OPPORTUNISTIC INFRASTRUCTURE: THE TRANS-MANHATTAN EXPRESSWAY

by

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Submitted to the Department of Architecture
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ABSTRACT

Urban Infrastructure: bridges, expressways, and on and off ramps often create barriers and uninhabitable spaces within the urban context. This phenomenon is evident in northern Manhattan where the Trans-Manhattan Expressway has imposed profound divisions within the dense urban community of Washington Heights.

Supporting a population of over one-hundred thousand, in 0.7 square miles, Washington Heights is one of the densest residential communities in Manhattan. Within this dense community no identifiable civic centers exist. However, the convergence of infrastructure and urbanism has the potential to synthesis new opportunities. This contemporary paradigm morphs existing infrastructure with new user-friendly architectural systems. This hybridization can alleviate the current asphyxiation associated with urban infrastructure, while transforming infrastructure to serve as a catalyst for urban life.

This thesis seeks to readapt the Trans-Manhattan Expressway for public use through two strategic interventions. The first seeks to reclaim the colossal George Washington Bridge Bus Terminal from impervious infrastructure to central civic icon. The second transforms a series of urban impediments which produce excess noise and pollution, into a public plaza. While these two projects address the independent conditions of each site, together they simultaneously transform a desolate lineage of urban infrastructure into the central civic icon of Washington Heights.

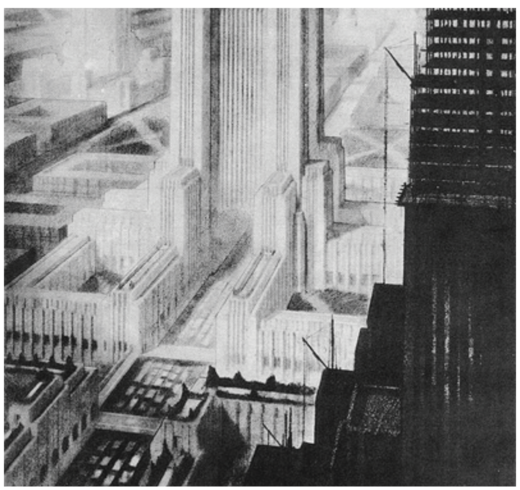
Thesis Supervisor: Nader Tehrani
Title: Professor of Architecture

OPPORTUNISTIC INFRASTRUCTURE:

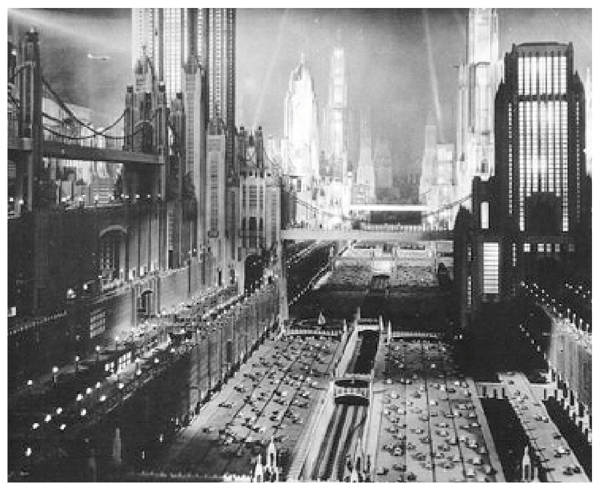
THE TRANS-MANHATTAN EXPRESSWAY

20TH CENTURY INFRASTRUCTURE

RAYMOND HOOD: 1950s MANHATTAN



HUGH FERRISS



JUST IMAGINE

1920s -1930s

THE METROPOLIS OF TOMORROW

THE METROPOLIS OF TOMORROW

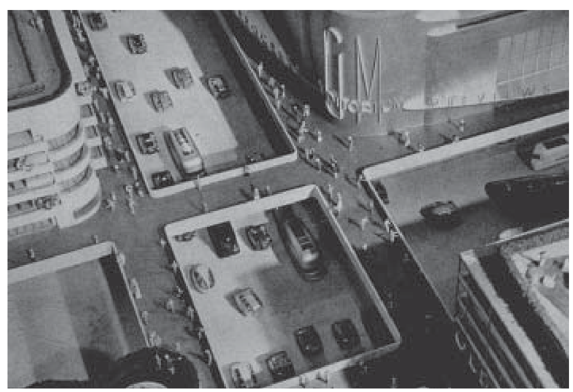
The technological advancements of the automobile in the twentieth century led artists and architects to conceptualize the future of the post-industrial landscape. The romantic illustrations of Hugh Ferriss, Raymond Hood, and GM's Futurama became the contemporary visions of an urban metropolis. These visionaries synthesized transportation systems seamlessly within the metropolis.

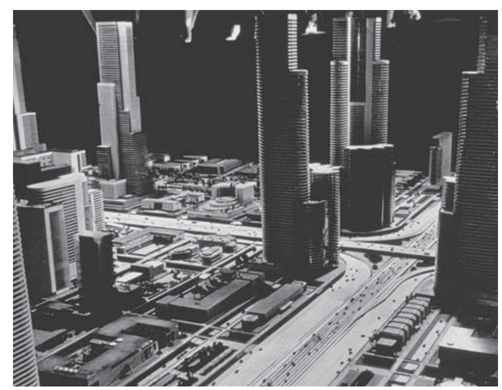
Directly embedded within these visions was the intertwining of both infrastructure and program. For example in Raymond Hood's *1929 proposal for a 1950s Manhattan,* Hood joined Brooklyn and New Jersey to Manhattan by a network of skyscraper bridges that housed people on the water, effectively eroding the boundaries between the island and its neighbors across the river. Hugh Ferriss's *Metropolis of Tomorrow* envisions the future city as one where "One can drive at will across the facades of buildings at the fifth, tenth, fifteenth, or twentieth story." [1]

These ideas influenced the culture of the early 20th century. Films including *Just Imagine and Things to Come,* conceptualized the future of the metropolis possessing a striking resemblance to the drawings of Hugh Ferriss.   *Just Imagine* envisions the city of New York in fifty years, while *Things to Come,* envisions the city of London in 2036.

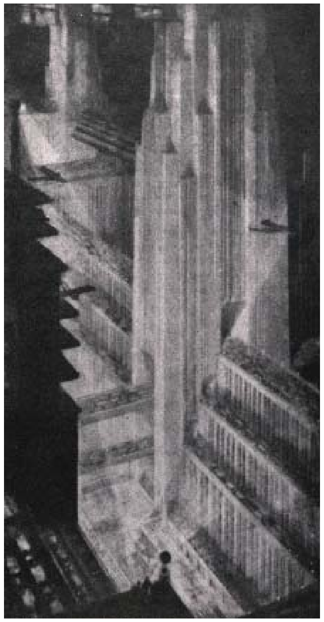
While most of these illustrations did in fact become reality, they did not create the utopian ideal that the master minds had originally anticipated. Instead these systems sliced the urban realm into pieces, inhibiting growth and connectivity, while reducing adjacent property values.

1 Ferriss, Hugh. *The Metropolis of Tomorrow.*

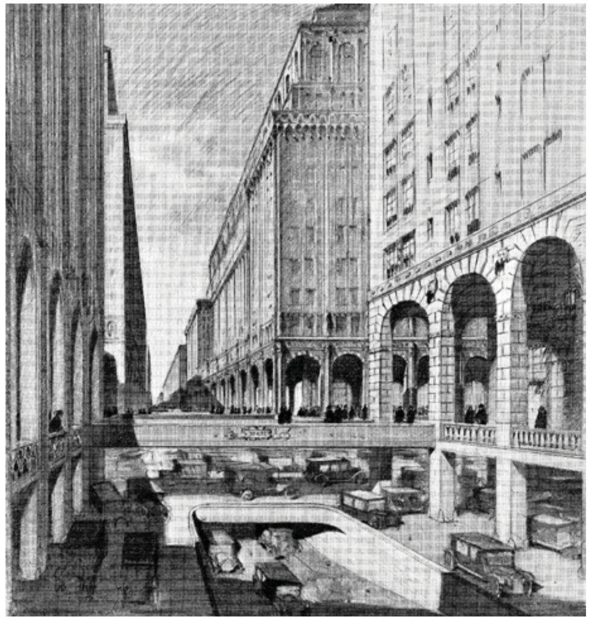




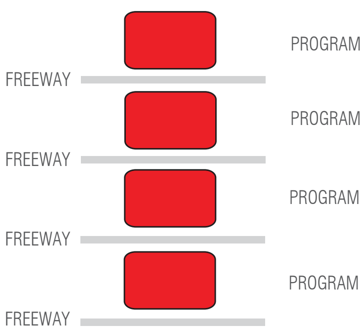
GENERAL MOTOR'S FUTURAMA EXHIBIT

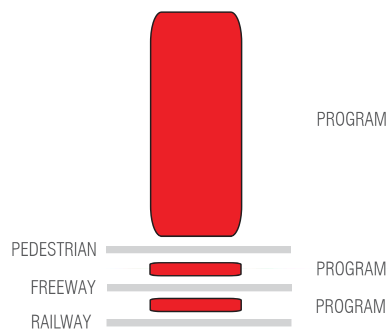


HUGH FERRIS:
OVERHEAD TRAFFIC WAYS



HUGH FERRIS:
PEDESTRIAN OVER WHEEL TRAFFIC





INFRASTRUCTURE/PROGRAM SECTIONAL BREAKDOWN

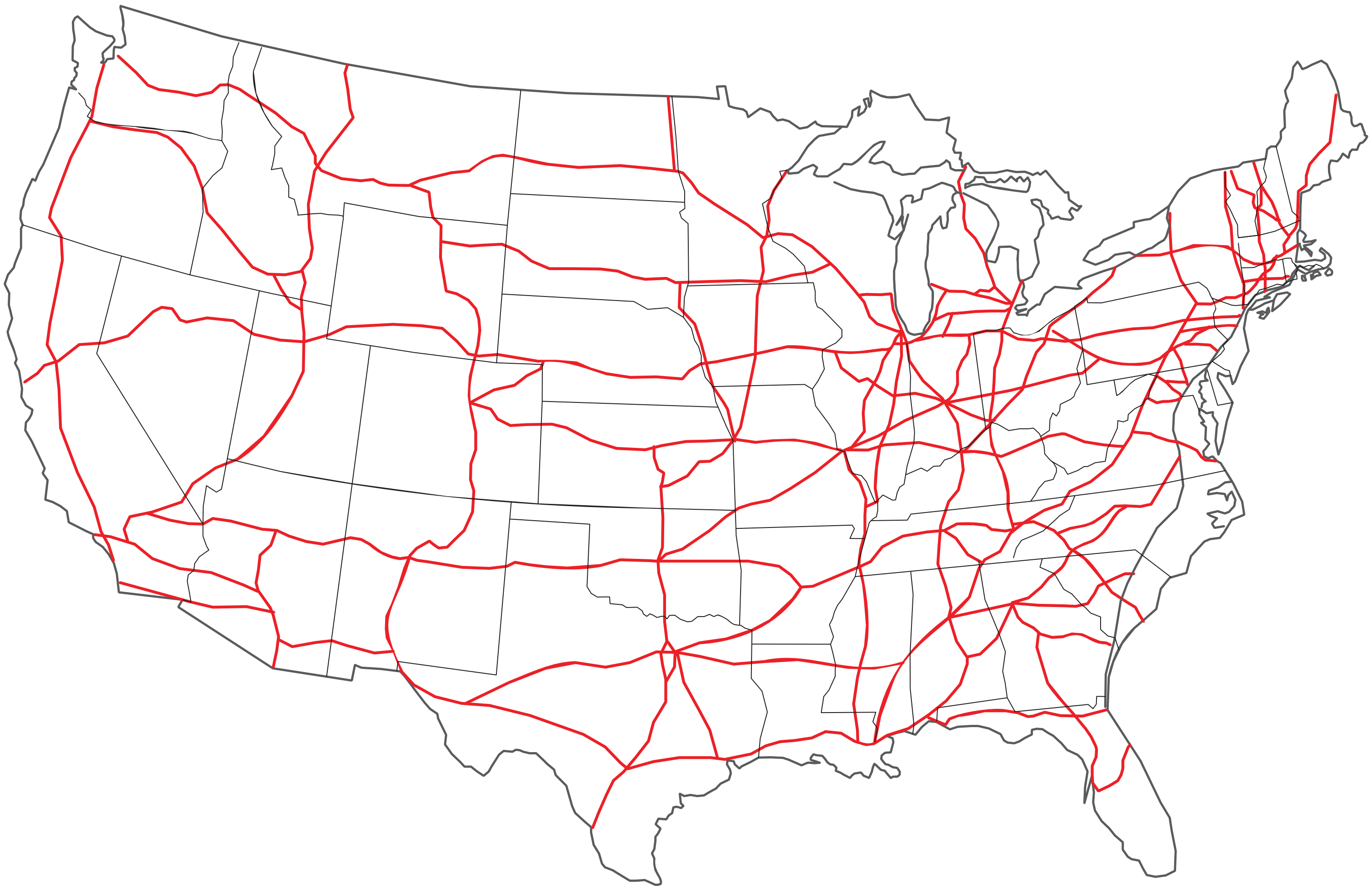
"The only adequete solution (to the growth of cities) lies in the realm of the third dimension...placing all pedestrians on a separate plane above that of the wheel traffic, and layering all rail traffic below on a separate plan." HUGH FERRISS

The introduction of transportation infrastructure within the city generated a series of layers. This augmentation of the urban plane produced a dynamic density within the city. Artists and architects saw potential in these conditions and sought to exploit these opportunities. Hugh Ferriss's *Overhead Traffic Ways* and *Pedestrian Over Wheel Traffic* illustrates,"The only adequate solution (to the growth of cities) lies in the realm of the third dimension...placing all pedestrians on a separate plane above that of the wheel traffic, and layering all rail traffic below on a separate plan." [2]

In *Overhead Traffic Ways* the infrastructure bisects the vertical program at all levels, whereas in *Pedestrian Over Traffic* the infrastructure is limited to the ground plane. This multiplication of the urban level, mixing program and transportation infrastructure, has always been a goal of the metropolis. This multiplication did actually take place, but with greater difference than architects had envisioned, for example a highway here, a local road there, and a public level there.

The augmentation of the urban plane was never thoughtfully planned or executed. Rather highways cleared large swaths of existing urban fabric by introducing foreign infrastructural systems into the landscape, resulting in desolate urban communities.

2 Ferriss, Hugh. *The Metropolis of Tomorrow.*



1940s -1950s

FEDERAL-AID HIGHWAY ACT OF 1956

FEDERAL-AID HIGHWAY ACT OF 1956

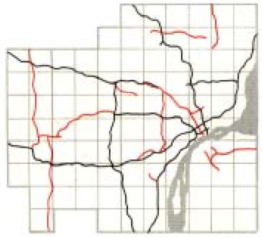
Following World War II, the Federal-Aid Highway Act of 1956, also known as the National Interstate and Defense Highways Act, was enacted on June 29, 1956, when Dwight D. Eisenhower signed this bill into law. Appropriating $25 billion for the construction of 41,000 miles of interstate highways over a 20-year period, it was the largest public works project in American history. These vehicular highways were symbolic to the social and economic progress of deteriorating cities. Highways were viewed as both a necessity and a sign of progress. They aimed at expanding mobility, promoting economic development, and helping to revitalize inner-urban areas.

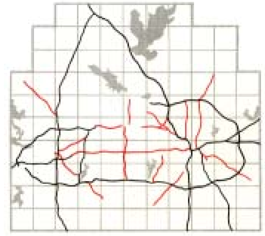
However, many of the proposed routes were drawn without considering local interest; and in many cases the construction of the highway system was considered a national issue which trumped local concerns. Highways were designed without regard to the fact that they divided neighborhoods and created physical barriers, while simultaneously exposing residents to negative living conditions.

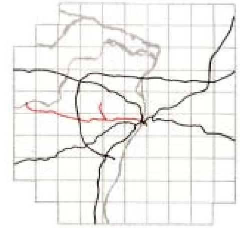
As a result of the Federal-Aid Highway Act, the nation became splintered, as 41,000 miles of highway infrastructure was introduced into the United States. This growth continues today as 4,000,000 miles of vehicular infrastructure exists in the United States, topping all other forms of transportation infrastructure.

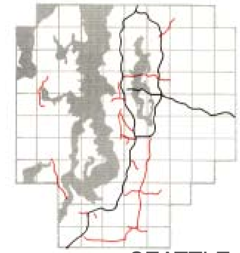
UNITED STATES INFRASTRUCTURE (2008) MILLIONS OF MILES

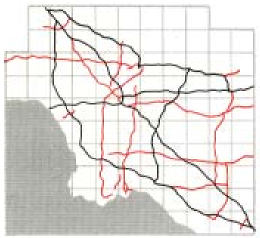

NEW YORK


DETROIT

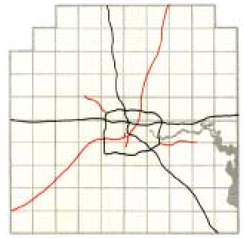

DALLAS

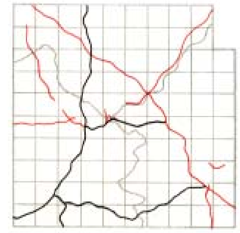

ST. LOUIS


SEATTLE


LOS ANGELES


SAN FRANCISCO


HOUSTON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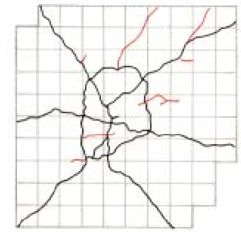
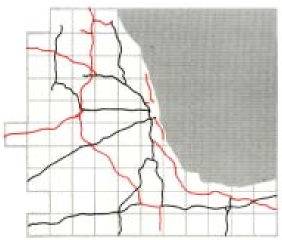
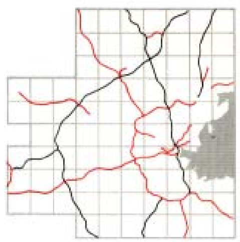
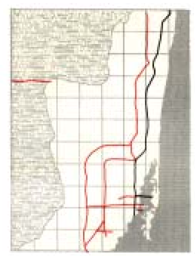
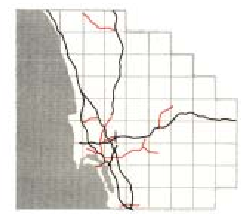

ATLANTA

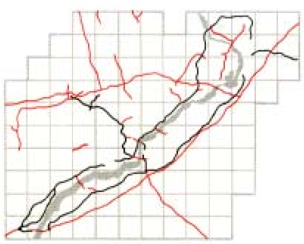

CHICAGO


BOSTON


MIAMI


BALTIMORE


SAN DIEGO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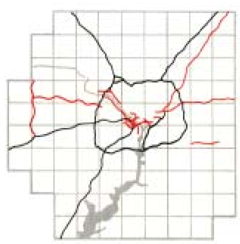
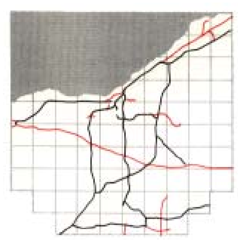
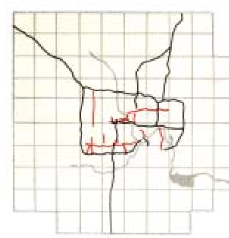
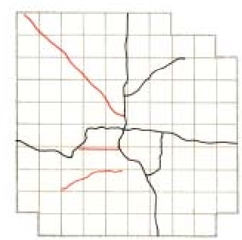

WASHINGTON DC


CLEVELAND


MINNEAPOLIS


DENVER

1960s -1970s

THE REVOLT

THE REVOLT

The Federal-Aid Highway Act of 1956 introduced urban highways into every major US city across the country. When policy makers and highway engineers determined that the new interstate system should penetrate the heart of the cities, they made a purposeful decision. In many cases highway infrastructure was rammed through existing communities, forcing residents out of their properties. In retrospect, it seems apparent that public officials and policy makers, especially at the state and local levels, used expressway construction to destroy lower-income, racial biased neighborhoods, in order to reshape the physical landscape of the postwar American city.

As the negative consequences to urban expressways became more apparent people fought back, calling for an end to construction. The revolts of the 1960s and 1970s, were a phenomenon in which planned highway construction in many US cities was halted due to widespread opposition. The revolts were further enhanced by rising fuel costs and the energy crisis.

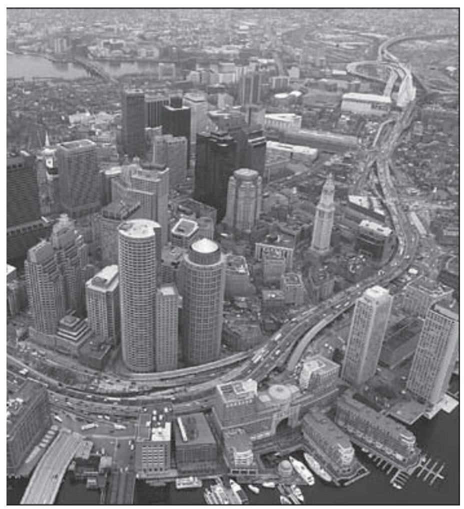
The first revolt was in San Francisco in 1959, where the Board of Supervisors voted to cancel seven of the city's ten planned expressways, after 30,000 citizens presented a petition to the city. These revolts spread throughout the 1960s and 1970s, public sentiment shifted against highway construction. In 1970 responding to massive anti-highway protests in Boston, governor Francis Sargent halted construction of all planned expressways inside the Route 128 loop, with the exception of the remaining segments of the Central Artery. By the end of the 1970s, it was impossible to build a new expressway through an American city.

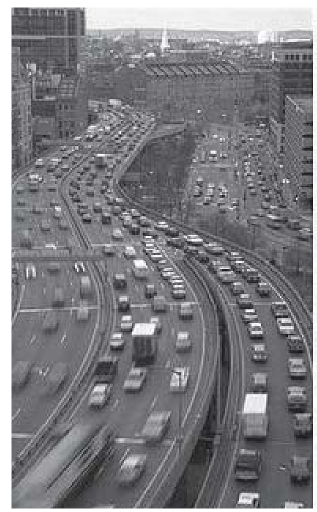
PROPAGANDA AND DEMONSTRATIONS OPPOSING EXPRESSWAYS

BEFORE

AFTER

EMBARCADERO EXPRESSWAY | SAN FRANCISCO, CALIFORNIA





BEFORE

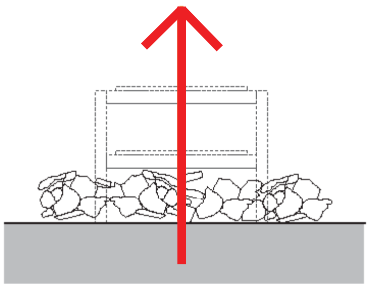
AFTER

CENTRAL ARTERY | BOSTON, MASSACHUSETTS

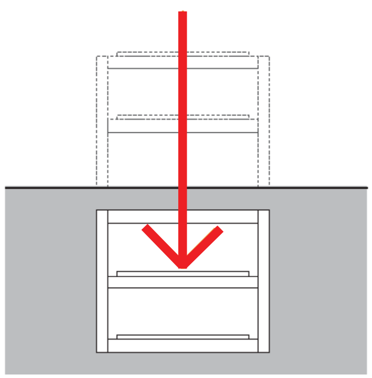
1980s - 2000s

UNDOING THE DAMAGE

RAZE IT



SINK IT



UNDOING THE DAMAGE

Although the initial goal of the transportation infrastructure was to promote connectivity, it instead splintered cities, slicing districts and neighborhoods while prohibiting connectivity. Today, cities either accept this suffocation, remove it, or bury it below grade. In an effort to undo the damage caused by urban expressways, some cities have gone to great lengths to correct the problems caused by their urban expressways.

The Embarcadero Freeway in San Francisco, CA, also known as the Embarcadero Skyway consisted of an elevated double-decker, the partly-elevated Doyle Drive approach to the Golden Gate Bridge, and the proposed and unbuilt section in between. The Embarcadero Freeway was demolished after the 1989 Loma Prieta earthquake and is now part of the U.S. Route 101 boulevard. Today the boulevard carries existing traffic from the freeway, eliminating the need for the existing elevated double-decker. The removal of this elevated expressway reconnected the urban fabric of San Francisco with the waterfront and today the land exists as a dynamic urban environment.

The central artery in Boston was a 3.5 mile elevated expressway constructed in the 1950s through the center of Boston. Large swaths of urban fabric were removed in order to make way for the elevated expressway. Planners circled blocks of fabric on aerial photographs to demarcate the buildings to be removed in preparation for the expressway

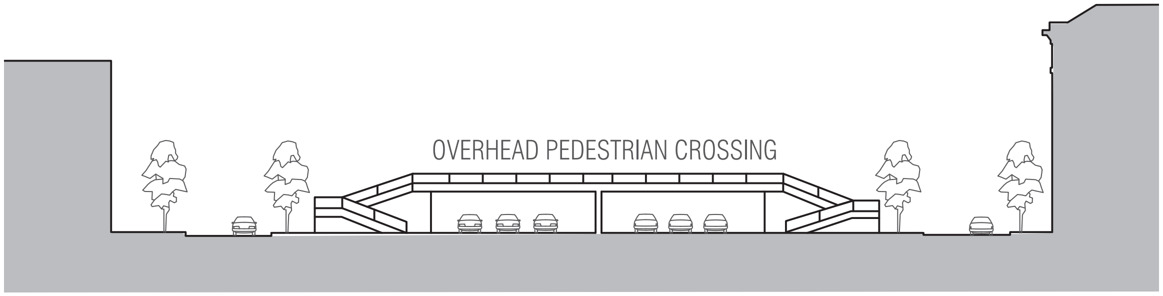
.

