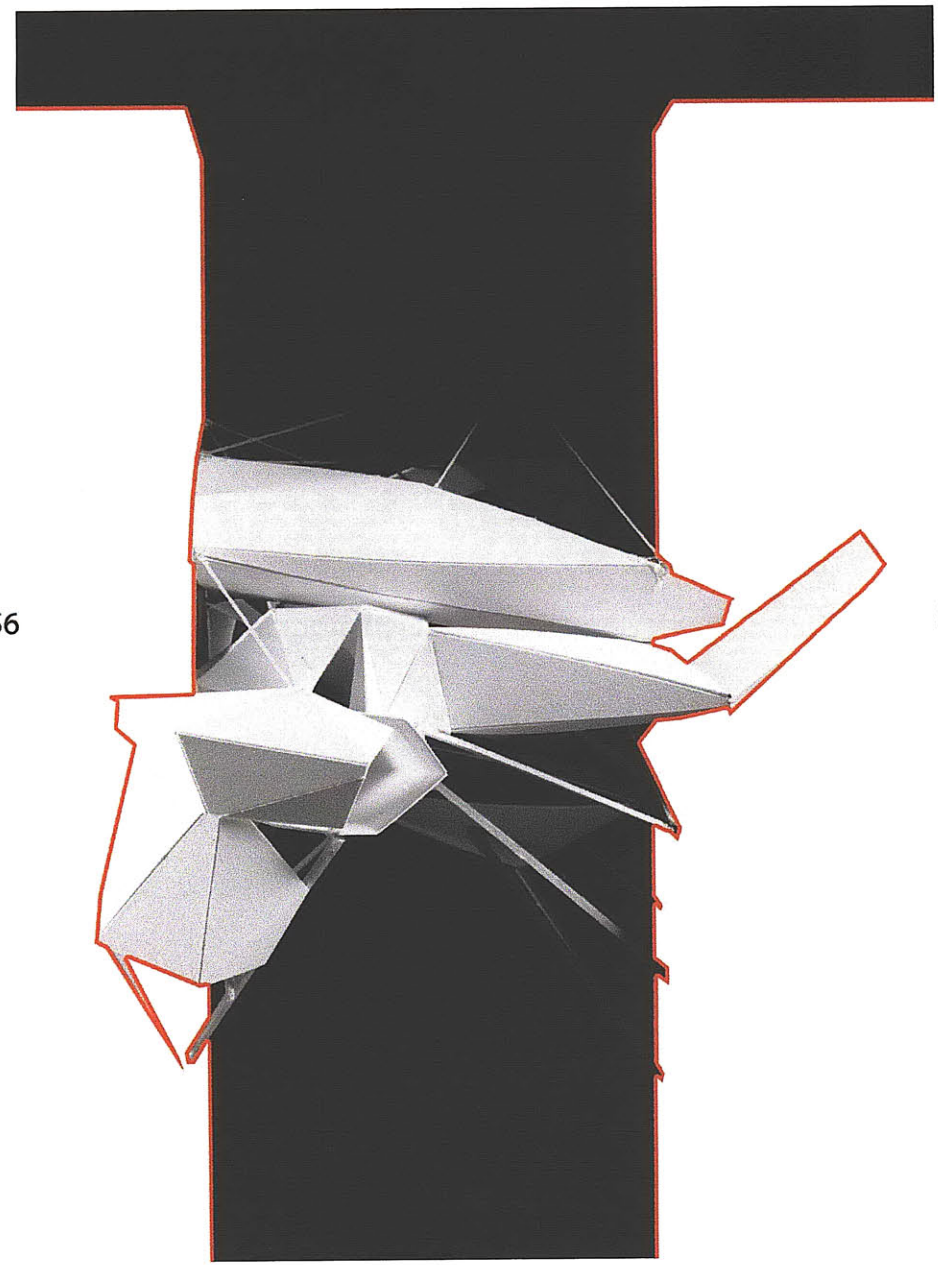




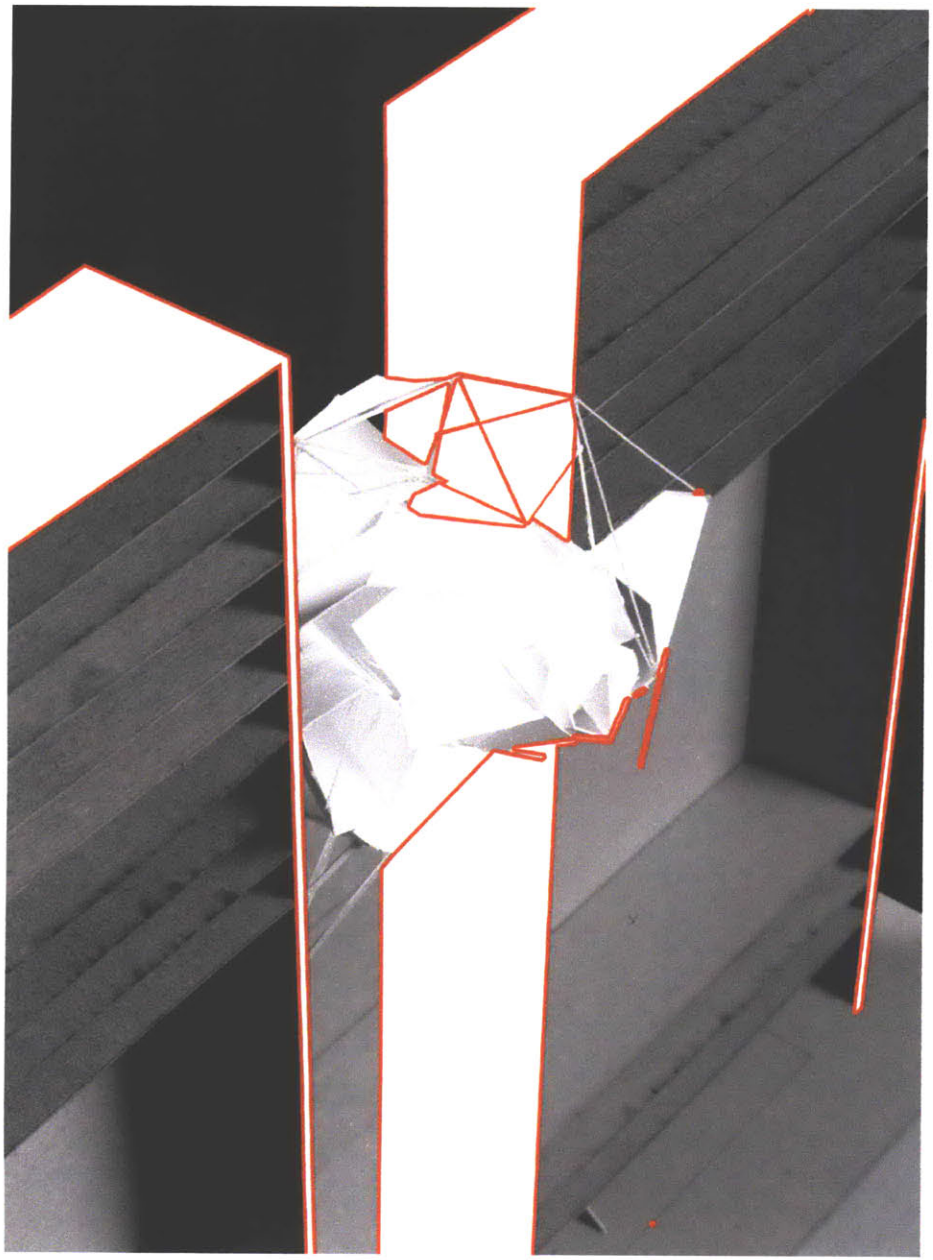


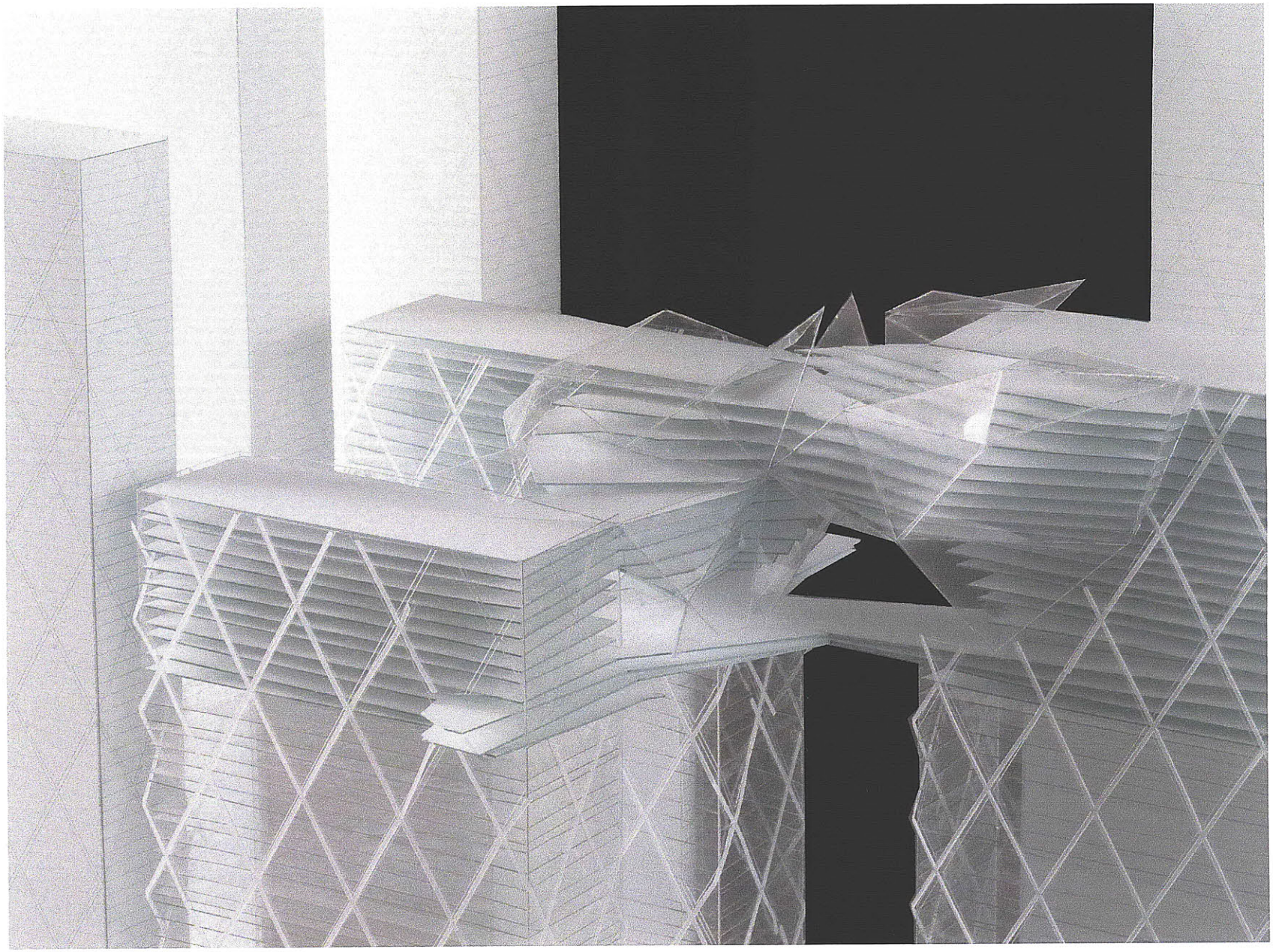
CapaCity In the Sky

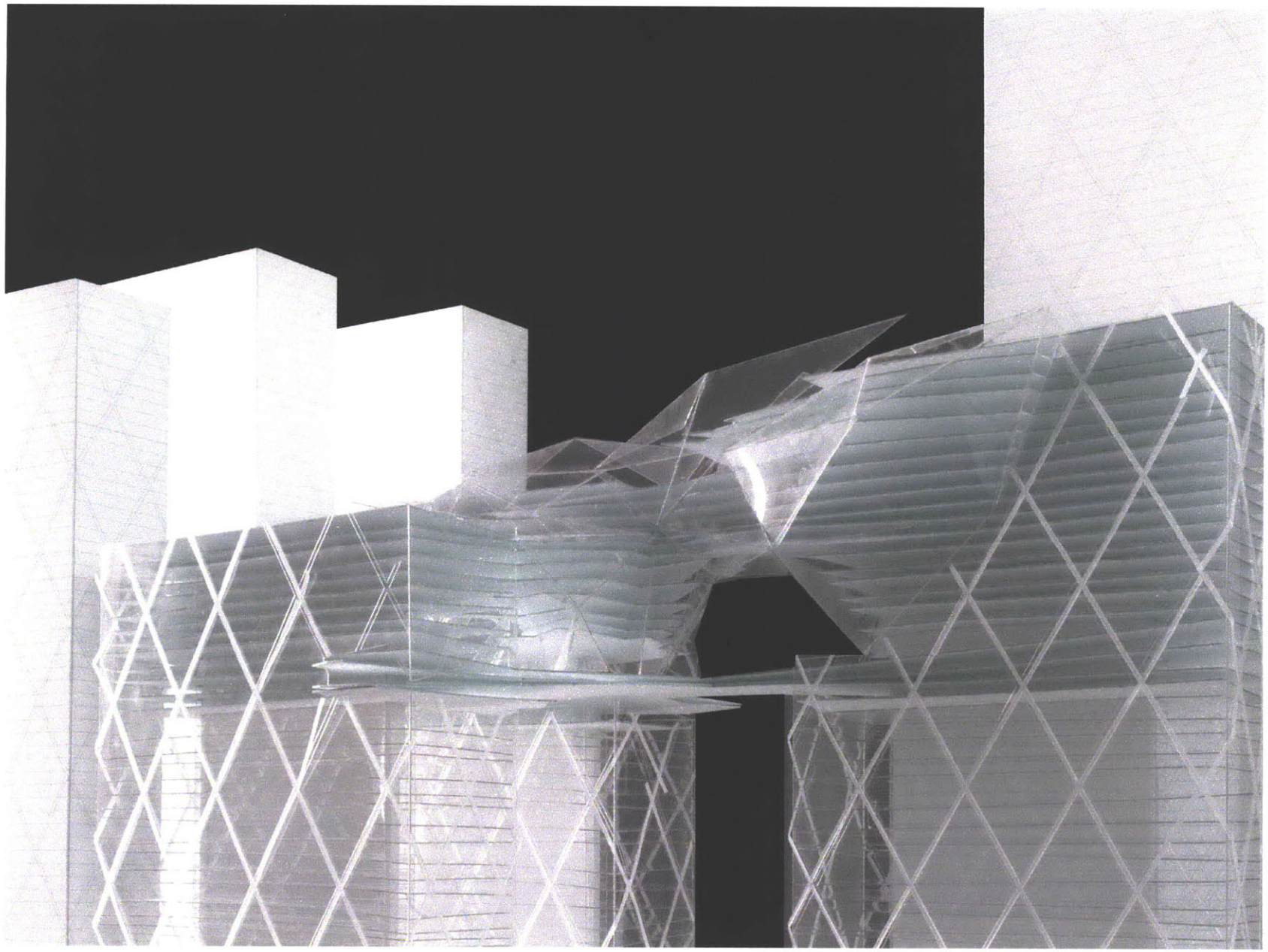
Model Photographs



S k e t c h M o d e l







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CapaCity In the Sky

Conclusion

"...buildings shouldn't be viewed as mechanical structures in isolation of each other but should instead work together advantageously as living, breathing entities".

- Kurokawa, Kisho on Symbiosis
Architect and Co-Founder of Metabolists Group

Conclusion

During the making of this thesis, there were a number of interesting discoveries made, directly related or not, which could have been developed into further areas of research - some into theses of their own.