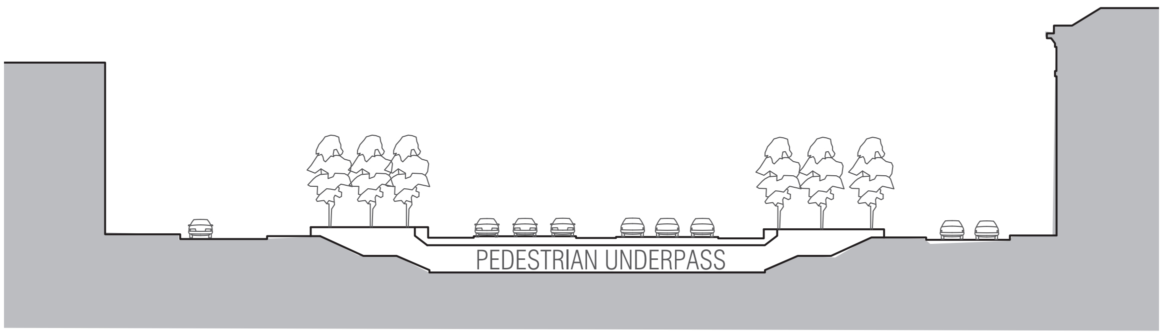
In the 1970s in response to its constant backlog and its negative urban attributes, the expressway became part of a controversial project to bury it below grade. The Central Artery/Tunnel Project or Big Dig rerouted the expressway into a 3.5 mile tunnel under the city. The project also replaced the space vacated by I-93 with the Rose Kennedy Greenway.

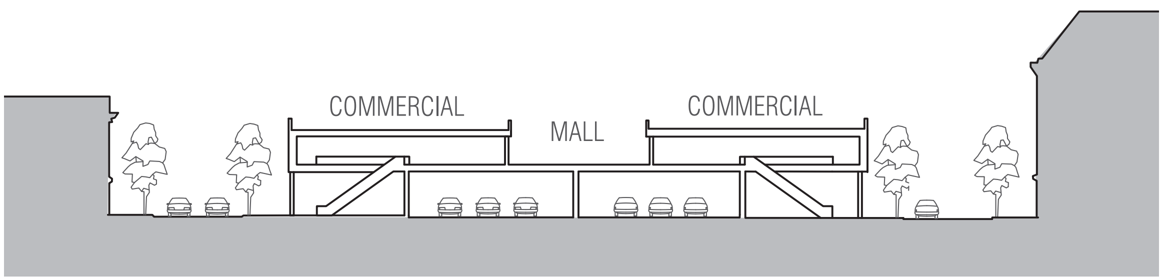
Today, the Rose Kennedy Greenway creates dead open space between Boston's North End and center city Boston. When the infrastructure was above grade, it linked Boston with the North End, although providing an awful adjacency, when it was removed, it introduced a linear void within the urban fabric.

The Big Dig was an important marker in the history of dealing with expressway infrastructure. Due to the insurmountable expense and challenges associated with the Big Dig, it is unlikely that future cities will embark on such a task. Today cities long for a new paradigm to deal with the discontinuities associated with expressways in the urban realm.

EXISTING METHODS FOR READAPTING INFRASTRUCTURE







HIGHWAY AT GRADE

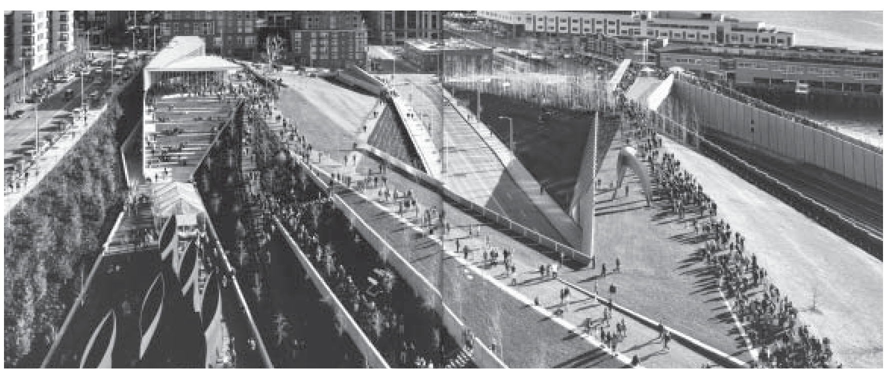
TYPICAL PEDESTRIAN BRIDGE
NEW YORK, NEW YORK

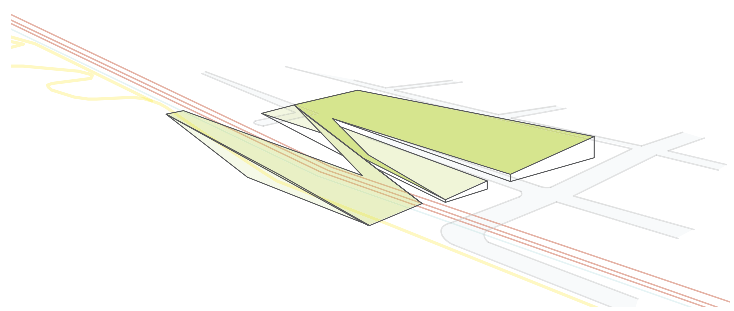
PRUDENTIAL CENTER
BOSTON, MASSACHUSETTS

EXISTING METHODS FOR READAPTING INFRASTRUCTURE

Existing adaptations of highway corridors both vertically and horizontally can be seen in many existing precedents in the United States. Directly embedded in these ideas is the theory that the highway would be no longer be an intruder, but become a welcomed component of the city structure, as much a part of its architecture as a fine building.

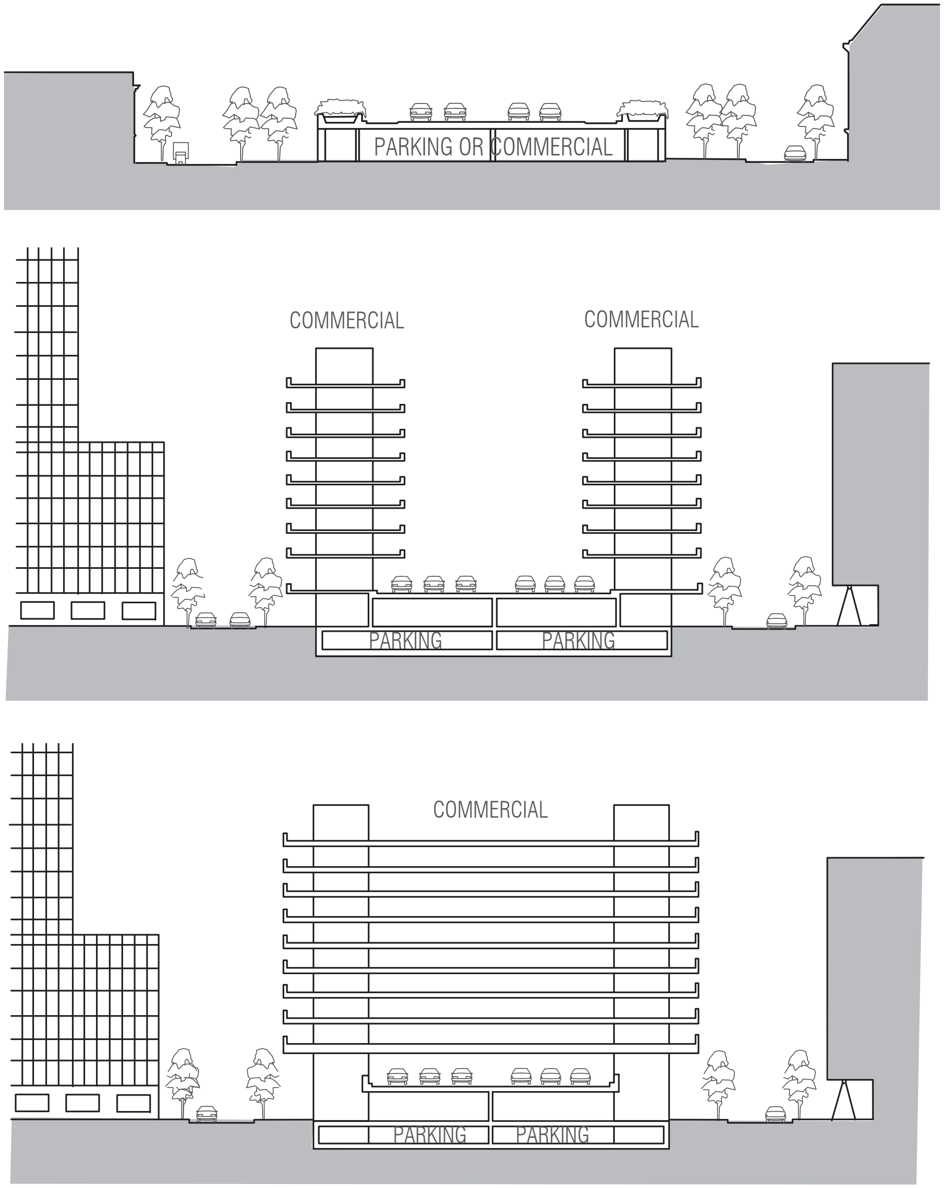
Today, certain typological models exist for reimaging communal spaces above, below, as well as adjacent to the highway. Many of these models rely on concealing the highway from its surrounding context. While these models are not seamless, they serve as a framework to lead to further developments. The challenge for today is to leverage the current opportunities of the highway and its adjacencies in order to reintegrate infrastructure seamlessly with its surrounding environment.





HYBRID

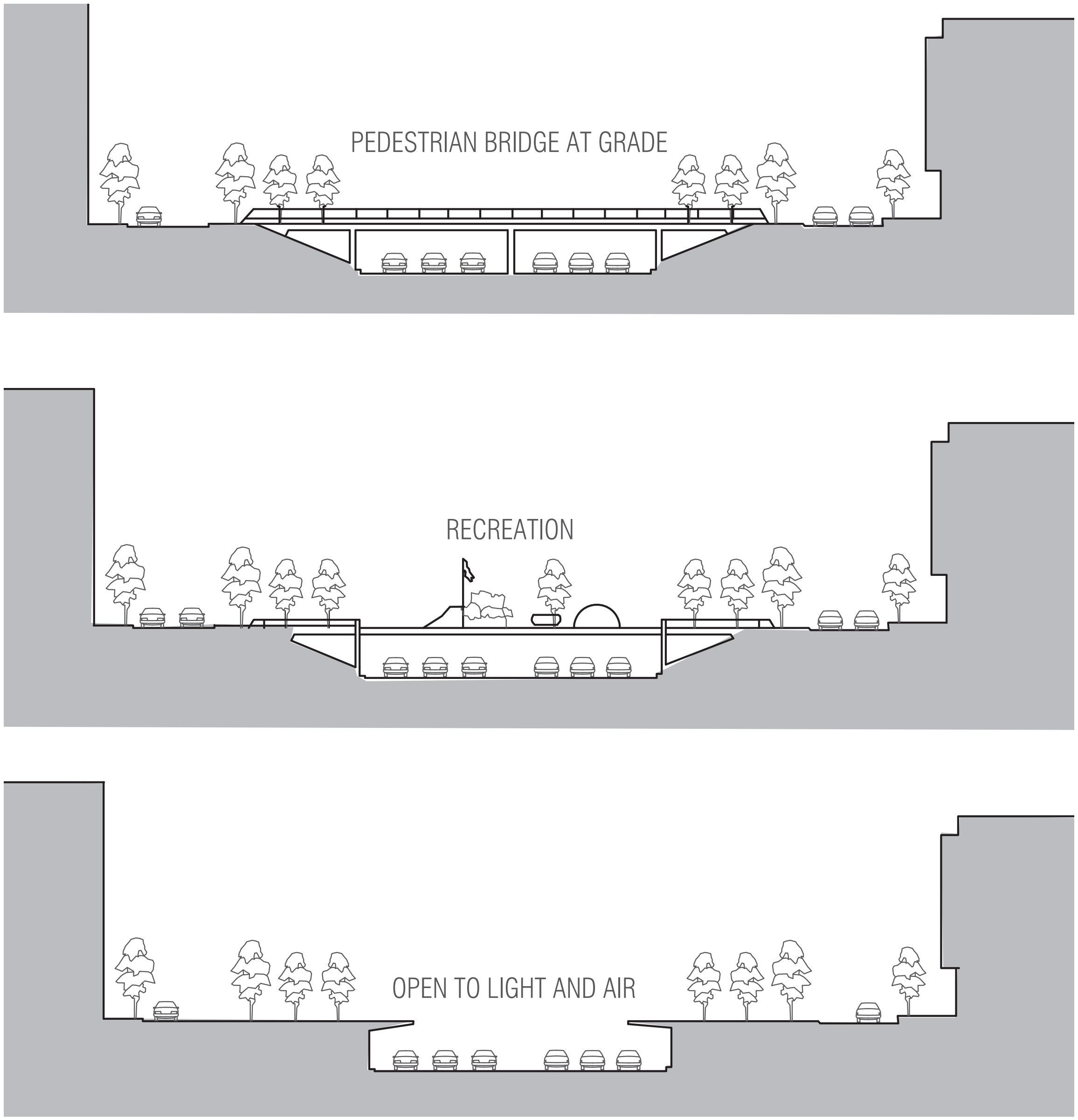
WEISS|MANFREDI'S OLYMPIC SCULPTURE PARK SEATTLE, WASHINGTON



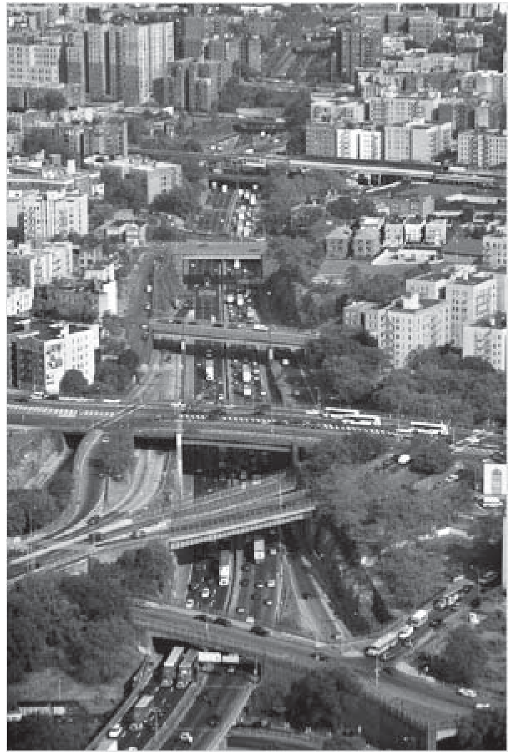
ELEVATED HIGHWAY

COMMERCIAL UNDER WESTWAY
NOTTING HILL, UNITED KINGDOM

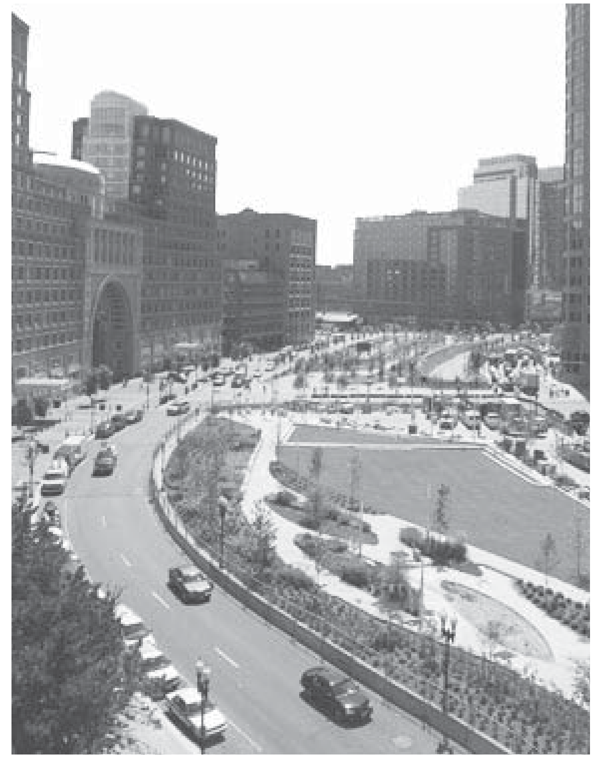
GATE TOWER BUILDING
OSAKA , JAPAN



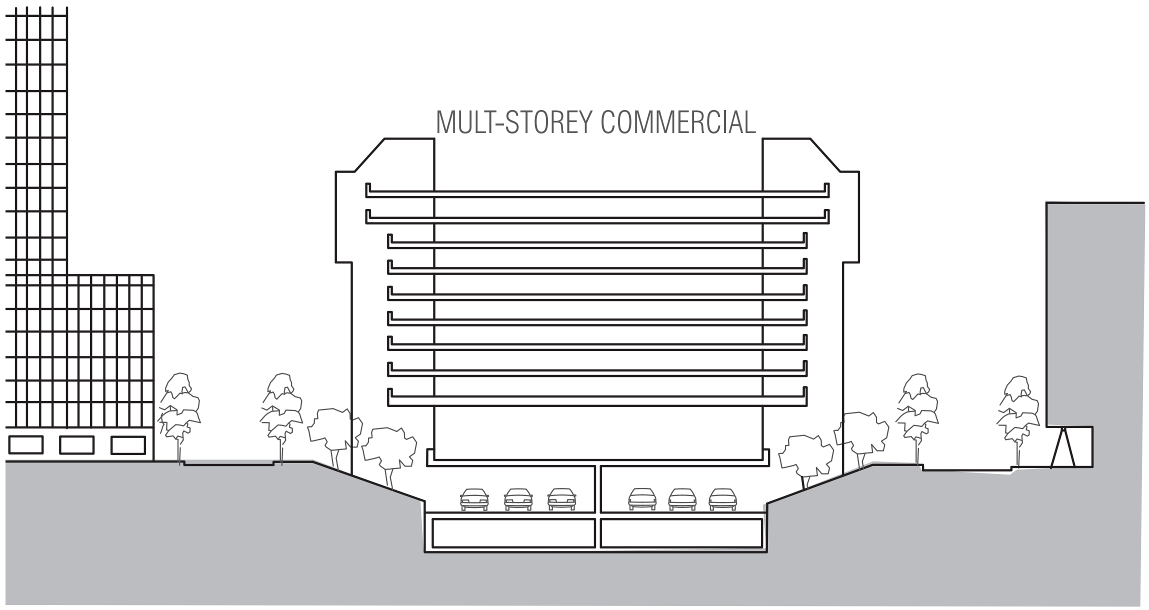
HIGHWAY BELOW GRADE

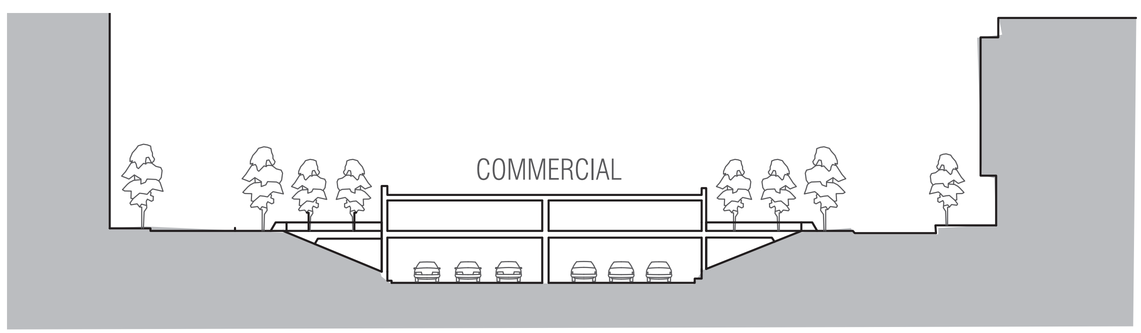


CROSS BRONX EXPRESSWAY
BRONX, NEW YORK



ROSE KENNEDY GREENWAY
BOSTON, MASSACHUSETTS





HIGHWAY BELOW GRADE

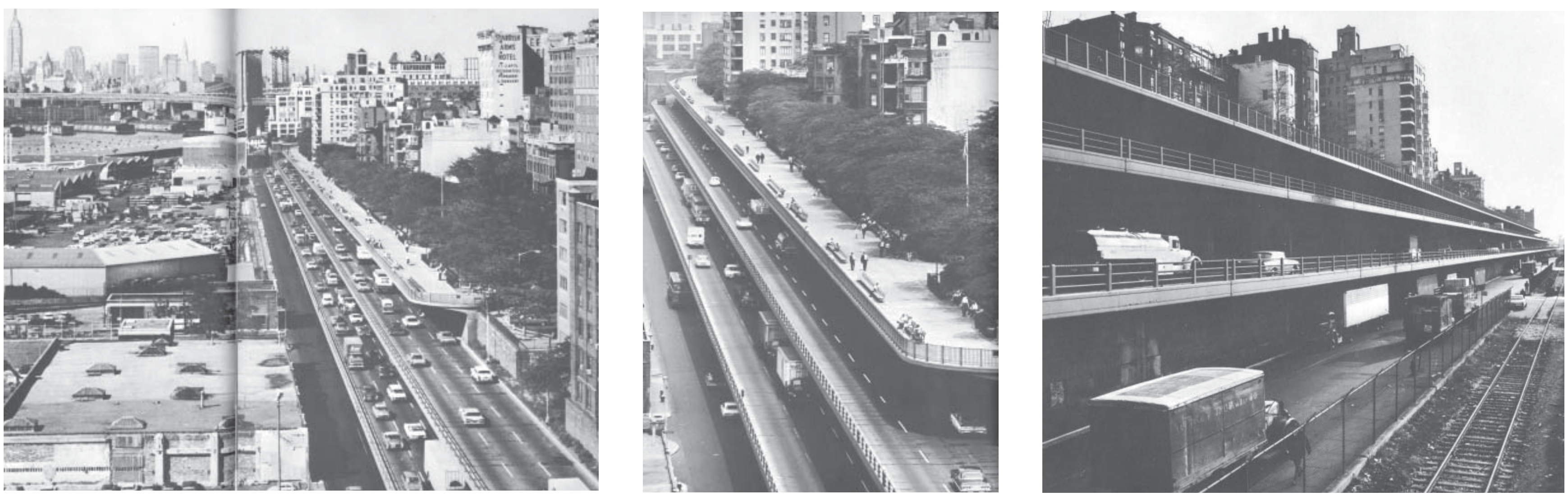
GEORGE WASHINGTON BRIDGE BUS TERMINAL
WASHINGTON HEIGHTS, NEW YORK

WASHINGTON APARTMENTS
WASHINGTON HEIGHTS, NEW YORK

DECKED HIGHWAY

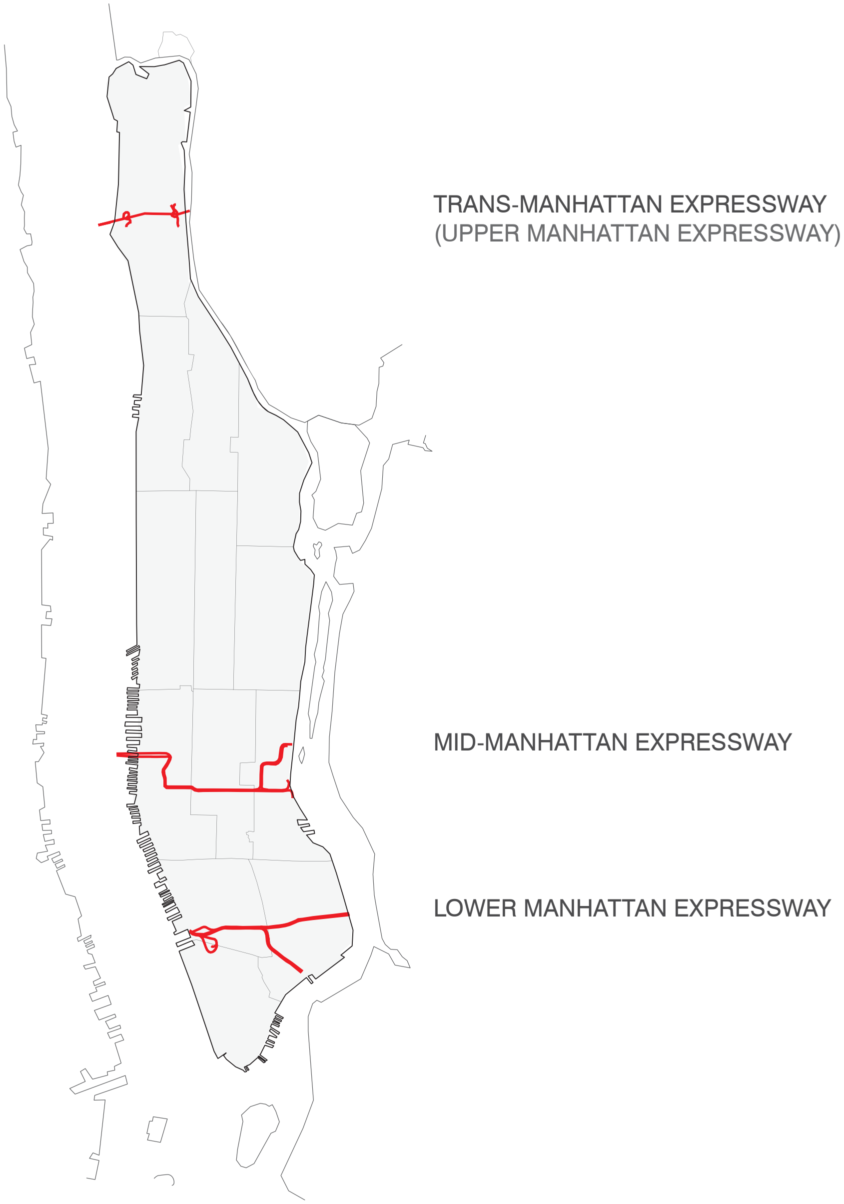
TERRACED HIGHWAY

FDR DRIVE, NEW YORK



BROOKLYN-QUEENS EXPRESSWAY, NEW YORK

MANHATTAN AS A MODEL FOR AMERICAN CITIES



ROBERT MOSES "THE POWER BROKER"

One of the most powerful people in the state of New York from the 1930s until the late 1960s was Robert Moses. He built bridges, expressways, housing projects, and roadways while changing shorelines. Robert Moses was a major influence in the shaping of the American city, because his works in New York became models for the entire nation. His vision of a city of highways and towers, influenced the planning of cities throughout the United States. Moses vision for New York was less one of neighborhoods and brownstones than one of soaring towers, open parks, highways, and beaches.

Robert Moses made New York known as the nation's first city for the automobile age. Under Moses, New York gained more highway miles than any other city in the United States, including Los Angeles. But where Los Angeles grew around its highways, Moses rammed the highways of New York through existing urban communities, altering the landscape dramatically. Moses destroyed neighborhoods, by forcing thirteen huge expressways across New York City. His work became a model for cities cross the United States with Boston, San Francisco, and Seattle all building expressways directly through their downtowns.

Three cross-town expressways were proposed by Moses for Manhattan. The lower, mid, and upper Manhattan expressways were believed to be necessary to the progress of Manhattan. In each case blocks of existing urban fabric were to be removed in order to make way for these concrete and asphalt lineages. The only of these to be constructed was the 0.9 mile Upper Manhattan Expressway or Trans-Manhattan Expressway, as it is known today.

THE LOWER MANHATTAN EXPRESSWAY

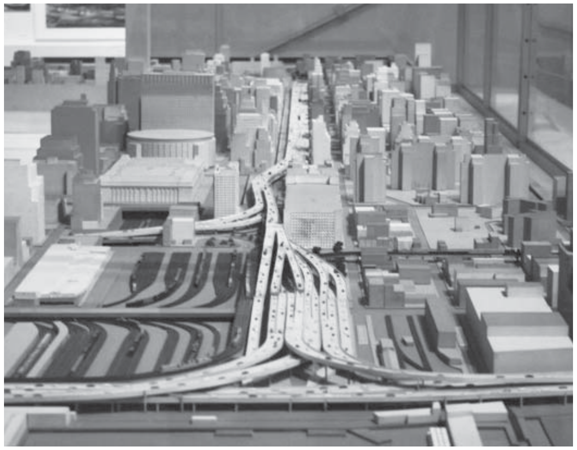
The Lower Manhattan Expressway was an expressway proposed by Robert Moses, which connected the Holland Tunnel on the west side to the Williamsburg and Manhattan Bridges on the east. The eight-lane elevated expressway was expected to handle 120,000 vehicles per day. The expressway proposed a 250 to 350 feet wide right-of-way, with a clearance of 50 to 60 feet between the edge of the expressway and the nearest buildings. Supports for the 1.5 mile long viaduct were to be widely spaced, while the underside of the structure accommodated a 48 foot wide roadway, 12 foot wide sidewalks on both sides, and a 1,400 car parking mall.

ROBERT MOSES

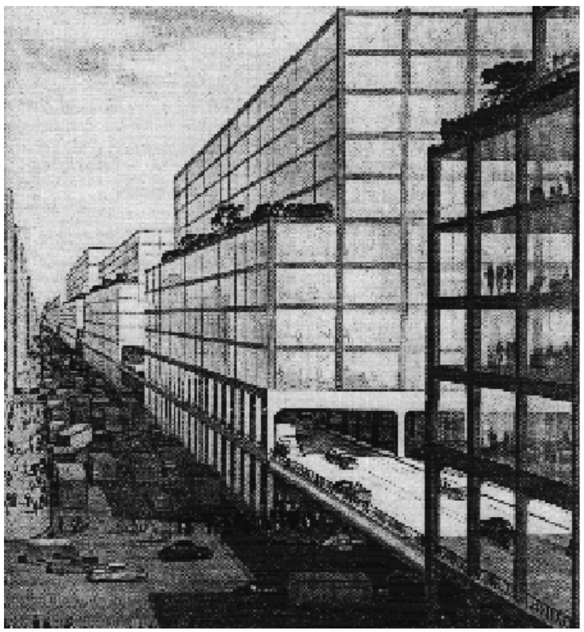
By 1961, Moses set into motion two federal initiatives that would have leveled fourteen blocks along Broome Street in SoHo. The expressway would condemed and destroyed many historic structures, displacing an estimated 2,800 families and 800 businesses. The contentious public hearings on the Lower Manhattan Expressway had grown more raucous by the 1960's.

Members of the affected communities, led by community activist Jane Jacobs, banded together to fight the Expressway. They held rallies, staged demonstrations and attended hearings to block the project. On December 11, 1962, during a six-hour-long session of the New York City Board of Estimate city officials voted unanimously against the planned expressway.

LOWER MANHATTAN EXPRESSWAY PROPOSAL



MID-MANHATTAN EXPRESSWAY



COMMERCIAL DEVELOPMENT WITHIN
MID-MANHATTAN EXPRESSWAY

THE MID-MANHATTAN EXPRESSWAY

The Mid-Manhattan Expressway was a six-lane elevated expressway proposed by Robert Moses that would have crossed Midtown Manhattan along 30th Street. The expressway was to connect the Lincoln Tunnel and West Side Highway with the Queens Midtown Tunnel and FDR Drive. The expressway was to be constructed within a 100-foot wide right-of-way. The viaduct would require substantial demolition of high-rise buildings within Midtown Manhattan.

One unique feature of the Mid-Manhattan Expressway was that it allowed for development above and beneath the expressway. The two three-lane roadways floated ten stories above street level and were separated by a median with elevators serving the development above the expressway. Beneath the expressway, space for commercial development and parking would have been provided. This was one of the earliest examples which readapted the elevated expressway for public use.
The proposal and imagery reflects strongly on Hugh Ferriss's 1920s and 1930s mega-structure visions for Manhattan.

THE TRANS-MANHATTAN EXPRESSWAY

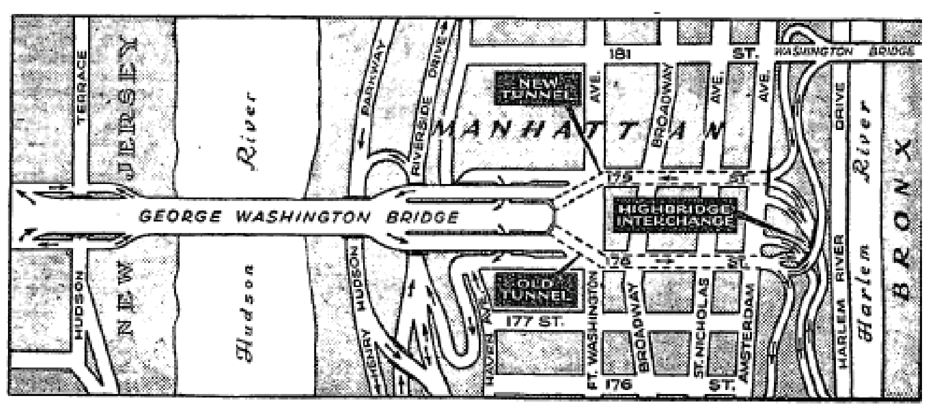
THE 178th AND 179th STREET TUNNELS:

Immediately following World War II, Robert Moses constructed a bypass, a predecessor to the Trans-Manhattan Expressway, through the Washington Heights section of upper Manhattan. The proposed bypass connected the George Washington Bridge with the Bronx using a pair of modest two-lane tunnels. Between 1938 and 1952, two two-lane tunnels were constructed beneath 178th street and 179th street. Eastbound traffic used the 178th Street Tunnel, while westbound tunnel used the 179th Street Tunnel.

AN EXPRESSWAY ACROSS NORTHERN MANHATTAN

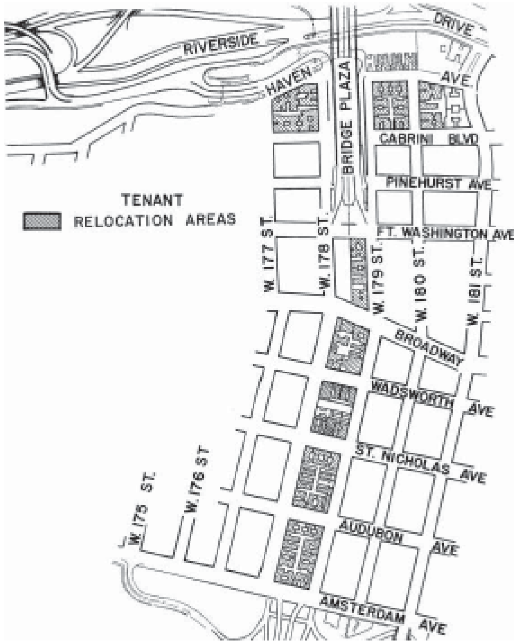
The construction of the Trans-Manhattan Expressway was undertaken in conjunction with the addition of the lower level of the George Washington Bridge. To augment the existing tunnels, Robert Moses proposed an open-cut east/west expressway across Manhattan Island that would connect the George Washington Bridge with the Cross Bronx Expressway. The City of New York approved the creation of the highway in June 1957 as part of a joint effort with the Port Authority of New York and New Jersey that also called for the creation of the lower deck on the George Washington Bridge and construction of the George Washington Bridge Bus Terminal above the cut for the expressway.

178TH STREET TUNNEL



178TH AND 179TH STREET TUNNEL ROUTES

TRANS-MANHATTAN EXPRESSWAY WITH GEORGE WASHINGTON BRIDGE BUS TERMINAL AND WASHINGTON APARTMENTS



TRANS-MANHATTAN EXPRESSWAY
RELOCATION AREAS

CONSTRUCTION

The existing ventilation buildings for the 178th and 179th street tunnels, which were along the right-of-way for the proposed expressway, were demolished to make way for expressway, leaving the existing tunnels obsolete. The tunnels were abandoned and today the original tunnels currently function as storage for the Port Authority of New York and New Jersey.

The 12-lane Trans-Manhattan Expressway occupies the entire block between 178th and 179th Streets. The construction resulted in the demolition of 76 buildings and the relocation of 1,818 families. The total construction cost was 60 million dollars of which 10 million was allocated for acquisitions.

The Trans-Manhattan Expressway opened to traffic in 1962 and today the 0.9 mile expressway, carries more than 250,000 vehicles per day. The expressway is the busiest in Manhattan and carries the most amount of commuters into Manhattan, carrying nearly double that of the Lincoln or Holland Tunnels.

The expressway is one of the few examples in New York City, and one of the earliest in the United States, where air rights over major highways were deployed. Upon completion of the expressway, the George Washington Bridge Bus Terminal and Washington Bridge Apartments opened above the expressway.

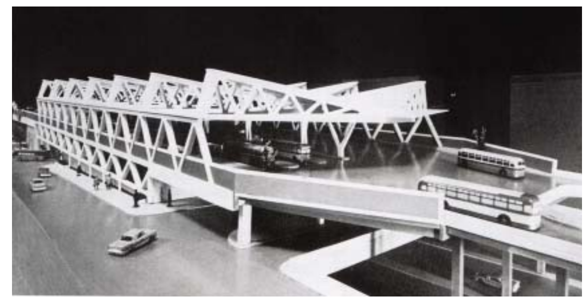
Robert Moses said the following at the completion of the George Washington Bridge lower level and the Trans-Manhattan Expressway:

"The depressed Trans-Manhattan Expressway connecting the George Washington Bridge and the Alexander Hamilton Bridge across the Harlem River will be fully opened to traffic with the completion of the Cross Bronx Expressway. This is the first expressway to be built across Manhattan, and we hope that the Lower Manhattan and Mid-Manhattan expressways, both of which have been the victims of inordinate and inexcusable delays caused by intemperate opposition and consequent official hesitation, will follow. These cross-town facilities are indispensable to be effectiveness of the entire metropolitan arterial objective of removing traffic through congested city streets." [3]

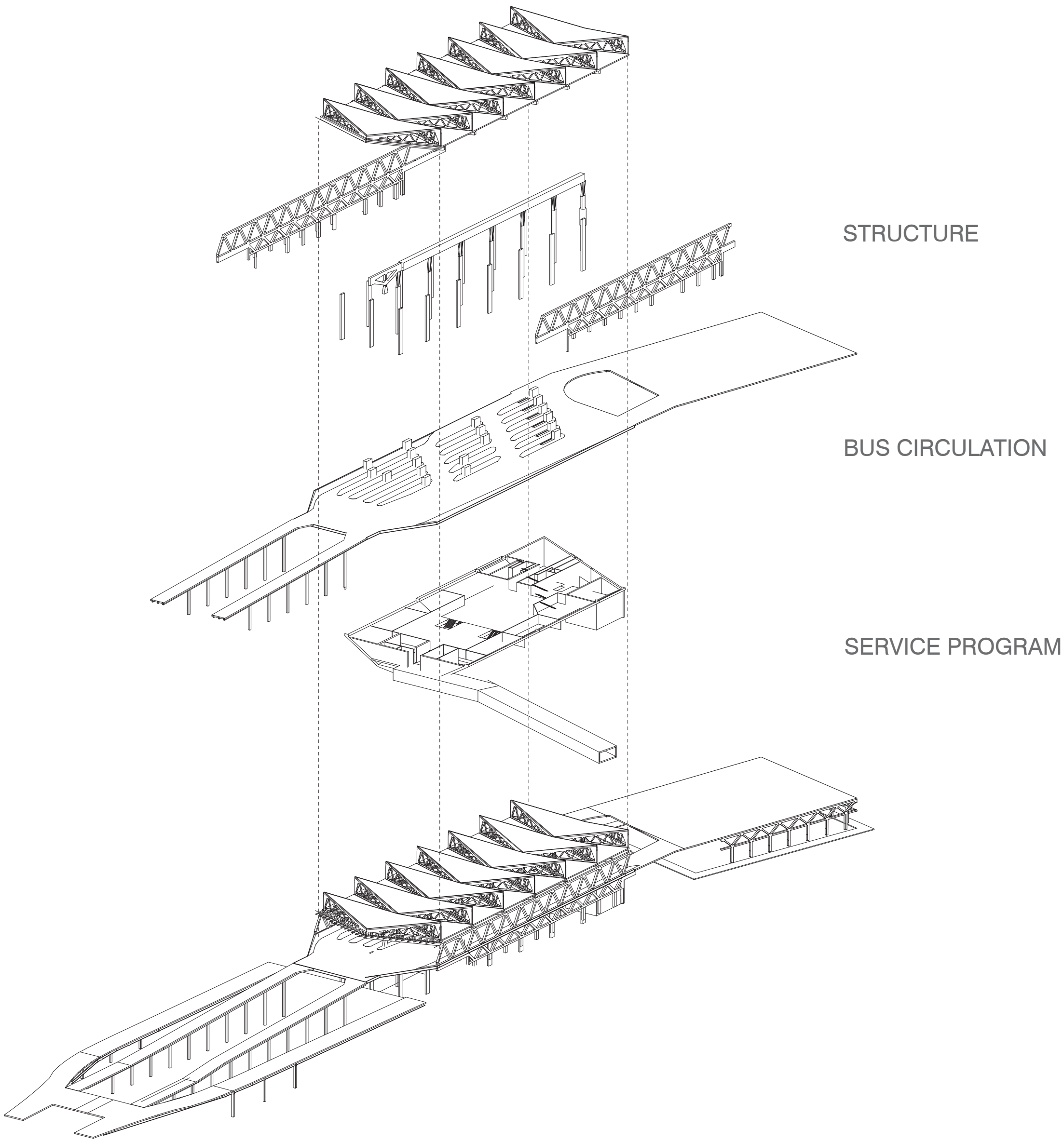
3 1955 Joint Study of Arterial Facilities

AIR-RIGHTS AND THE TRANS-MANHATTAN EXPRESSWAY

GEORGE WASHINGTON BRIDGE BUS TERMINAL



DESIGN MODELS



By the late 1950s a significant portion of Washington Heights was dilapidated or deteriorating. The Trans-Manhattan Expressway provided an opportunity to revitalize the urban area. The demolition for the expressway had already destroyed several of the softest areas of the neighborhood. In the earliest discussions of the project, the air rights above the expressway were viewed as a viable strategy to recuperate some of the taxes lost and levy the costs of re-housing the displaced residents.

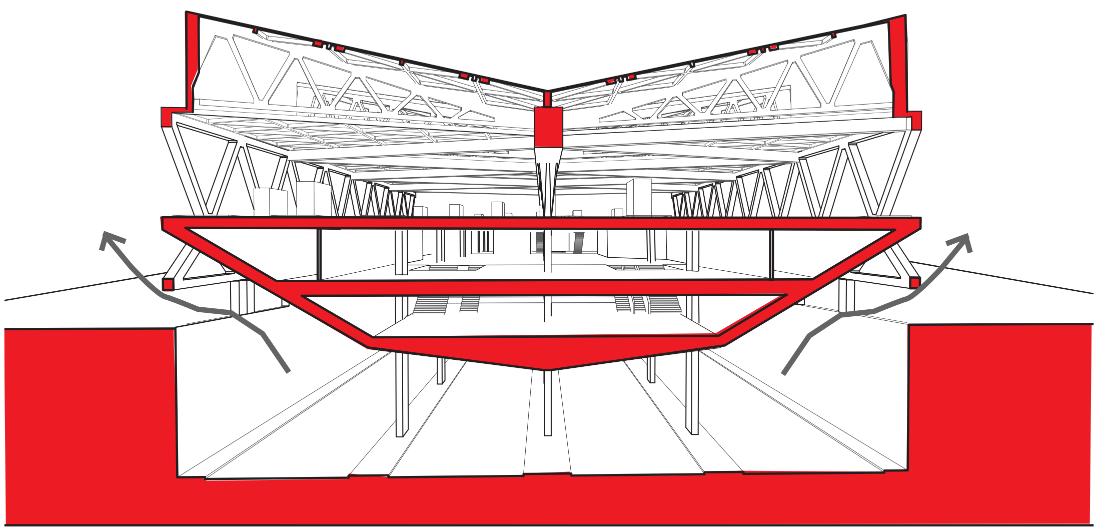
THE GEORGE WASHINGTON BRIDGE BUS TERMINAL

The George Washington Bridge Bus Terminal is Nervi's first American project. The project was commissioned by the Port Authority of New York and New Jersey. The terminal received the 1964 AIA Gold Medal, the most prestigious American architecture award.

The bus terminal contains three levels. The lowest connects to New York city's A subway line on the west, while opening onto Broadway Avenue on the east. The main level opens onto Fort Washington Avenue on the west while containing a concourse with ten retail and service shops. The upper level is primarily used for bus circulation. Two ramps transport buses directly from I-95 onto the bus level. At the eastern most edge is a parking deck which allows buses to turn around.

BUS TERMINAL WITH TRANS-MANHATTAN EXPRESSWAY BENEATH

VENTILATING FACADE

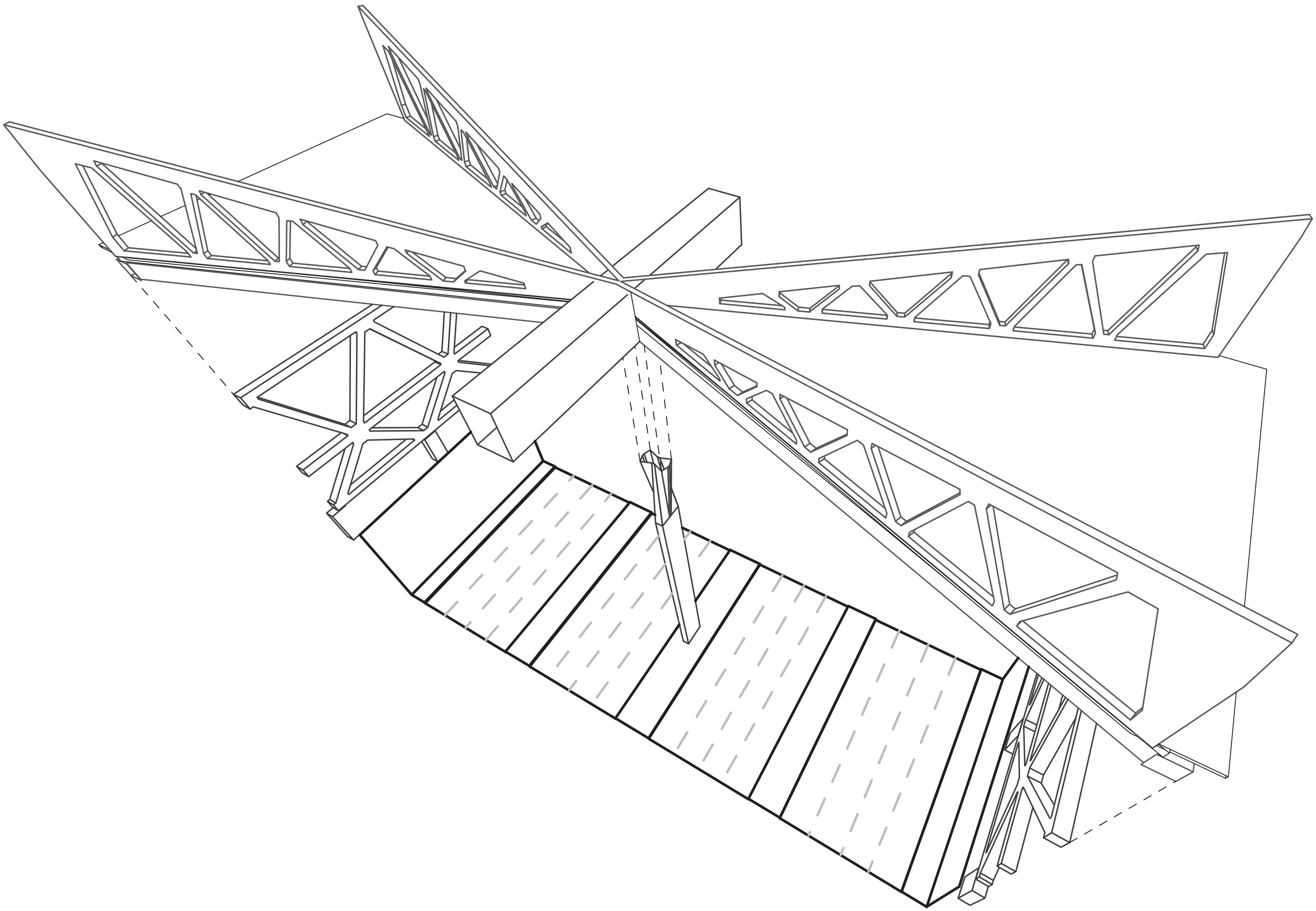


EXPRESSWAY VENTILATION

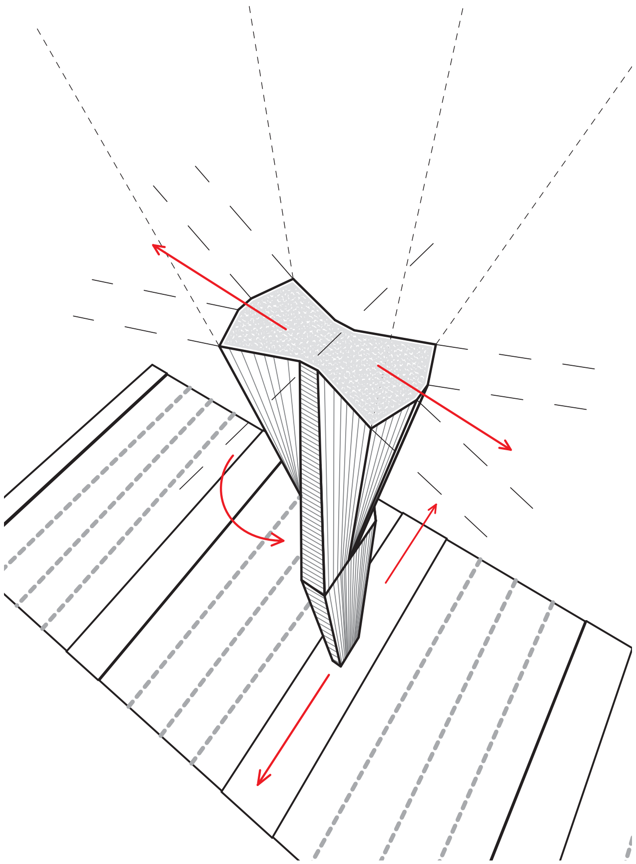
Unlike Nervi's other works in Italy which use light-weight ferrocement, the George Washington Bridge Bus Terminal uses ordinary cast-in-place reinforced concrete. The terminal is constructed of steel-reinforced concrete trusses, fourteen of which are cantilevered from supports in the median of the Trans-Manhattan Expressway. The columns transform as they rise, twisting to conform to the geometry of the butterfly roof.