For instance, though the main purpose of this thesis was to explore the issue of connectivity via public space, it soon became a personal attempt at trying to re-challenge the dogma that architecture has forever existed as the product of an architect or group of architects, grounded on its own separate site and with its own envelope. To say that there can be no 'shared' architecture due to the physical and economic boundaries imposed by form and a sense of ownership both from the designers' and developers' standpoints is limiting. That architecture and more specifically skyscrapers must exist as separate entities is a limiting preconception that has been ingrained in architects for centuries. The Archigram and the Metabolist groups, were amongst the first to challenge these ideas, proposing plug-in or symbiotic architectures that were meant to function and grow together.

Unfortunately, in both their cases - there were no existing conditions from which to design yet and so proposals for entire cities had to be put forth, none of which were possible to carry out - largely for reasons of practicality.

More recently, with OMA's CCTV building, REX's Museum Plaza, and competition entries such as those proposed by the team of Mier, Eisenman, Siegel and Holl for the WTC competition, we can begin to witness a fresh challenge to the preconceptions of the high-rise typology. Yet it remains that every building is its own icon in competition with the others adjacent - just as are its architects.

Thus the proposal came in two parts, one architectural and the other urban. The architectural part was the main focus of this thesis and ap-

peared in the form of three hypothetical/generic towers with five stories difference between each of them. These were to be connected at their upper-most levels and making use of a network-ed three dimensional diagrid as their structural system. The advantages of the scheme are advanced mechanical, increased sky surface, connectivity, light penetration through the structure and safety assurance through means of egress.

The urban proposal emerged from the architectural, as a means of connecting one architectural prototype to another via an air-way system - in an intended plug-in fashion. The intention was that this would in turn, eventually promote other future (or existing) towers to unite in a similar fashion eventually connecting entire cities above ground.

In achieving these architectural (physical) goals, the hope is that the city would in turn, stand united, connected and dynamically active and that its people would take care of the rest (its social issues).

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