In order to deal with ventilation of the Trans-Manhattan Expressway, Nervi invented a design strategy to ventilate the expressway. The section of the terminal slopes in order to permit light and air to the expressway below. These sloped surfaces allow the two triangular side trusses to ventilate the expressway onto 178th and 179th street. Although this was initially a novel idea, the catastrophic pollution associated with this idea is still evident today.

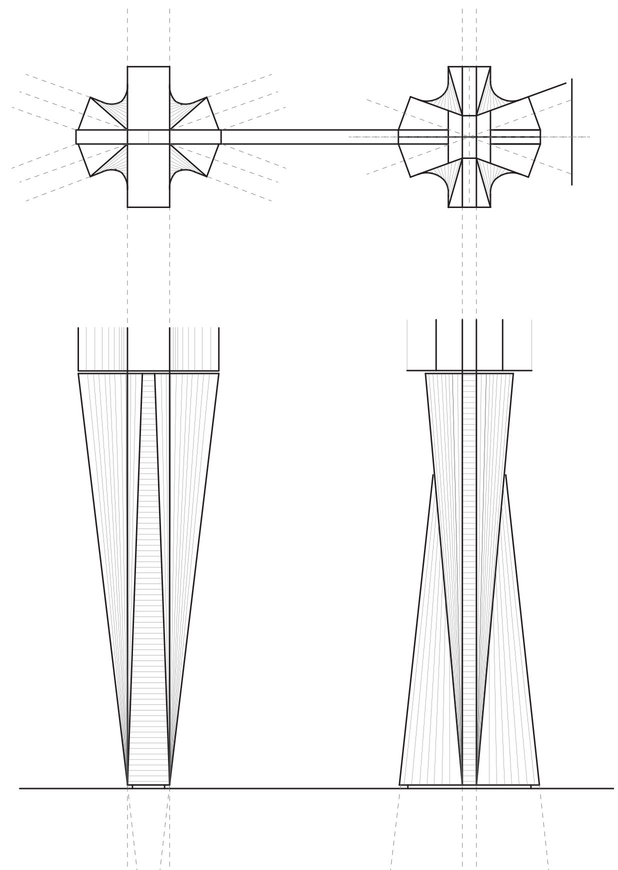
The building occupies one block, between 178th and 179th streets and Fort Washington and Broadway avenues. It is 187 feet wide and is divided into two bays, each 93 feet 6 inches wide. The structure, specifically the roof, is 460 feet long. The central row of columns, which carry the spine beam, are placed at approximately 65 feet 6 inch centers.



NERVI SUPPORT COLUMN WITH CANTILEVER ROOF



NERVI SUPPORT COLUMN



COLUMN PLAN AND ELEVATIONS

BUS TERMINAL AND WASHINGTON
APARTMENT CONSTRUCTION

ADVERTISEMENT - NEW YORK TIMES - SEPTEMBER 2 , 1962

WASHINGTON BRIDGE APARTMENTS

Planners believed that the construction of the Washington Bridge apartments would spur new private initiatives, either through new buildings or rehabilitation of existing housing. The apartments promised a new type of living experience, with 960 units cast aloft the expressway. The project was advertised as a symbol of middle class emergence, with its proximity to the expressway being advertised as a visual and functional 'amenity.'

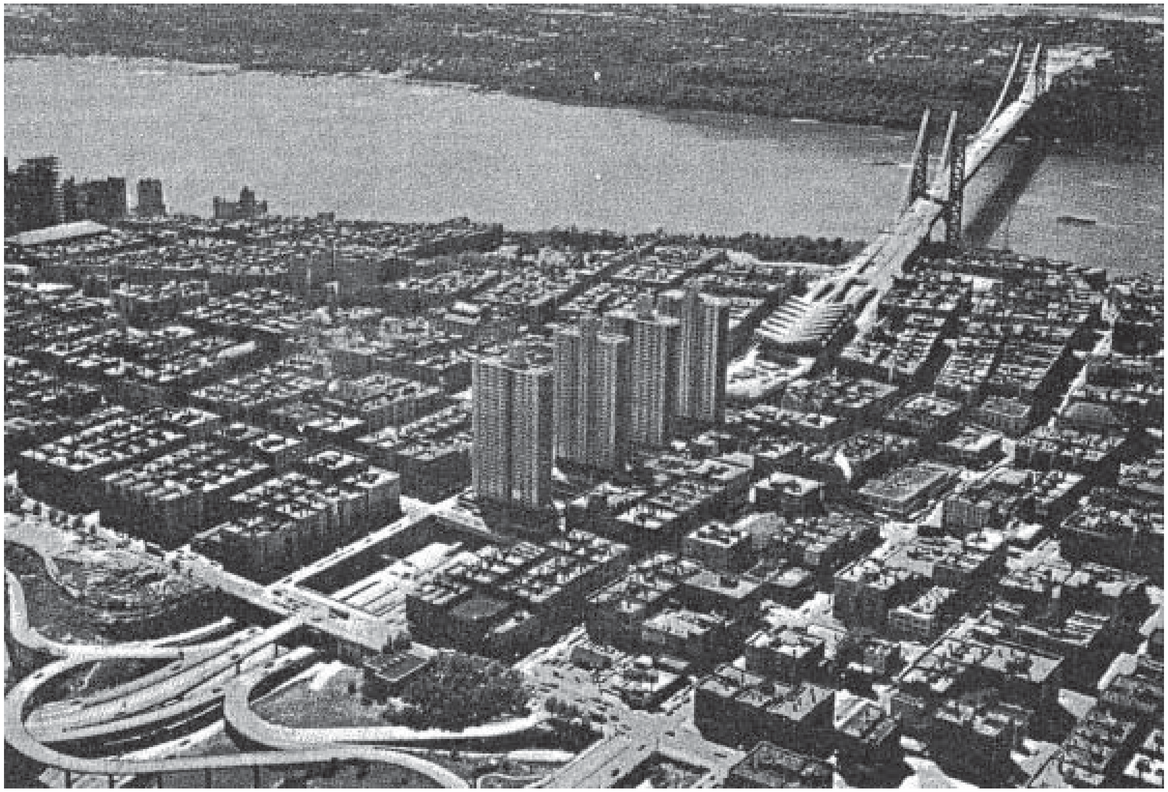
However the location of the Bridge Apartments proved to be detrimental to the residents. The first Federally-funded study of indoor air by the Environmental Protection Agency concluded that the configuration of the Washington Bridge Apartments actually encouraged the drawing of carbon monoxide from the roadway into the building. The study showed that the apartments actually contained higher levels of carbon monoxide than the roadway below.

In 1967 Robert Kennedy visited some of the most polluted areas in Manhattan.   On this tour the late Senator Robert F. Kennedy said, "the choice of this location for these apartments, astride one of the most heavily traveled highways in New York City, shows a total disregard for environmental factors on the part of our city planners."[4]   Robert Kennedy advocated for a "crash" program to "build a vaporproof barrier" over the highway that passes underneath the Washington Bridge apartment buildings.[5]

However Kennedy's requests were not fulfilled and today the buildings no longer exist as an utopian image of a middle-class metropolis but as a curiosity of a bygone period of naïf planning. Today the apartments house lower class Dominican immigrants, however the pollution and noise generated by the expressway is ever more apparent.

4 New York Times. December 24, 1968
5 New York Times. June 20, 1967

WASHINGTON HEIGHTS AND NORTHERN MANHATTAN

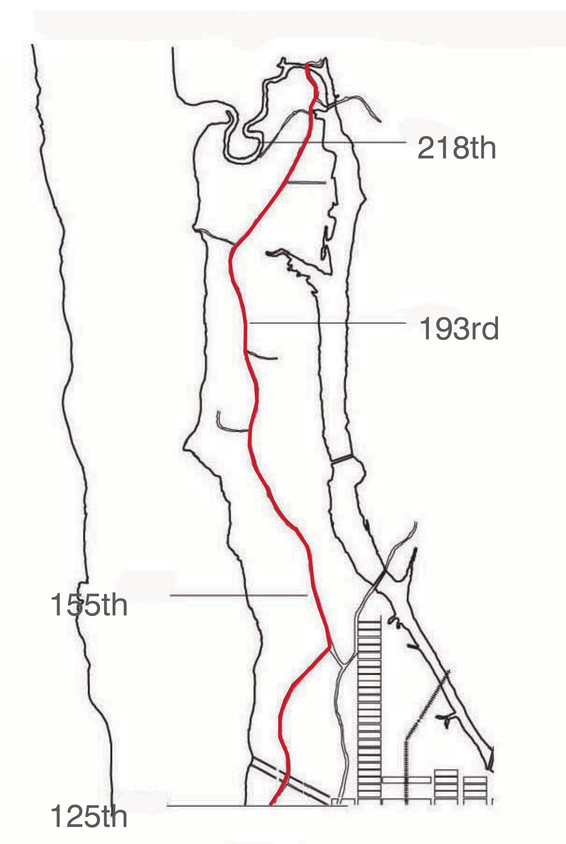


TRANS-MANHATTAN EXPRESSWAY EVOLUTION

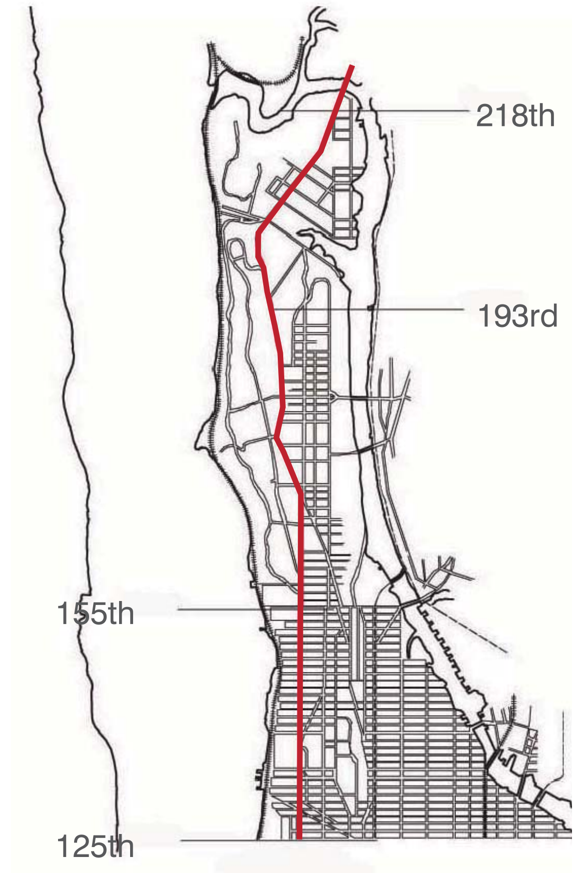
One of the key characteristics of Northern Manhattan is its topography. Consisting of a series of ridges and bluffs overlooking the Hudson and Harlem rivers, the topography of Northern Manhattan defines three distinct communities. The community of Inwood Heights is located at the northern most tip, with Washington Heights in the center, and Washington Heights South to the south. All three of these communities were developed around Broadway Avenue, the main corridor which runs from the northern most tip of Manhattan to the southern most edge. Each one of these communities has their own distinct character and demographics.

The Trans-Manhattan Expressway bisects the center of the Washington Heights community. Before the Trans-Manhattan Expressway and George Washington Bridge the community of Washington Heights had been an uninterrupted continuum of urban fabric. With the introduction of the George Washington Bridge and the Trans-Manhattan Expressway in the 1960s, this fabric had to be removed.

In the early 1960s Washington Heights transformed from a population of middle-class German, Jews, Irish, and Cubans into one of working class Dominican immigrants. Today Washington Heights is a dynamic multicultural community, however the area immediately adjacent to the Trans-Manhattan Expressway is a dead zone, suffering from excess noise and poor air quality.

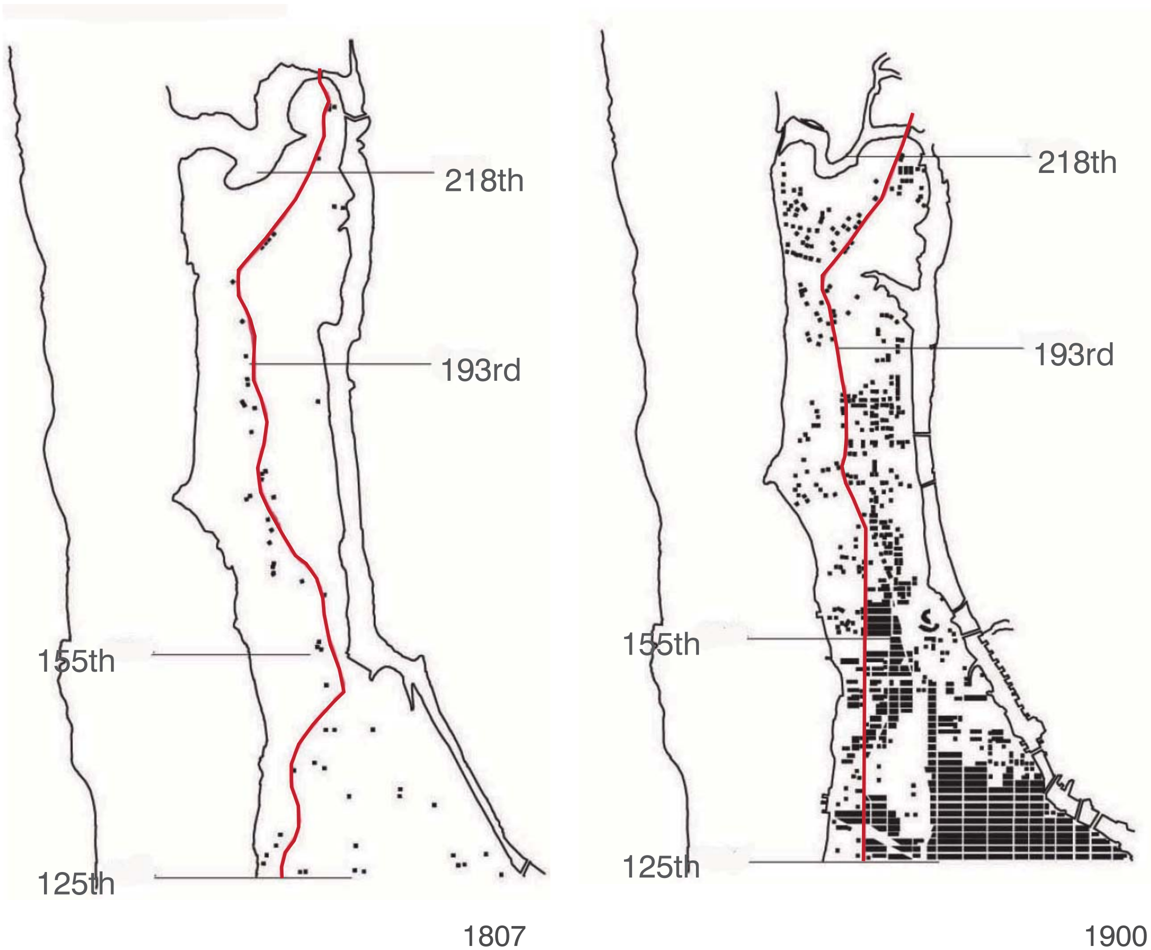


1807



1900

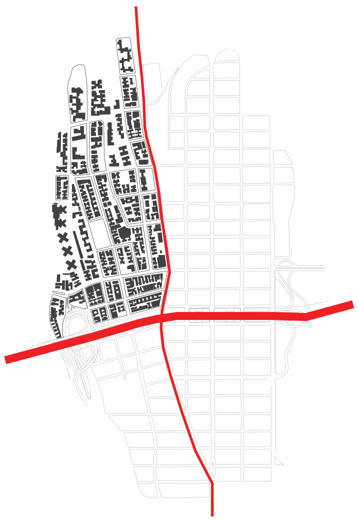
TRANSPORTATION NETWORK EVOLUTION (BROADWAY AVENUE IN RED)



Taken From:
New York City Department of City Planning.
Manhattan Community District 12.

BUILT ENVIRONMENT EVOLUTION

(BROADWAY AVENUE IN RED)

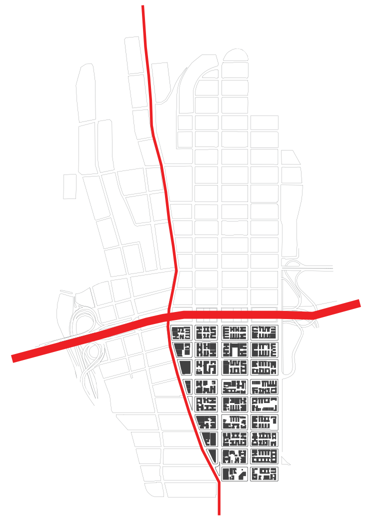


WASHINGTON HEIGHTS NORTH (1920 - 1929)
EAST OF BROADWAY

\$\$\$\$\$

WASHINGTON HEIGHTS NORTH (1920 - 1929)
EAST OF BROADWAY (NORTH OF 168TH)

\$\$\$\$



WASHINGTON HEIGHTS NORTH (1901 - 1919)
WEST OF BROADWAY (NORTH OF 168TH)

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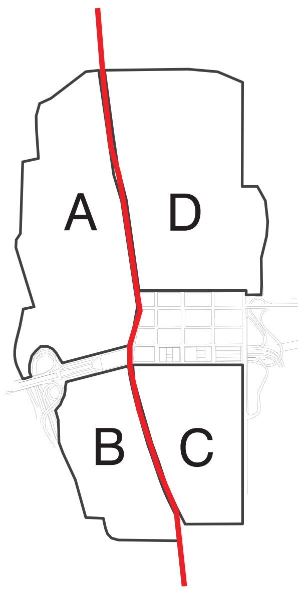
WASHINGTON HEIGHTS NORTH (1901 - 1919)
EAST OF BROADWAY

\$

WASHINGTON HEIGHTS MORPHOLOGY



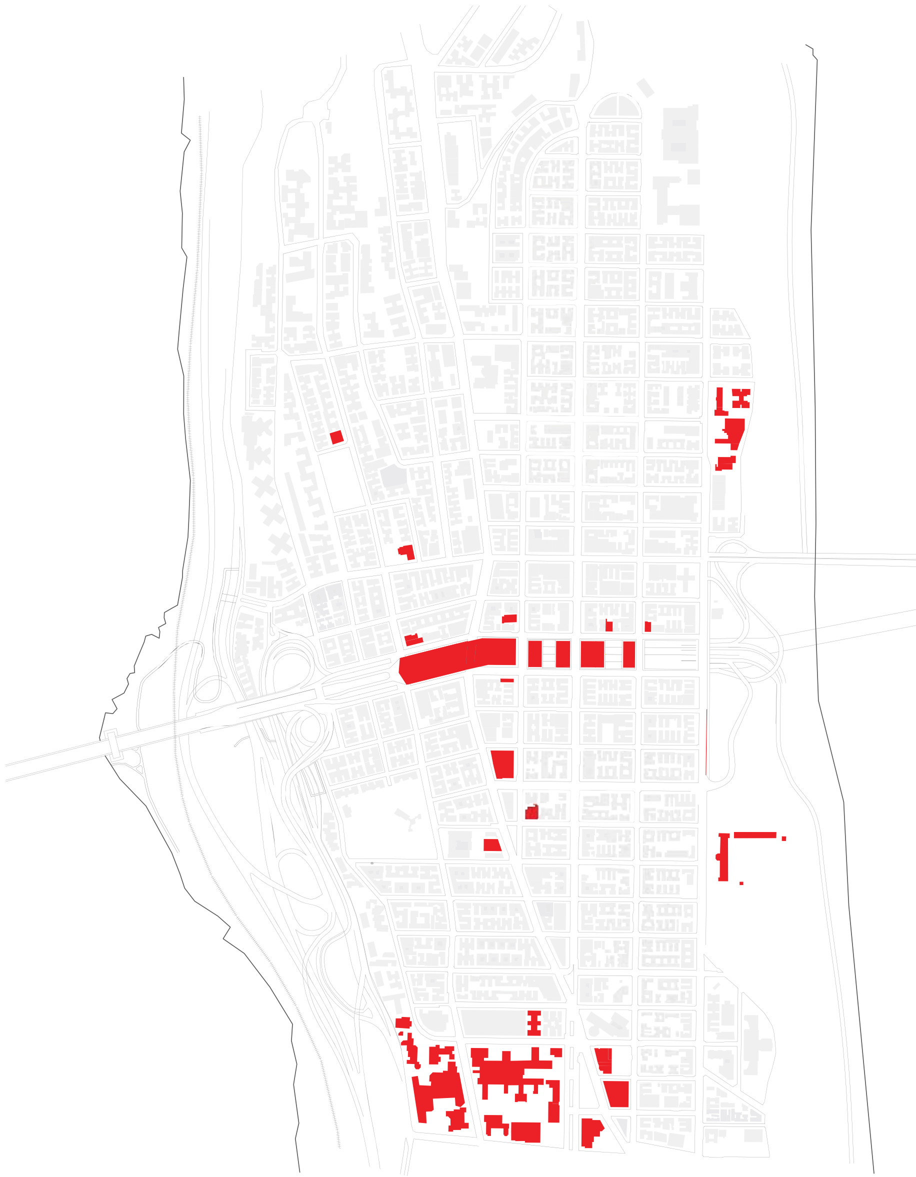
Washington Heights is composed of five districts that together define the Washington Heights community. The Trans-Manhattan Expressway forms the first division between these districts. Broadway Avenue further divides the community of Washington Heights into East and West precincts. Together these geographical constraints produce four distinct residential districts within Washington Heights, which contain varying demographic and economic characteristics. The two eastern districts are primarily of Dominican dissent and lower income. The west is a mix of middle-class white and Hispanic with the northwest being the wealthiest of these quadrants.

The Trans-Manhattan Expressway and 181st street corridor combine with both Broadway Avenue and St. Nicholas Avenue to dominate as the central business district for northern Manhattan. In the area surrounding the Trans-Manhattan Expressway residents report a number of dead zones as a result of excess noise and pollution from the expressway. The need to bring this area back to life as a retail, commercial, and entertainment based transit center is evident.

WASHINGTON HEIGHTS, NEW YORK	149,694 PEOPLE PER SQUARE MILE	
UPPER EAST SIDE, NEW YORK	109,628 PEOPLE PER SQUARE MILE	1.25 x
NORTHERN MANHATTAN	70,649 PEOPLE PER SQUARE MILE	2 x
CAMBRIDGE, MASSACHUSETTS	15,768 PEOPLE PER SQUARE MILE	9.5 x
BOSTON, MASSACHUSETTS	12,199 PEOPLE PER SQUARE MILE	12 x

URBAN DENSITY

The area adjacent to the Trans-Manhattan Expressway is one of the most dense urban communities in Manhattan and the United States. The 0.7 square mile community contains 105,000 residents living in 35,591 units.



NOTABLE BUILDINGS

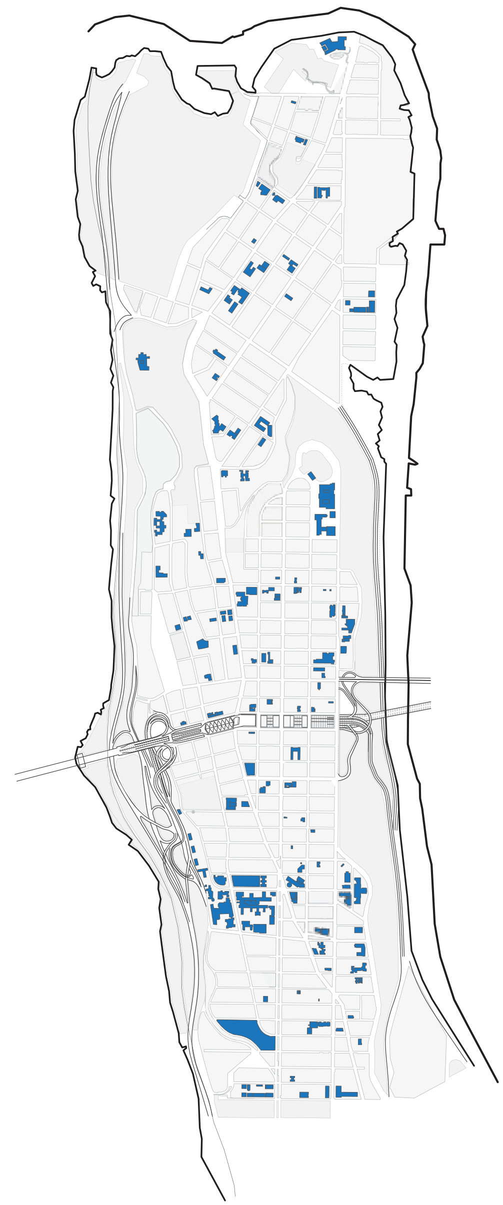
Supporting a population of 105,000 residents in 0.7 square miles, Washington Heights is one of the densest residential communities in Manhattan. The urban density is 149,694 people per square mile, nearly ten times greater than Boston, MA and twelve times that of Cambridge, MA. However, within this dense community no identifiable civic center exists and although the periphery is surround by large amounts of open space, most of these areas remain inaccessible due to peripheral infrastructure and extreme topographical conditions.

Within Washington Heights few significant architectural icons exist. The most notable buildings in the entire community are the George Washington Bridge Bus Terminal and the Washington Heights Bridge Apartments. The shear monumental presence of these structures, provide an opportunity to redefine this area as the central civic center for the Washington Heights community.

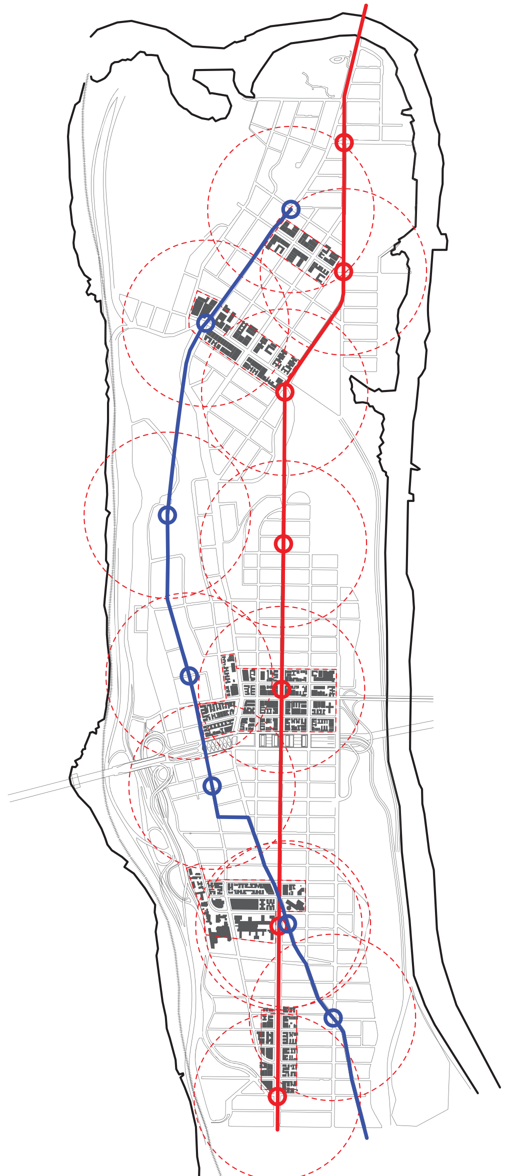
WASHINGTON BRIDGE APARTMENTS


COMMERCIAL


RESIDENTIAL

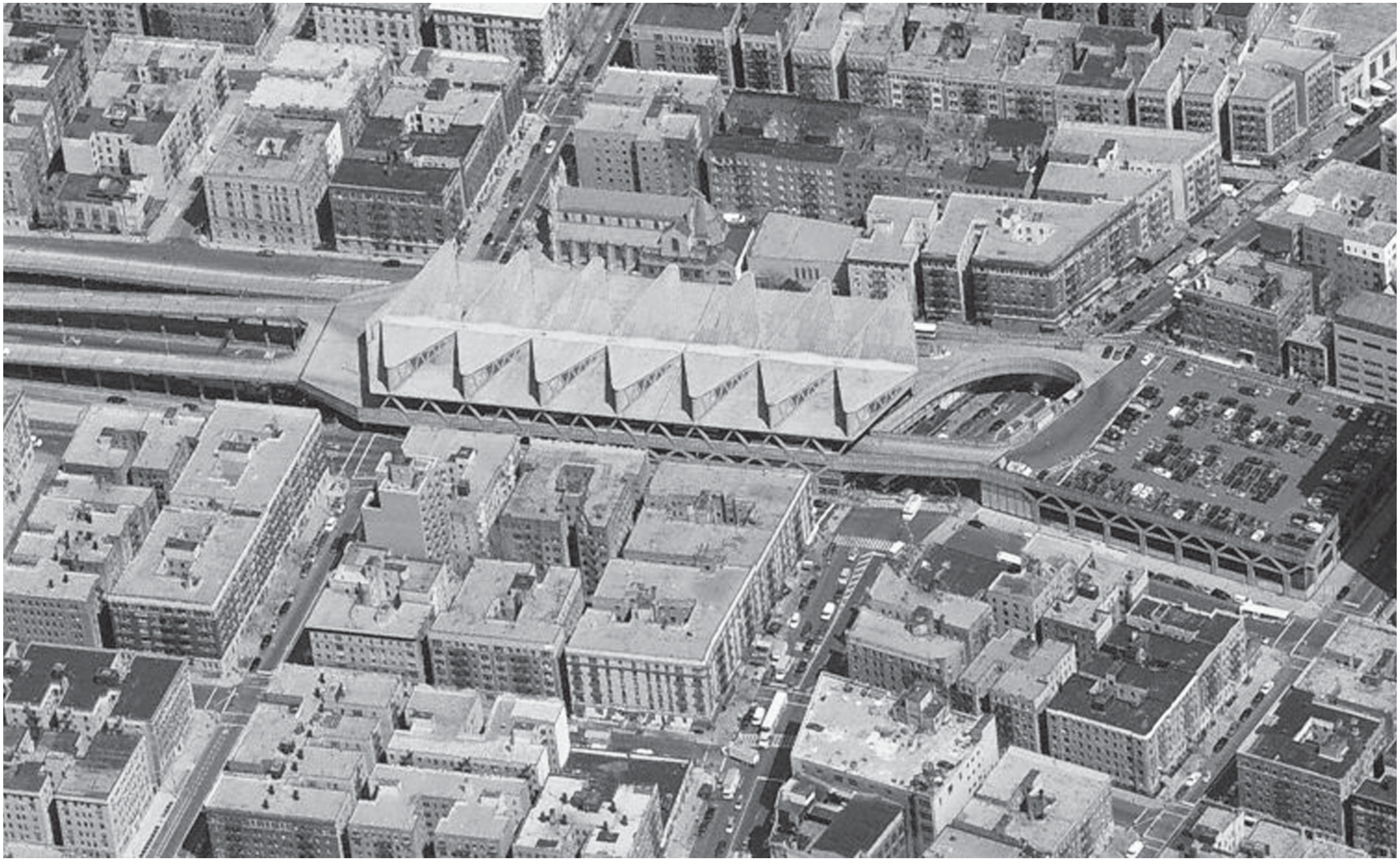

INSTITUTIONAL

OPEN SPACE



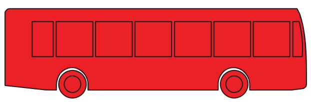
TRANSIT WITH COMMERCIAL DISTRICTS

DESIGN INTERVENTIONS



IMPERVIOUS BUS TERMINAL TO PUBLIC ROOM

PORT AUTHORITY BUS TERMINAL



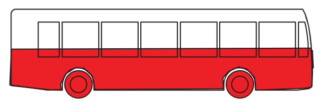
110%

200,000 DAILY PASSANGERS

7,000 BUSES DAILY

223 BUS GATES

GEORGE WASHINGTON BRIDGE BUS TERMINAL

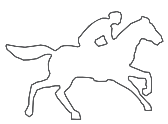


50%

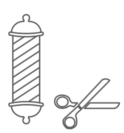
17,500 DAILY PASSANGERS

950 BUSES DAILY

32 LOADING AREAS

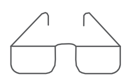


OFF-TRACK BETTING PARLOR



BARBER

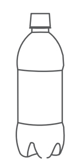
DENTIST



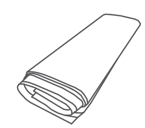
OPTOMETRIST

ENTERTAINMENT

CREDIT UNION



CONVENIENCE



NEWSTAND

CURRENT MOM AND POP STORES

BUS TERMINAL UNDER-USED AND OUTDATED

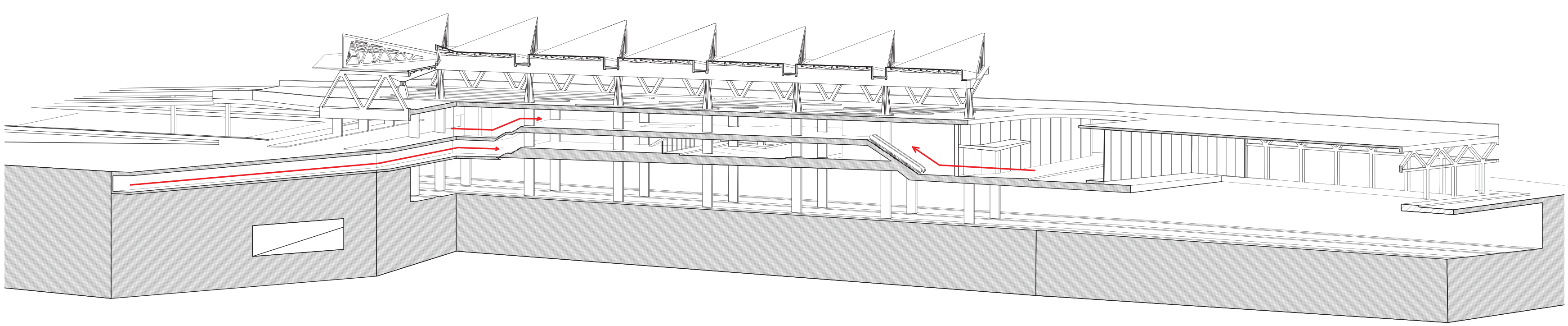
The George Washington Bridge Bus Terminal currently operates at fifty percent its capacity. The bus terminal serves 17,500 daily passengers, on 950 buses daily. It has never quite escaped the shadow of the popular, mid-town Port Authority Bus Terminal, located in the heart of Manhattan.

Despite its unpopularity with travelers, the station currently has a dozen 'mom and pop' shops, which primarily serve the local community of Washington Heights. The station is an integral part of the local community, with its off-track betting parlor and service-oriented retail spaces. The station is currently more successful as a community center than it is as a bus terminal. This thesis proposes to vacate the existing bus terminal, and return this colossal iconic structure back to the community of Washington Heights.

INFRA(STRUCTURE) MEETS SMALL COMMUNITY

Despite the George Washington Bridge Bus Terminal's connection to the local community the terminal still exists as a colossal piece of infrastructure in the center of Washington Heights. This imposing concrete structure impedes upon the quaint urban fabric of Washington Heights, while the entrances to the east and west, with their broad overpasses, create dark and uninviting urban environments.

Since the bus terminal in its own right is a piece of discontinuous urban infrastructure, the urban strategy is to void the existing terminal and infuse it will a new use in order to transform this piece of infrastructure to serve as a catalyst for pubic life. Once this iconic structure is returned to the city, the community will have a central civic icon, for the community of Washington Heights.



EXISTING BUS TERMINAL CIRCULATION

179TH STREET IMPERVIOUS FACADE

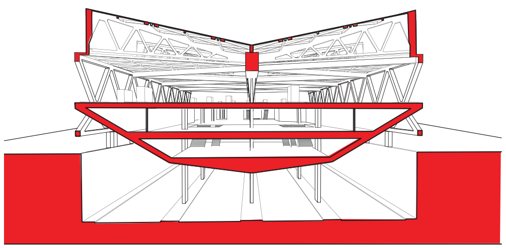
178TH STREET IMPERVIOUS FACADE

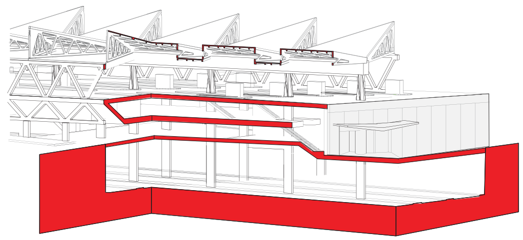
FORT WASHINGTON AVENUE ENTRANCE

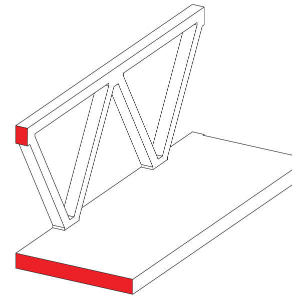
BROADWAY AVENUE ENTRANCE

DARK BUS TERMINAL LEVEL

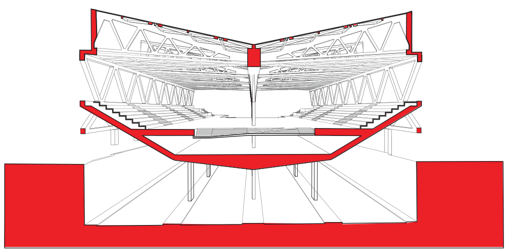

DARK FORT WASHINGTON AVENUE ENTRANCE

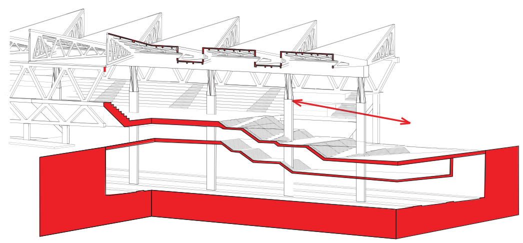


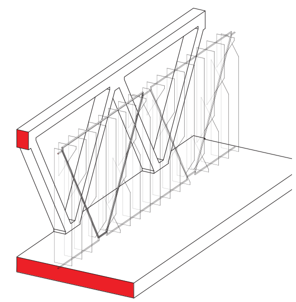




EXISTING







REMOVE EXISTING BUS TERMINAL LEVEL

OPEN TERMINAL TO CITY

WRAP THE TERMINAL
FOR CLIMATIC CONDITIONS

PROPOSED

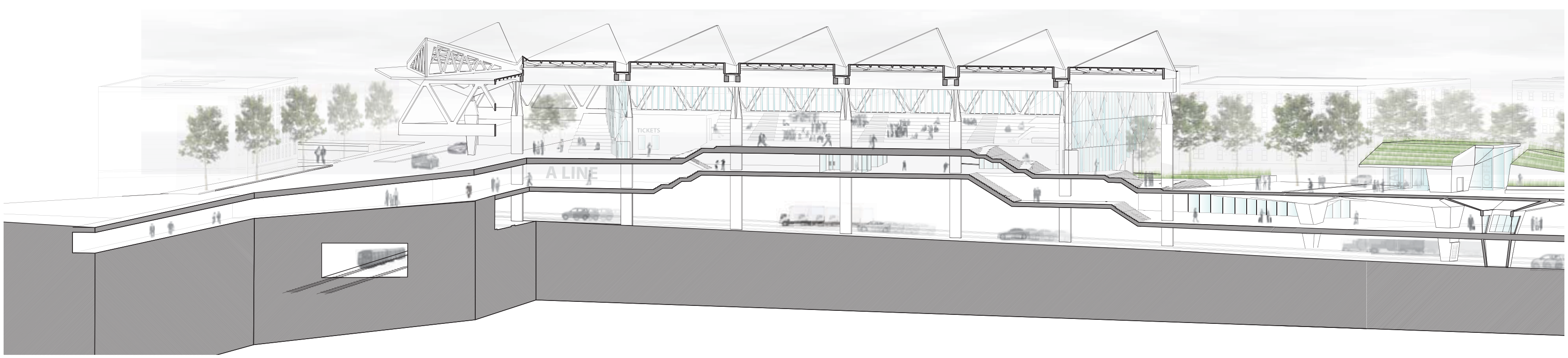
IMPERVIOUS BUS TERMINAL TO PUBLIC ROOM

The first intervention looks at the existing impervious George Washington Bridge Bus Terminal situated in the heart of the Washington Heights community. The thesis proposes to transform the existing bus terminal into a central civic icon to house community events and exhibitions. The existing terminal will be voided to form a new public room. This new space will host private events and exhibitions while still serving as a major infrastructural connector for Washington Heights.

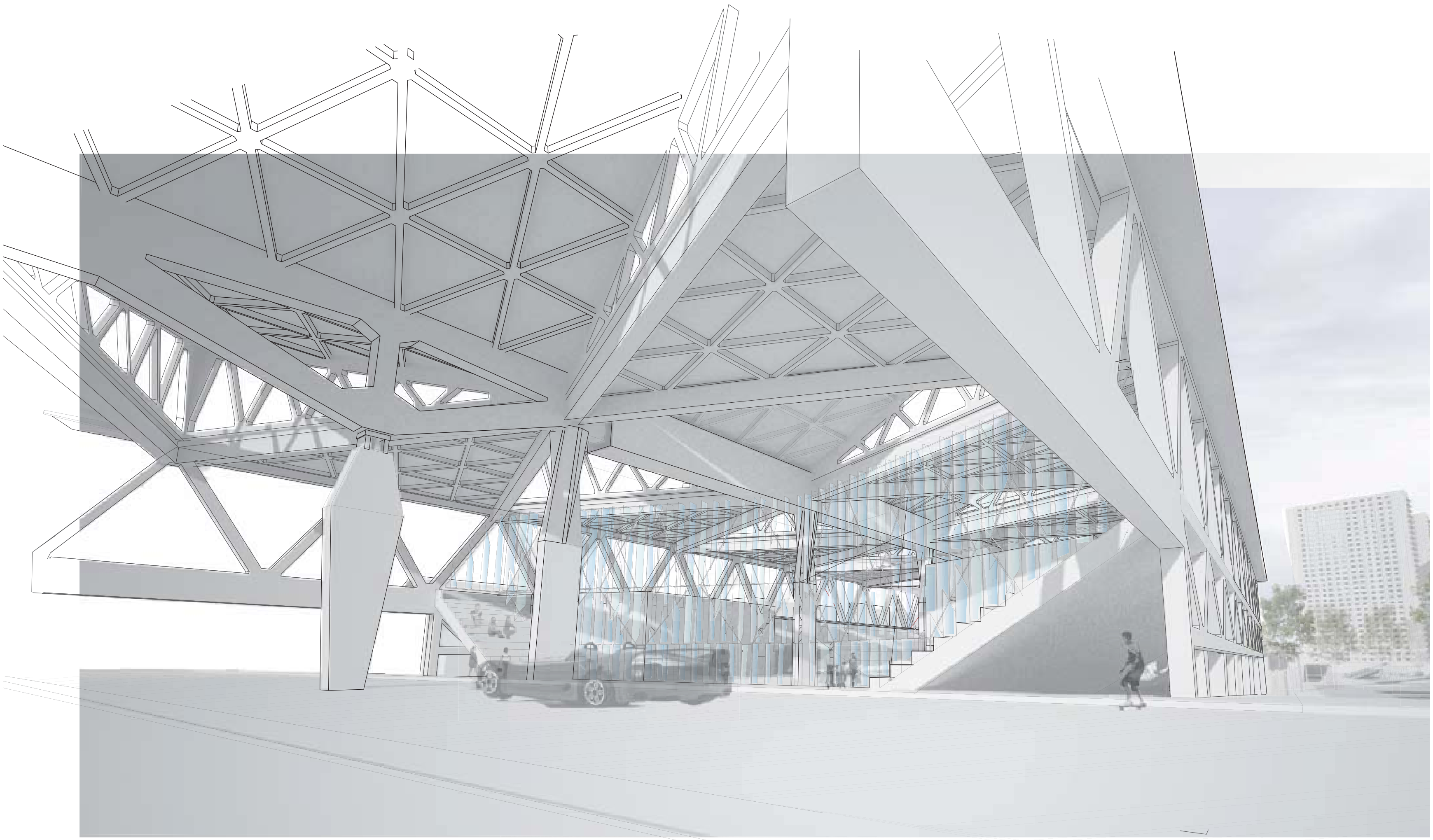
Three operations are performed on the bus terminal to transform the existing impervious structure into an event and exhibition space. The first intervention removes the second level bus circulation. Once this level is removed, the project takes advantage of the sloped surfaces, which Nervi used to ventilate the expressway. These sloped surfaces become seating for the new event and exhibition space.

The second intervention opens the impervious piece of infrastructure onto the city by creating monumental stairs and ramps along the two entrances on Broadway Avenue and Fort Washington Avenue. While these new entrances open the Nervi building onto the city, they simultaneously create two dynamic urban areas at each entrance.

The third intervention wraps the existing concrete structure with an internal operable glass skin. The skin protects the proposed public room against the extreme climatic conditions of New York, allowing the proposed public room to be used throughout the year in all conditions. When the weather permits the room can be transformed into an open public pavilion.

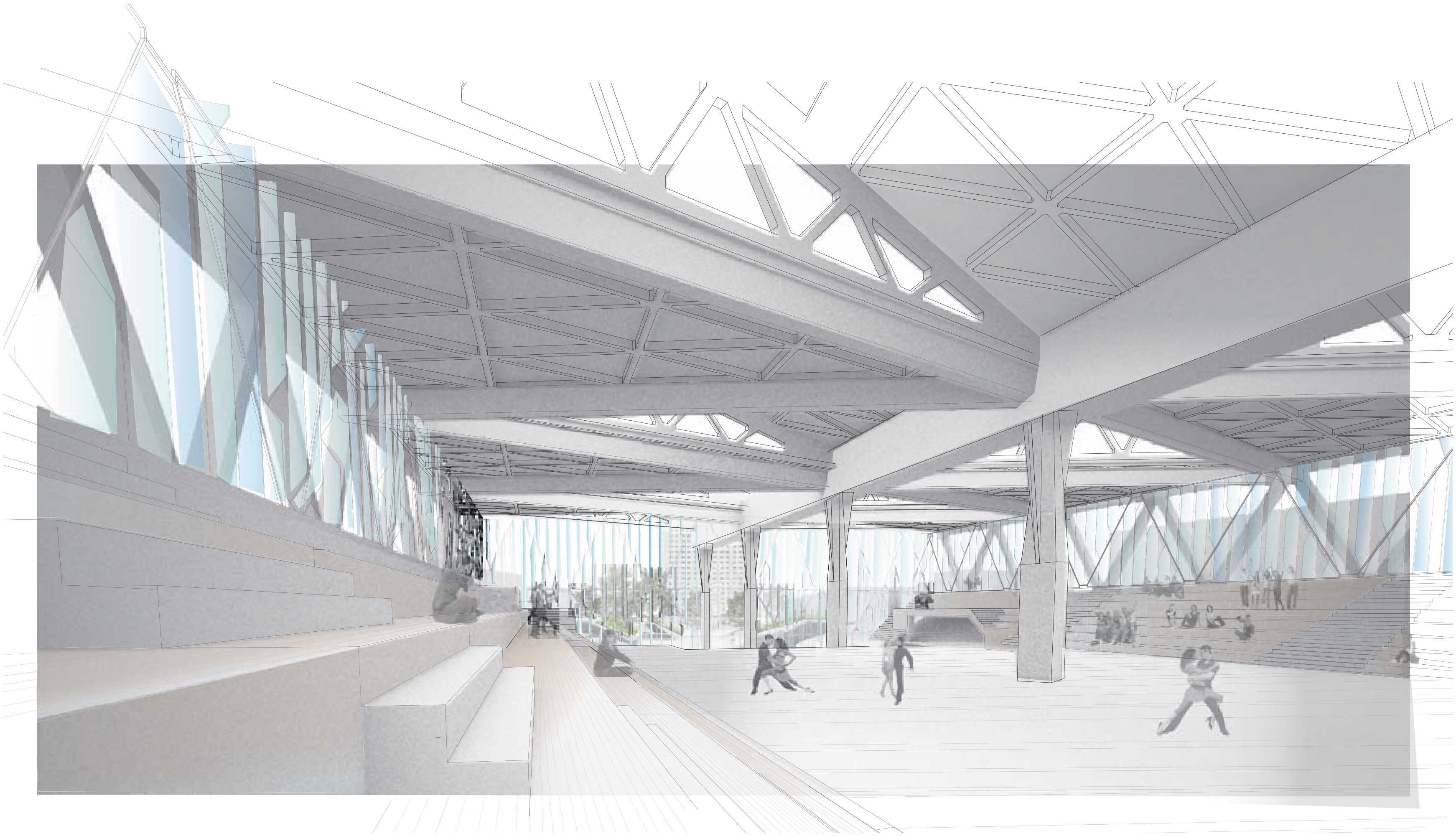


EXISTING FORT WASHINGTON AVENUE BUS TERMINAL ENTRANCE

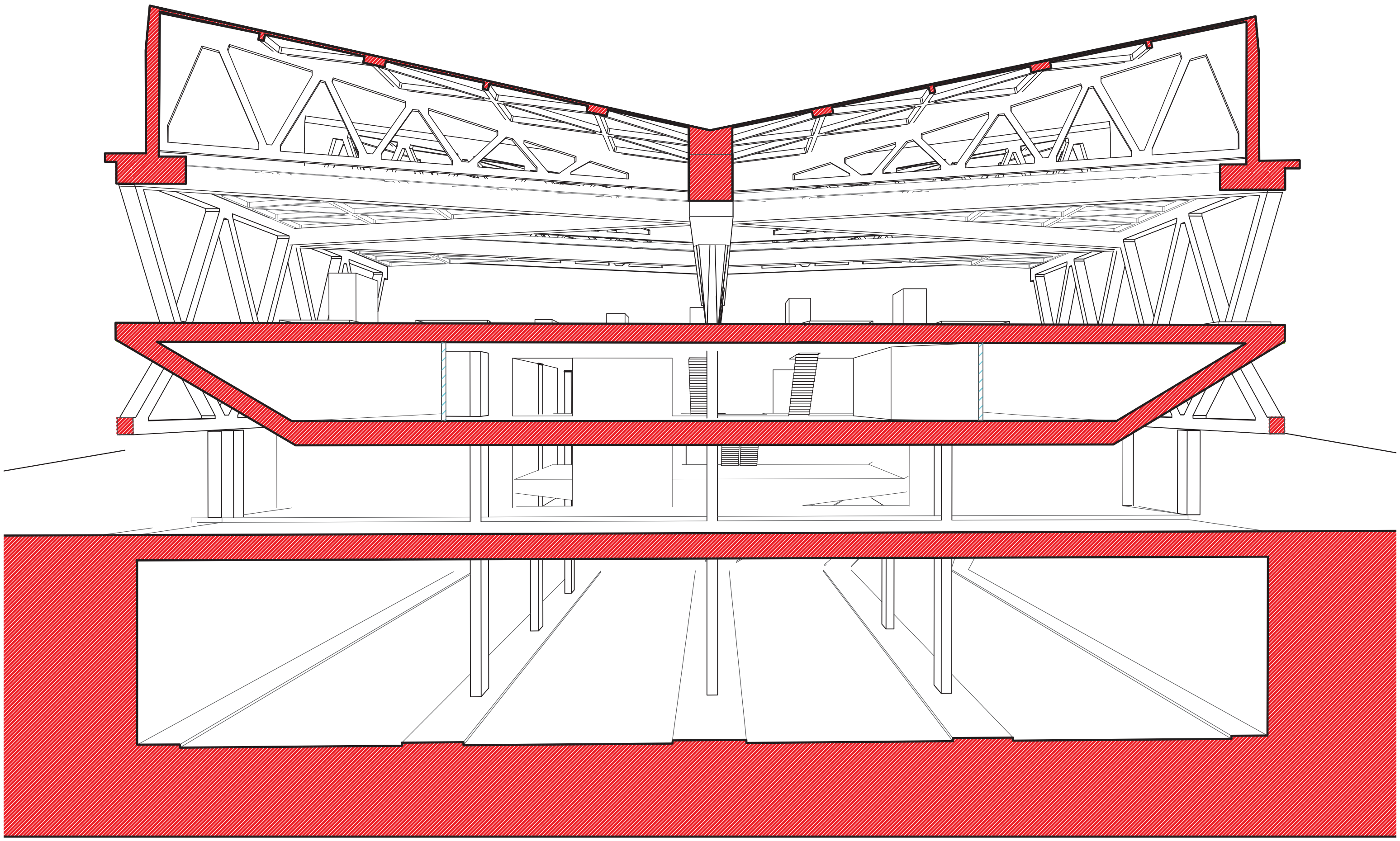


PROPOSED FORT WASHINGTON AVENUE ENTRANCE

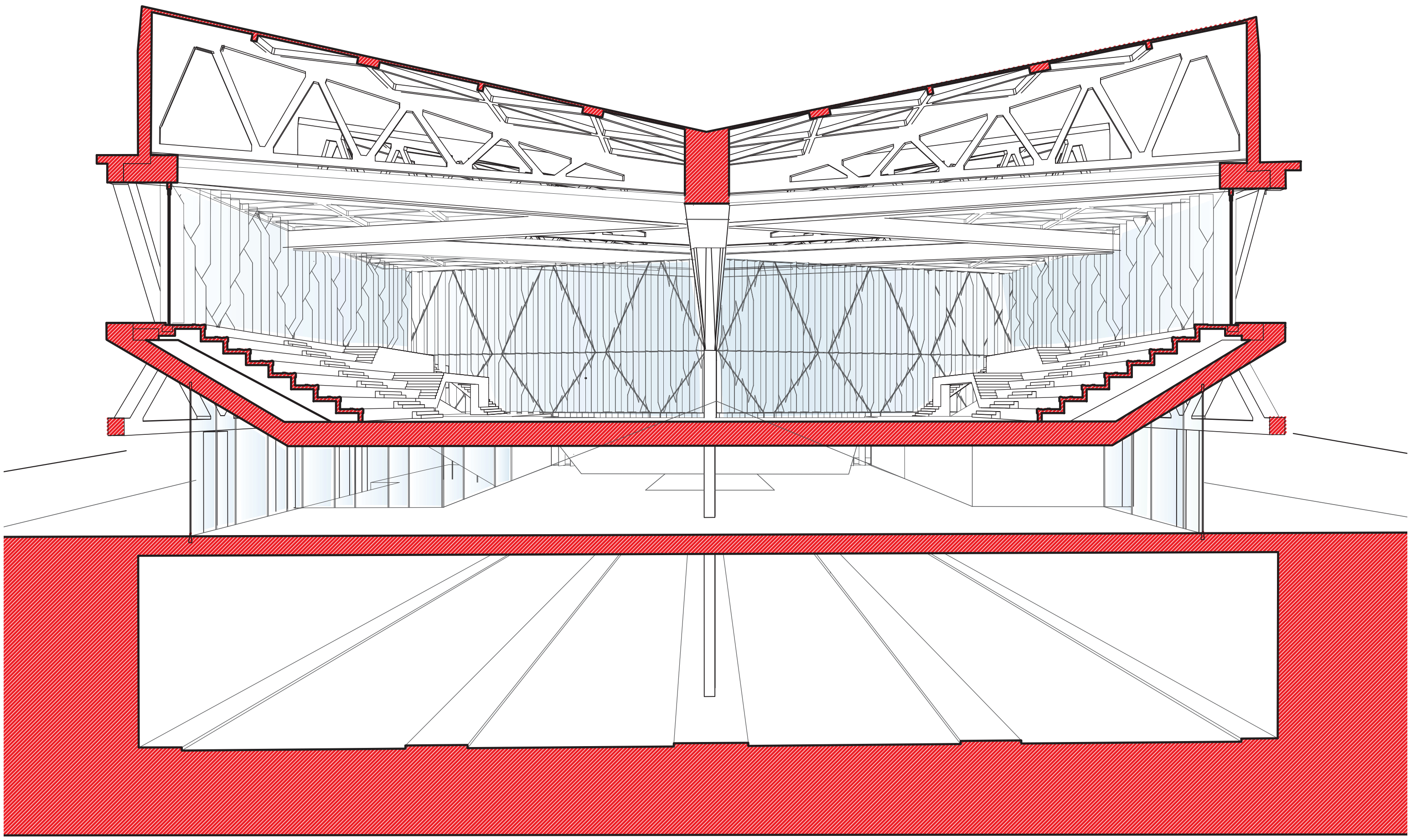
EXISTING GEORGE WASHINGTON BRIDGE BUS TERMNAL INTERIOR



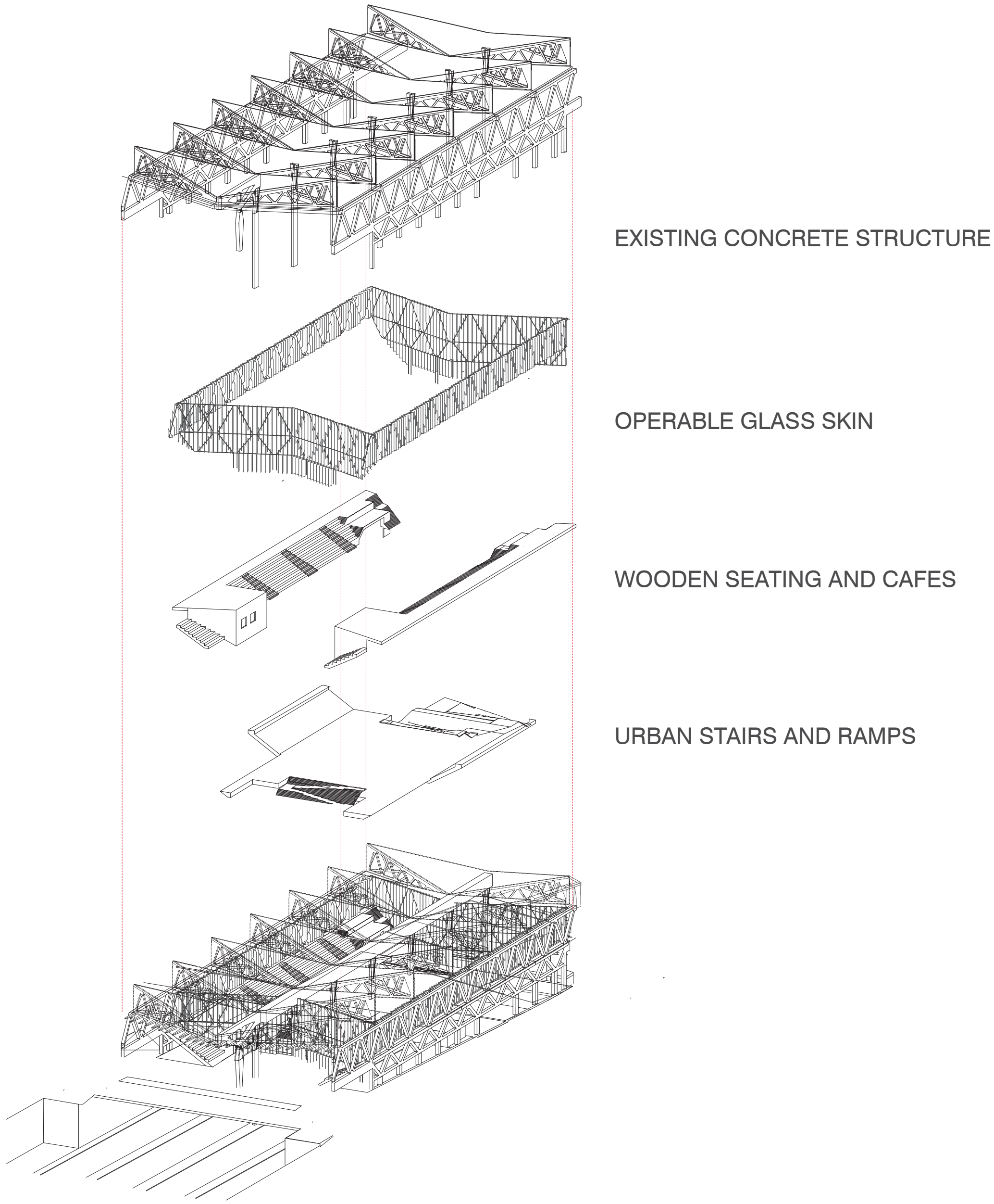
PROPOSED EVENT AND EXHIBITION SPACE



EXISTING



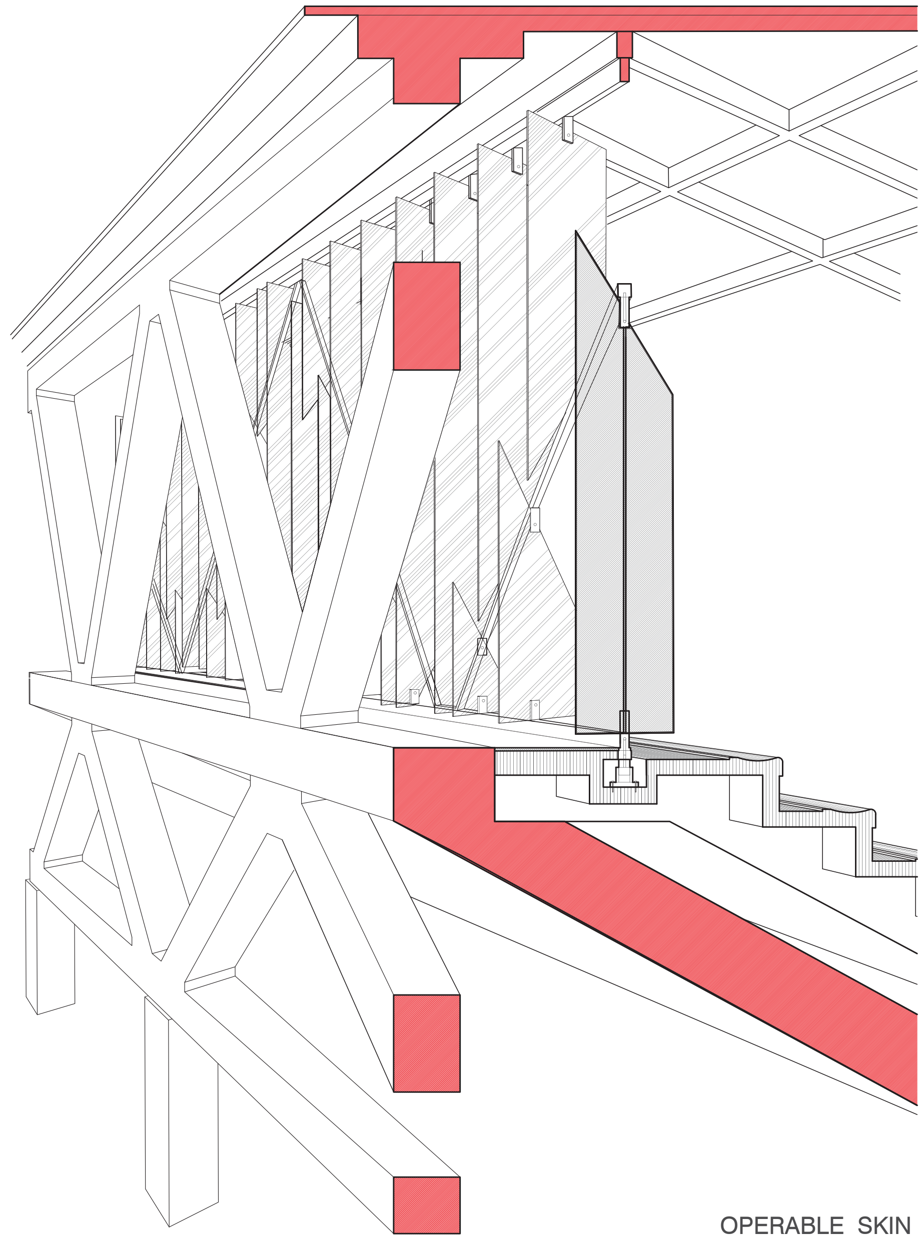
PROPOSED



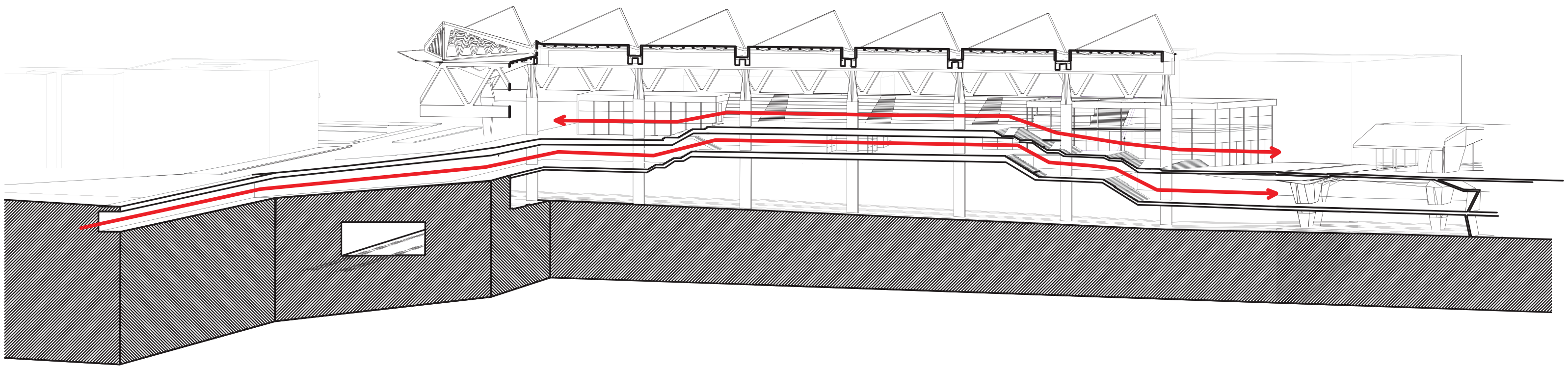
The proposed operable skin is tucked behind the existing triangular Nervi structure. It derives its form from Nervi, in order to maximize the transparency of the building to the adjacent community of Washington Heights. The operable skin allows the new public room to be open during the warm summer months and closed during the colder months.

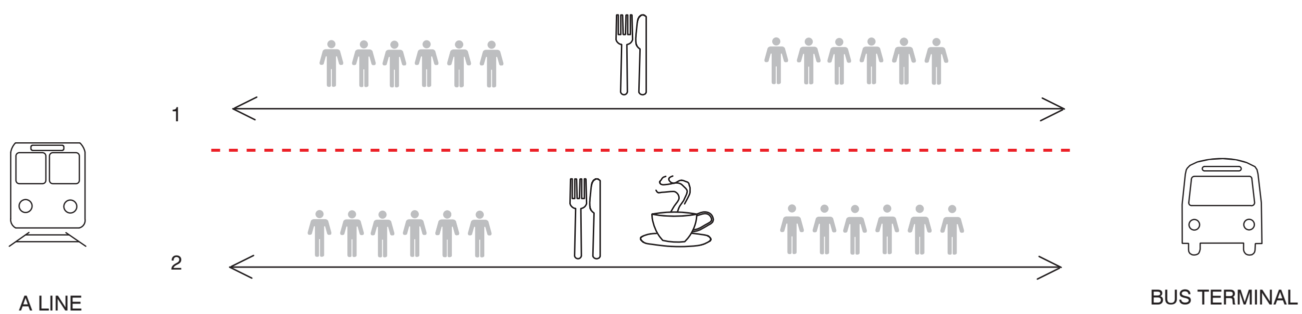
The new materials of the operable skin and bleachers are foreign in order to demarcate the new with the existing. The glass skin and wooden bleachers are slid into the existing building, respecting the historical precedent of Pier Luigi Nervi.

The two levels to the Nervi building allow the public room to be easily adapted for different uses. The sectional relationship allows the public room to function for private events and exhibitions, while still providing the infrastructure connection to the A subway line and proposed bus terminal. However, when the room is not used for private events, it is open to the public and exists as an informal gathering space for performances and events. The two cafes on the main level also serve to activate the existing terminal when private events are not occurring.

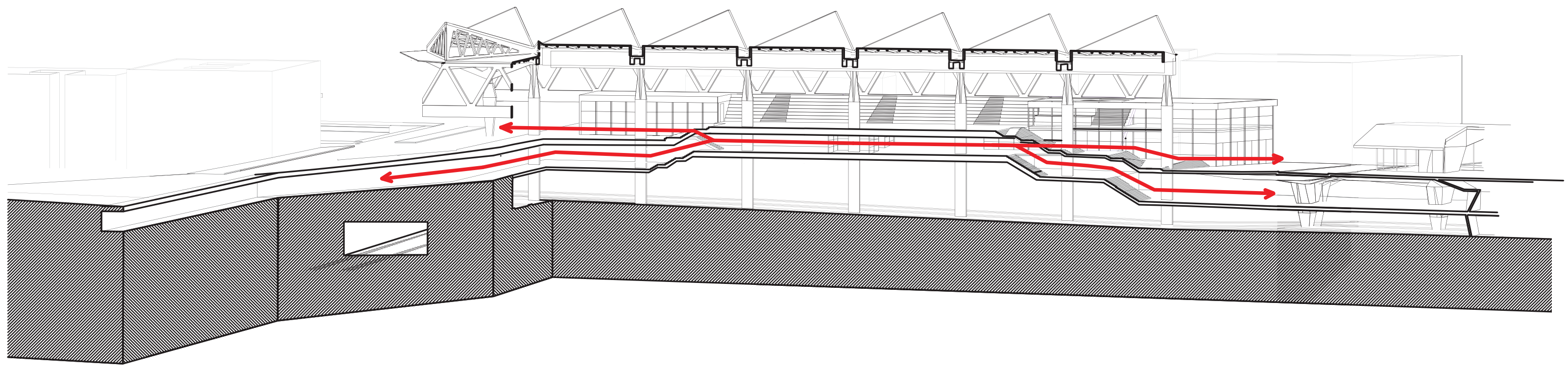


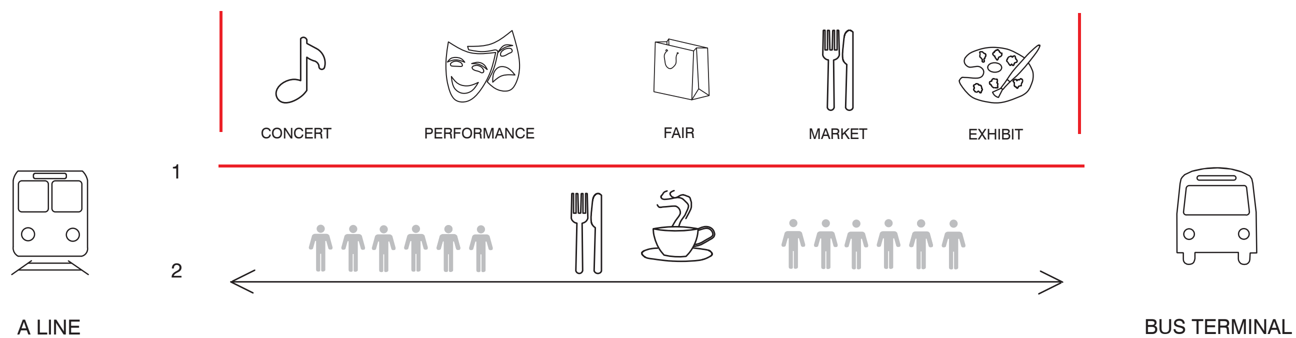
OPERABLE SKIN



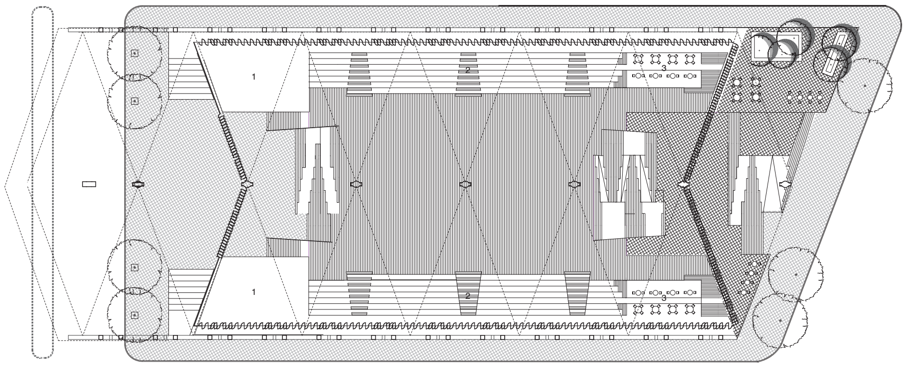


BOTH LEVELS OPEN TO GENERAL PUBLIC



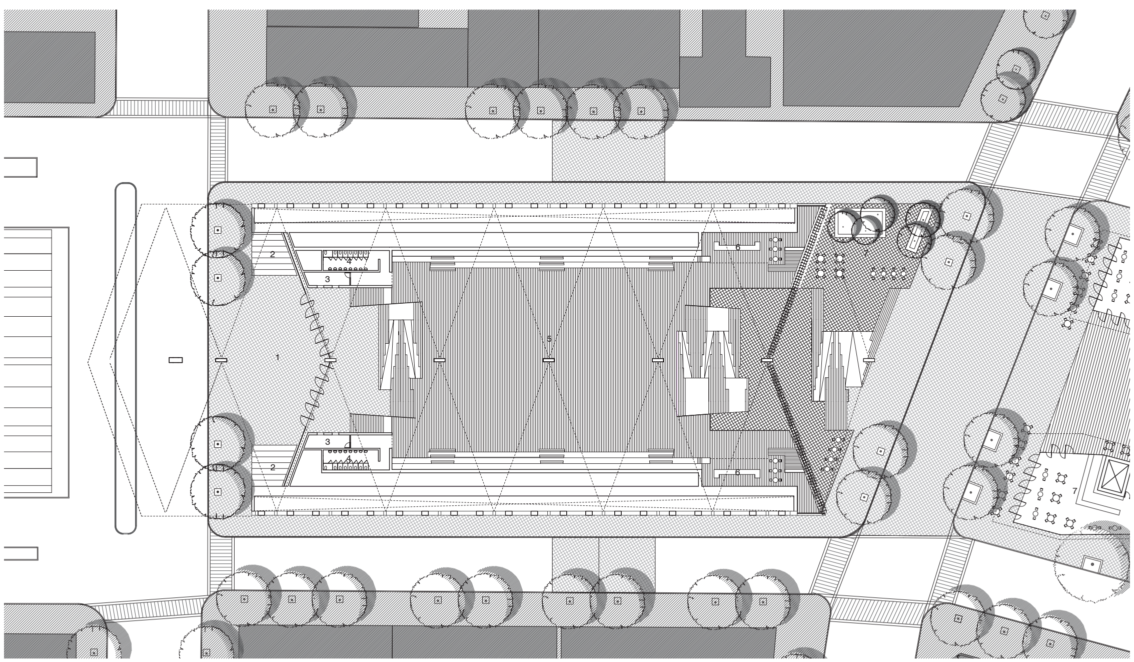


PRIVATE EVENTS (UPPER LEVEL)
INFRASTRUCTURAL CONNECTOR (LOWER LEVEL)



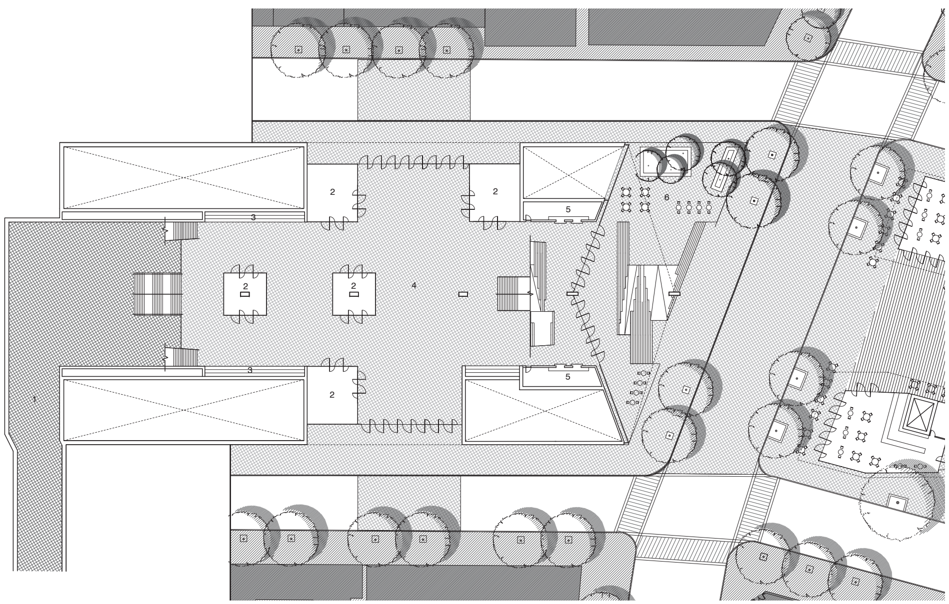
MEZZANINE LEVEL

1 BALCONY
2 EVENT SEATING
3 DINING TERRACE



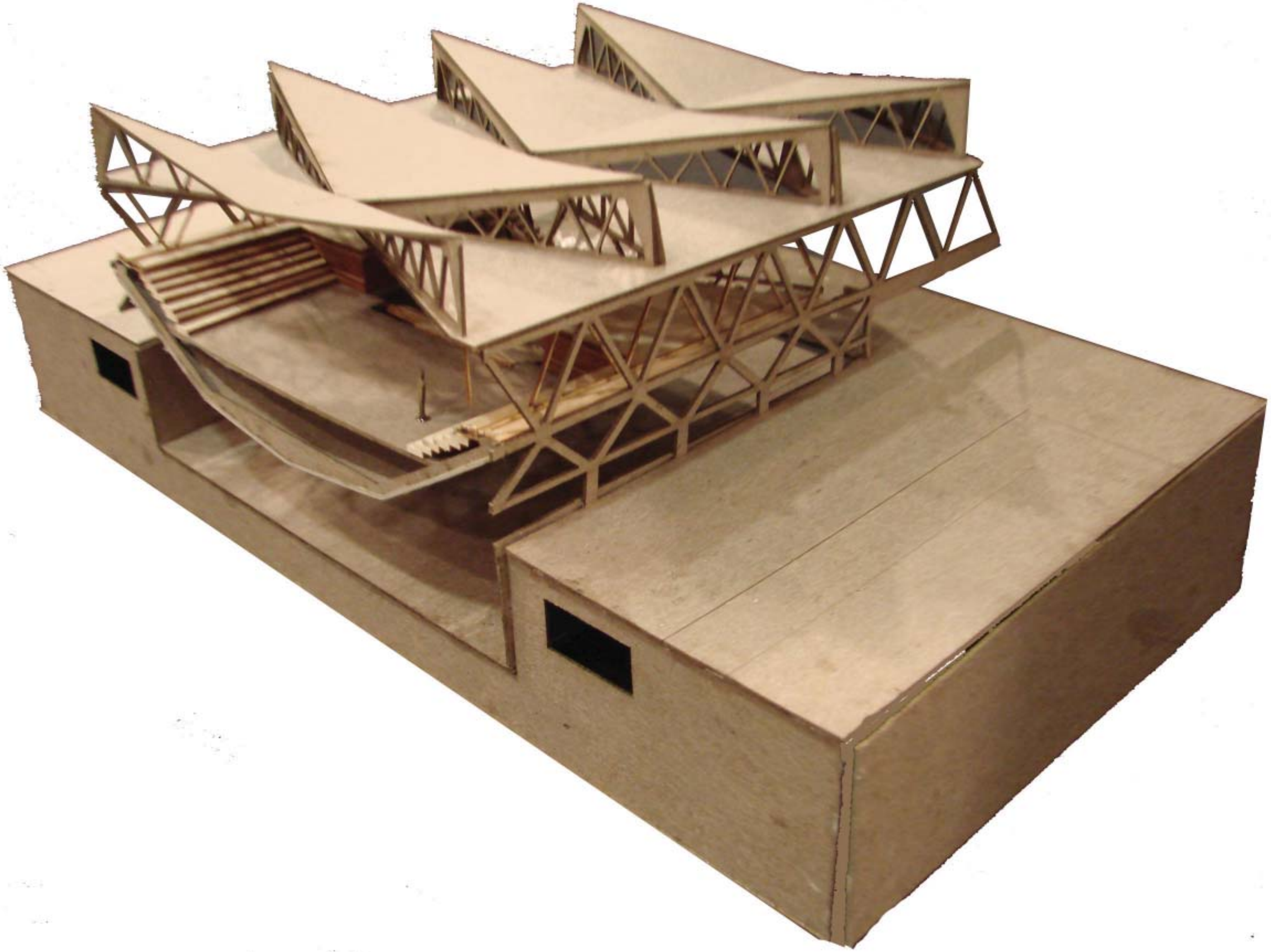
MAIN LEVEL

1 RECEPTION AREA
2 AMPHITHEATER
3 TICKET SALES
4 RESTROOMS
5 PUBLIC ROOM
6 CAFE
7 TERRACE

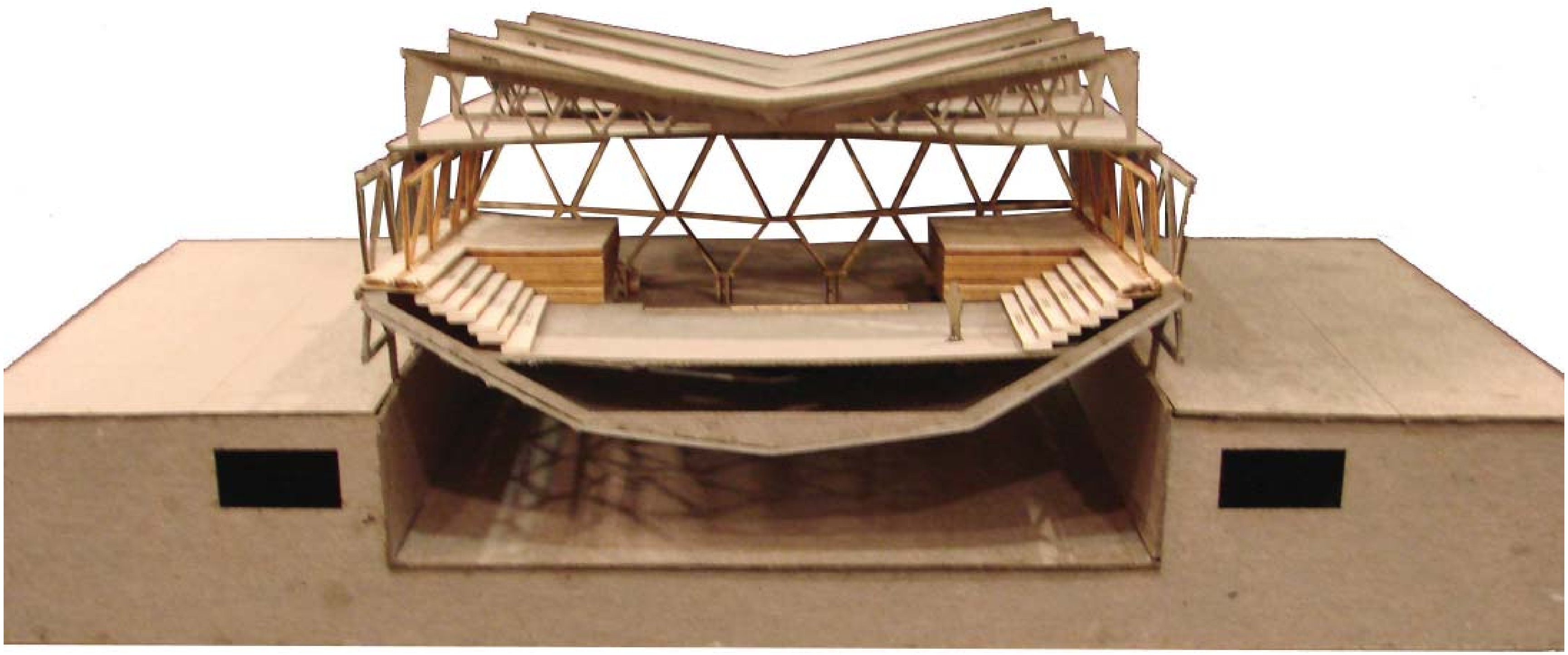


LOWER LEVEL

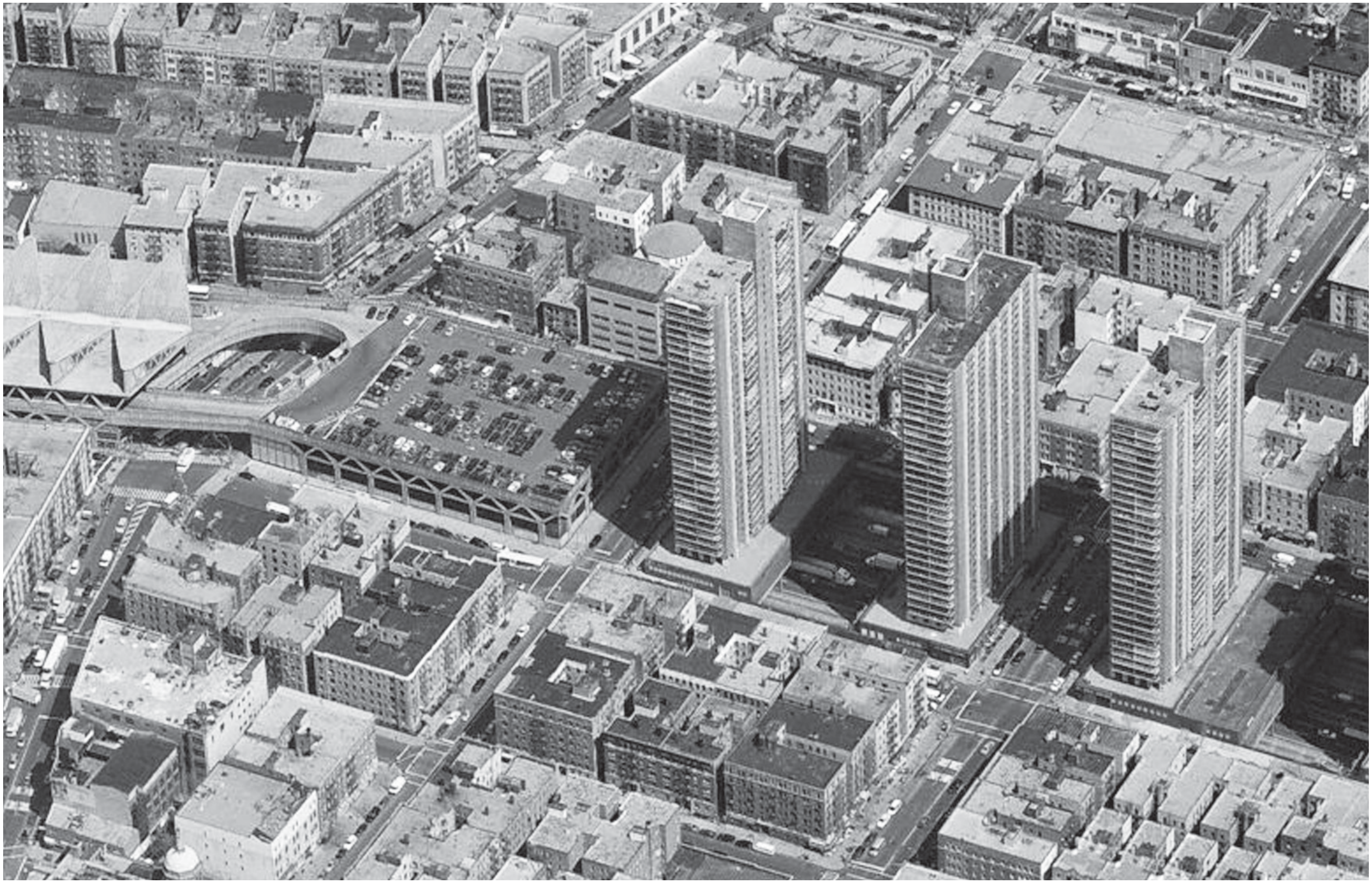
1 A TRANSIT LINE
2 RETAIL/SERVICE
3 SEATING
4 RECEPTION AREA
5 TICKET SALES
6 TERRACE



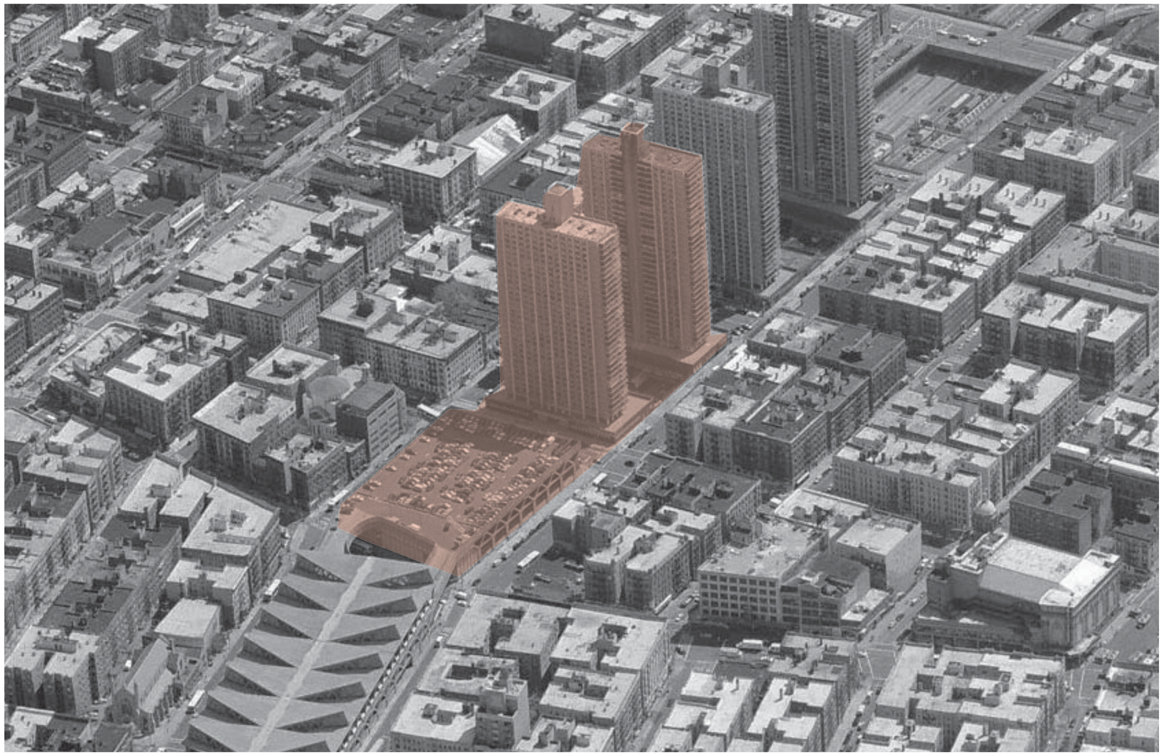
SECTIONAL MODEL

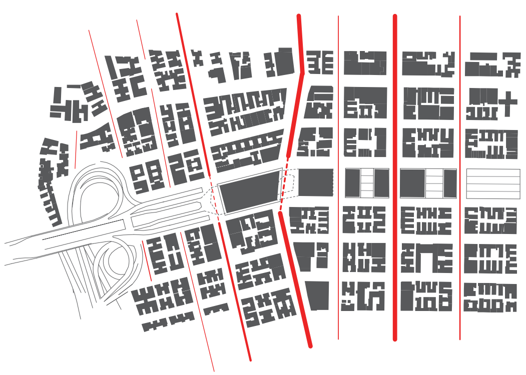


SECTIONAL MODEL WITH THREE INTERVENTIONS

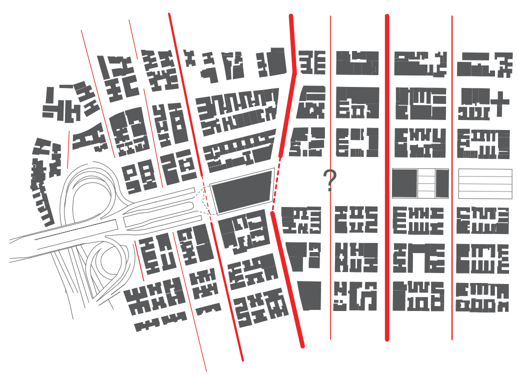


URBAN IMPEDIMENTS TO PUBLIC PLAZA





PEDESTRIAN INTENSITY



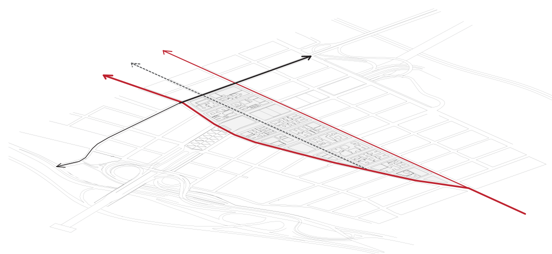
INTERVENTION AREA

URBAN IMPEDIMENTS TO PUBLIC PLAZA

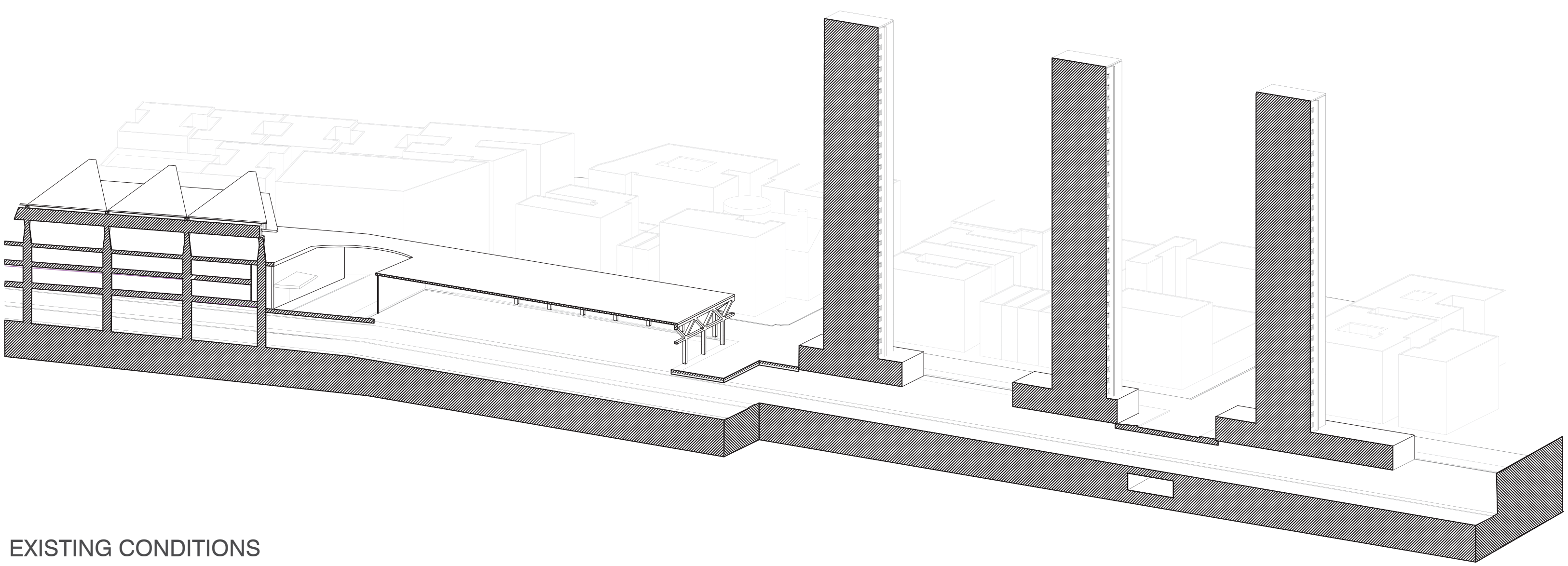
The second intervention focuses on the area defined by two of the most populated pedestrian avenues in Washington Heights. Both Broadway Avenue and St. Nicholas Avenue are two of the most robust avenues in Northern Manhattan. These two avenues converge into Broadway Avenue which runs to mid-town and lower manhattan.

The area is currently defined by a series of expressway voids, a hollow parking structure, and two residential towers. The area exists as a desolate urban landscape, since the area is consumed by excess noise and pollution. However, its location, in the center of Washington Heights, immediately adjacent to the Pier Luigi Nervi building, and two Washington Bridge Apartment towers, positions it to be one of the most important points in the Washington Heights community.

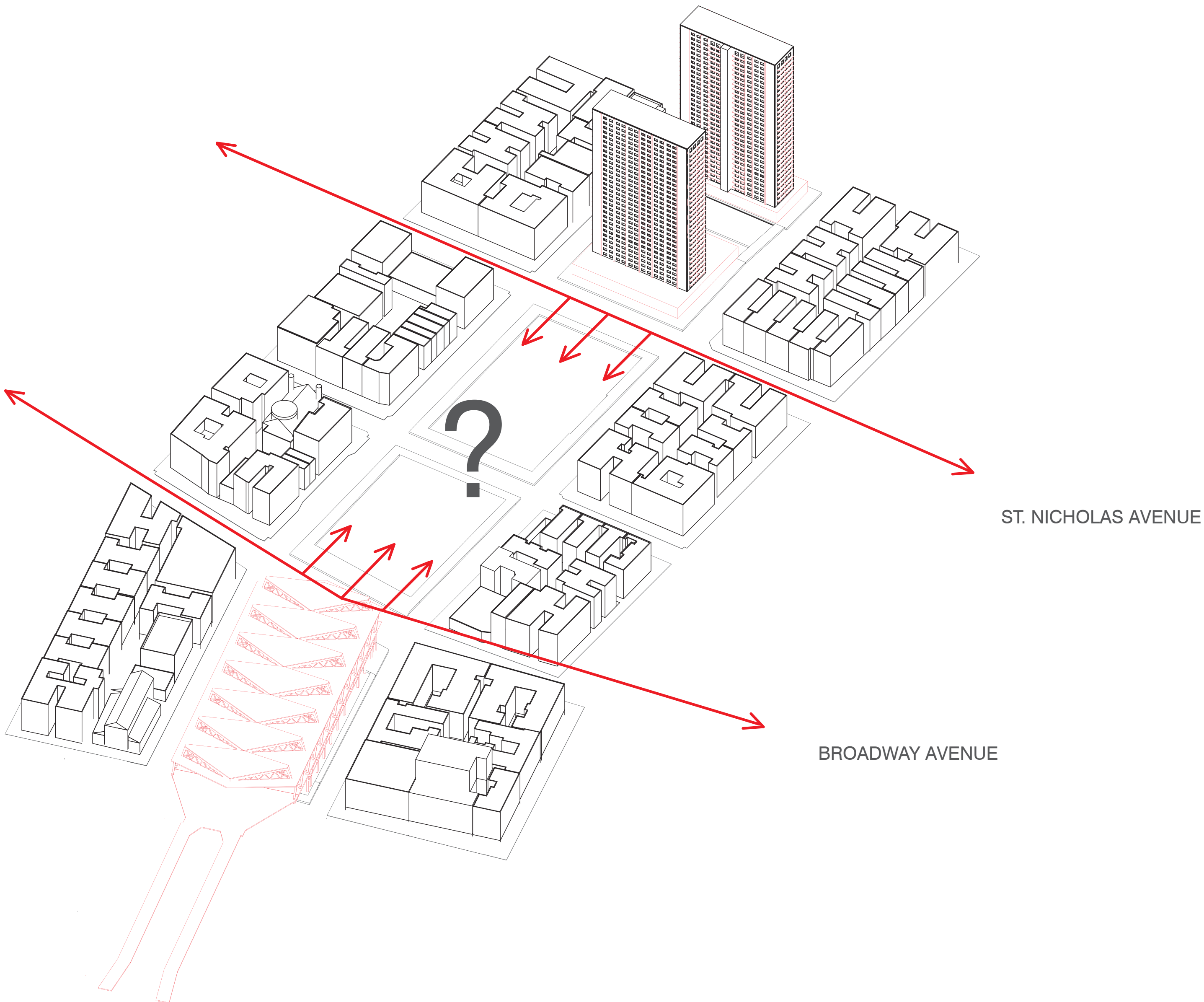
The urban strategy for this area is to strengthen the existing void by creating a public plaza and bus terminal that reinvigorates the existing barren urban landscape. The proposed plaza will act as an urban interface reuniting the adjacent urban fabric, Nervi building, and remaining towers. This specific intervention seeks to reinvent the mushroom column typology to serve as a paradigm for readapting infrastructure to serve as a catalyst for public life.



BROADWAY AND ST. NICHOLAS AVENUE CONVERGING



EXISTING CONDITIONS


?
ST. NICHOLAS AVENUE
BROADWAY AVENUE

BROADWAY AVENUE

ST. NICHOLAS AVENUE

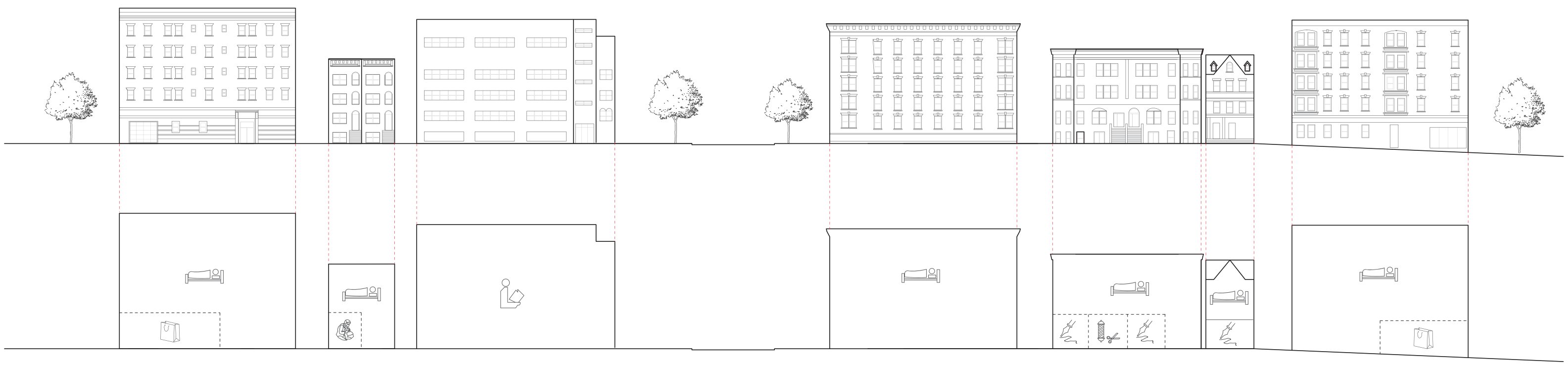
ROBUST URBAN STREETS

DESOLATE URBAN LANDSCAPE | HOLLOW PARKING STRUCTURE WITH TOWERS BEYOND

DISCONTINUOUS ELEVATED PARKING STRUCTURE

EXPRESSWAY VOID

HOLLOW PARKING STRUCTURE AND WASHINGTON BRIDGE APARTMENTS



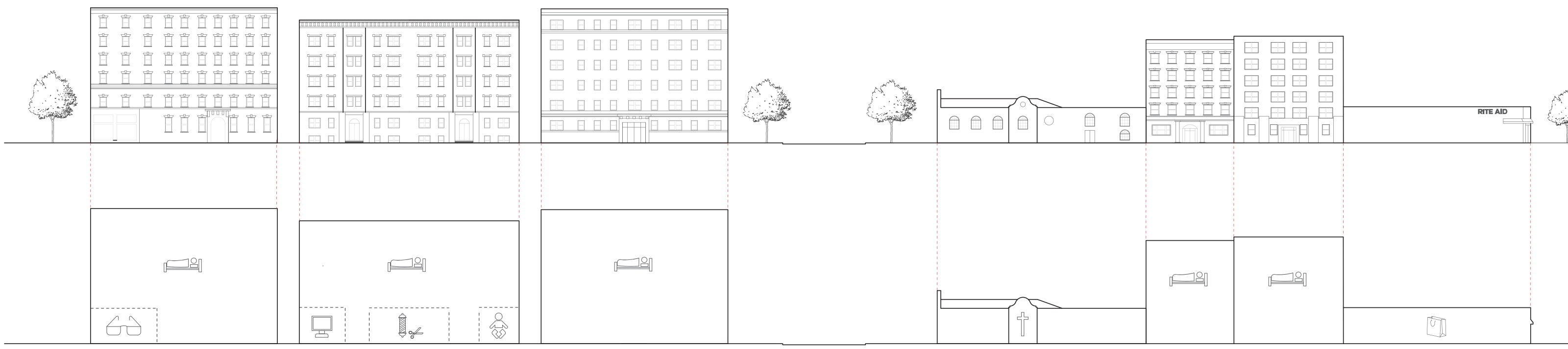
ADJACENT ELEVATIONS

POMPIDOU

UNION SQUARE

FONTANA DEI QUATTRO

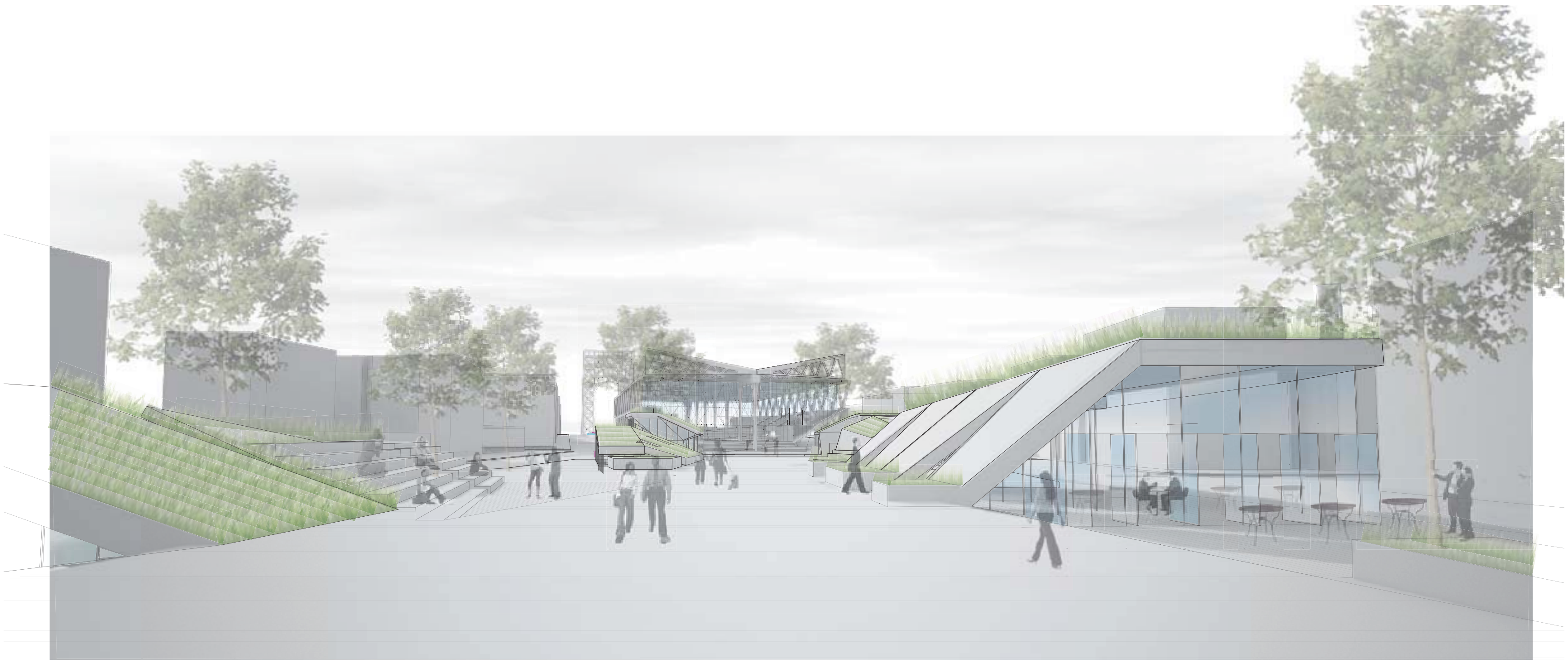
SCALAR PLAZA STUDIES



ADJACENT ELEVATIONS

FANEILL HALL

ROCKEFELLER CENTER



PROPOSED PUBLIC PLAZA

URBAN IMPEDIMENTS TO PUBLIC PLAZA

The existing George Washington Bridge Bus Terminal was analyzed and used for inspiration as a strategy to readapt expressway infrastructure for public use. Three layers were identified within the existing Nervi building. The first layer consists of the expressway constraint: four three lane roadways pass beneath Washington Heights each containing a five to ten feet wide median. This median is the only opportunity, which can be used to support structures above in the air rights space of the expressway. The second layer is the transitional layer where the columns change directions in order to support the butterfly roof. The third layer is a free zone where Nervi uses the butterfly roof to provide light and air to the bus terminal below.

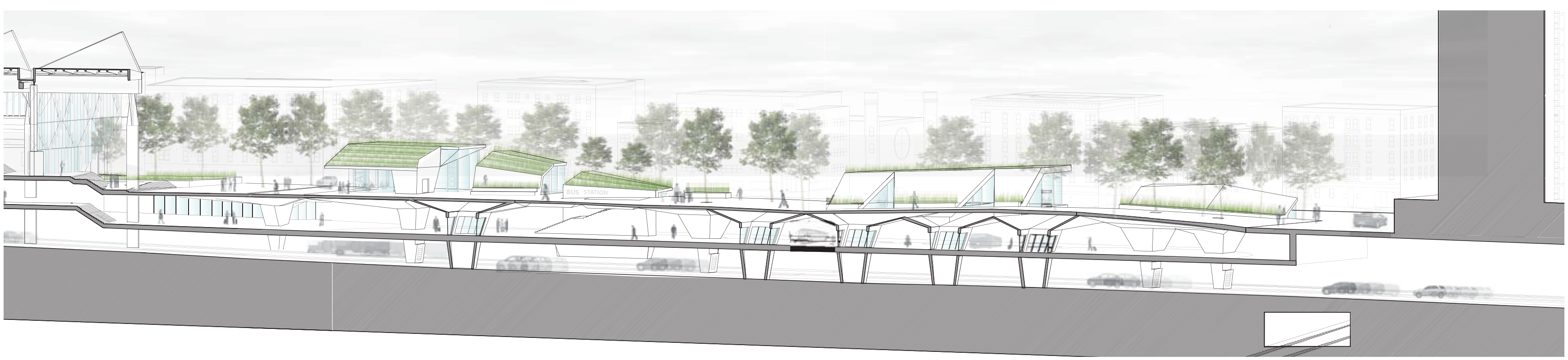
The new public plaza and bus terminal seeks to radicalize each of these three layers through reinventing the existing mushroom column typology.

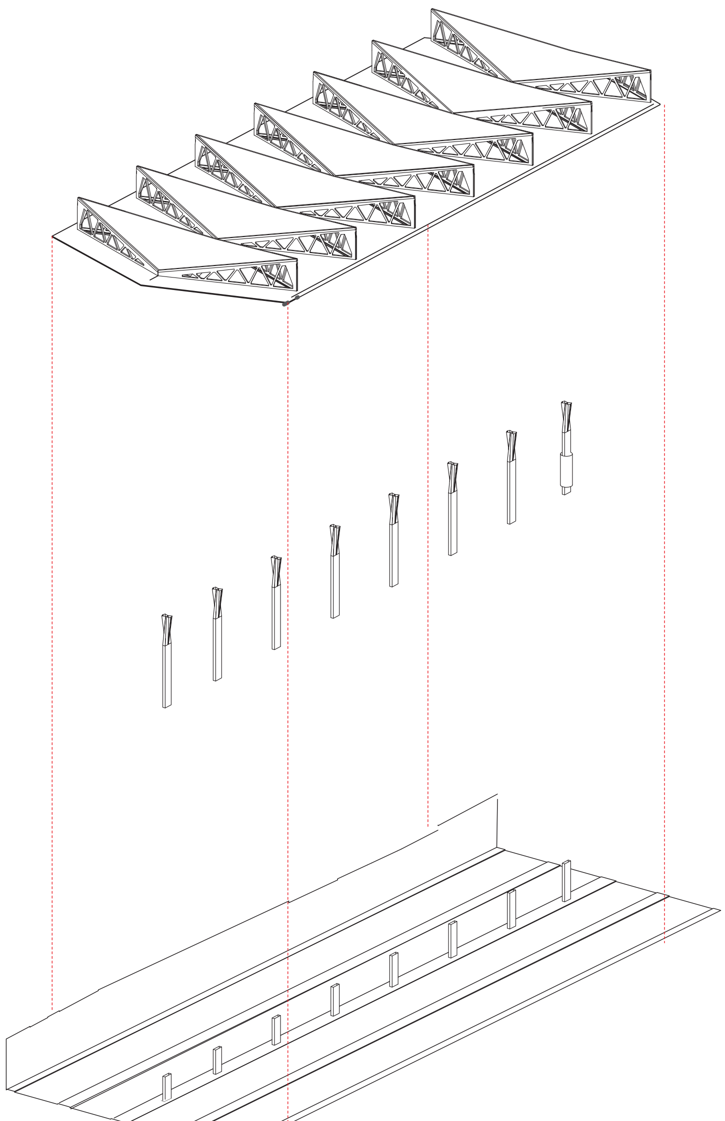
The first enhancement made within the expressway constraint layer are the columns are spatialized to form different spaces within the new bus terminal. Peripheral, transitional, and compartmental spaces are formed by strategically spacing the columns within the three medians of the Trans-Manhattan Expressway.

The second enhancement functionalizes each column. Each of the columns provides a specific program or function for the plaza, bus terminal, or expressway. For example, several of the columns form cafes, ticket booths, and circulation systems. Whereas other columns provide services for the plaza and expressway. Freeway ventilation, air treatment, water collection, and plaza planters are some of the functions accommodated by the new columns.

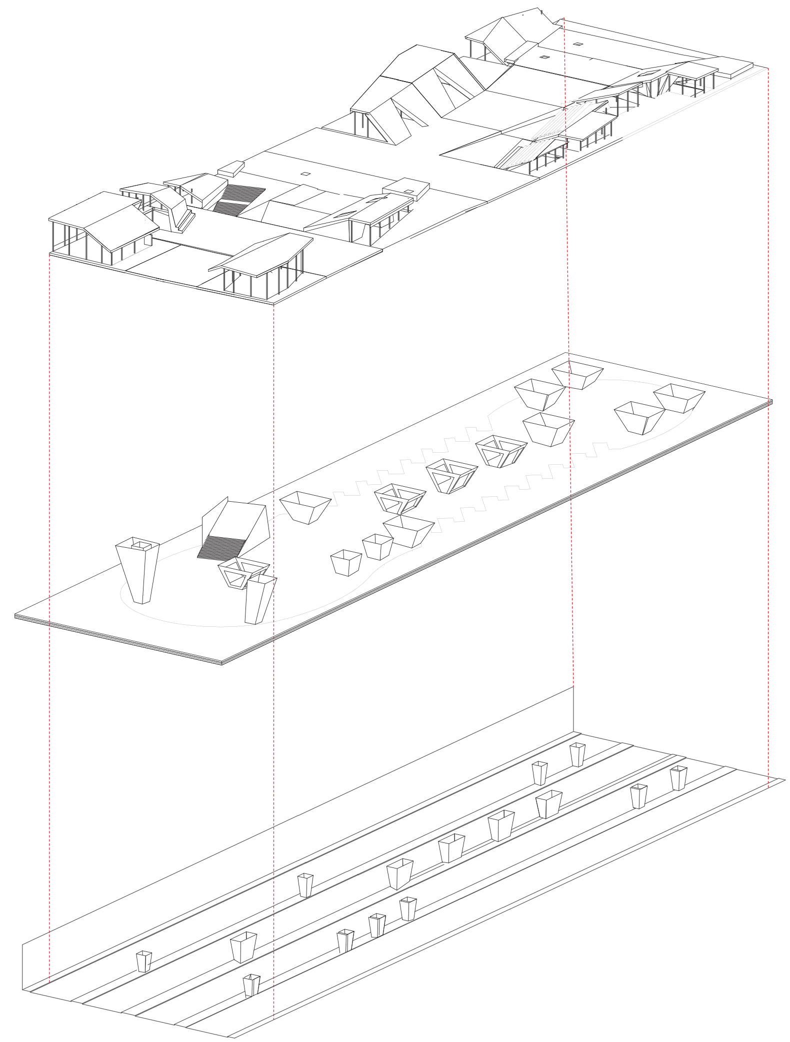
The third improvement is to radicalize Nervi's free zone. To break away from the symmetry of Nervi's roof and to create a surface which responds to the urban conditions of the site. The plaza surface is meant to act as an interface between the adjacent discontinuous fabric, stitching it together in order to create a dynamic environment in the heart of the city.

Together these three interventions create a new paradigm that can be deployed at discontinuous infrastructure sites. The resulting plaza and bus terminal, creates a dynamic open space in a community in desperate need of civic open space.

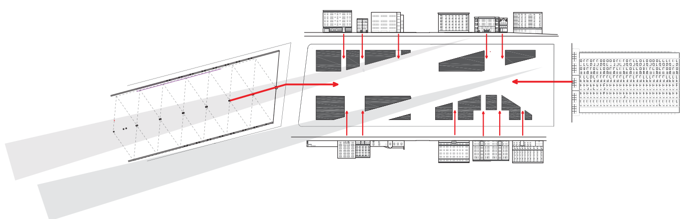




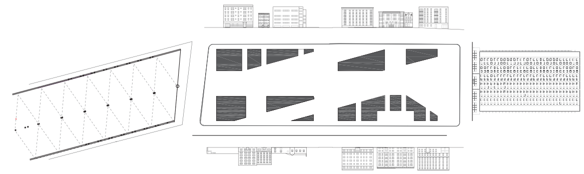
NERVI BUS TERMINAL



PROPOSED PLAZA AND BUS TERMINAL

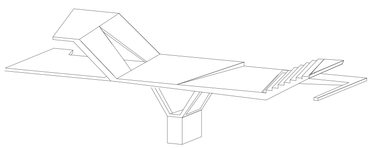


URBAN OPPORTUNITES AND CONSTRAINTS

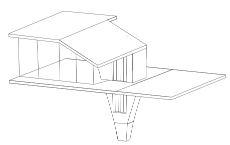


CONTINUITY VERSUS DISCONTINUITY

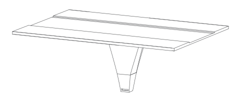
03 RADICALIZED SURFACE



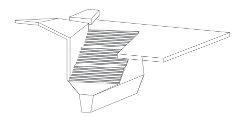
CAFE / AMPITHEATER



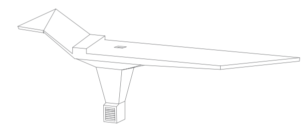
ELEVATOR / CAFE



STREET / WATER COLLECTION

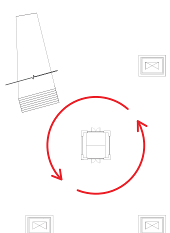


CIRCULATION

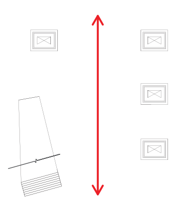


PLANTER / FREEWAY FILTRATION

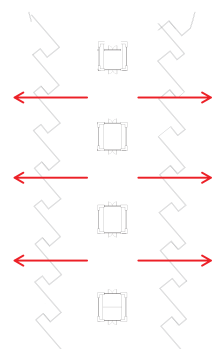
02 FUNCTIONALIZE COLUMNS



PERIPHERAL

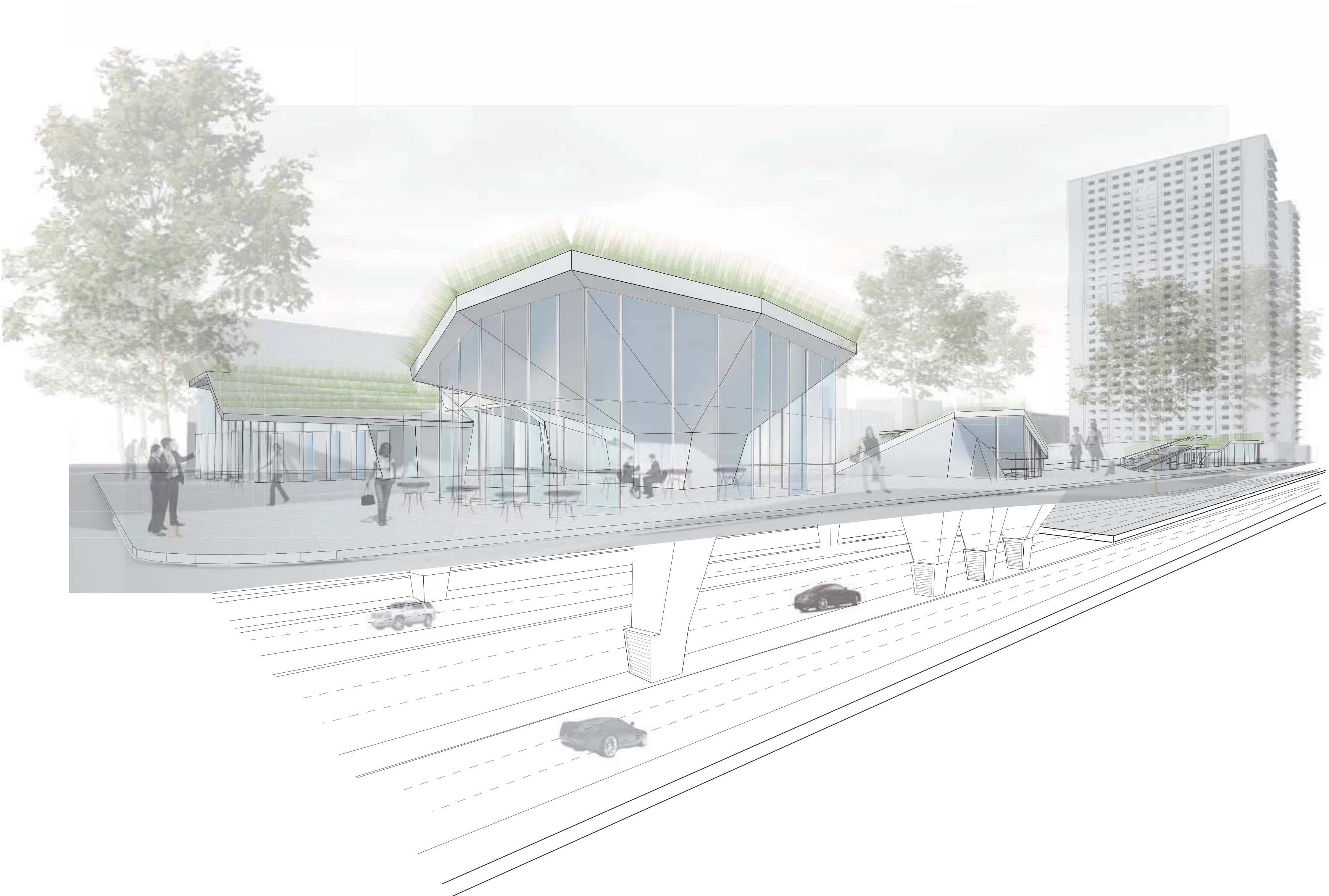


TRANSITIONAL

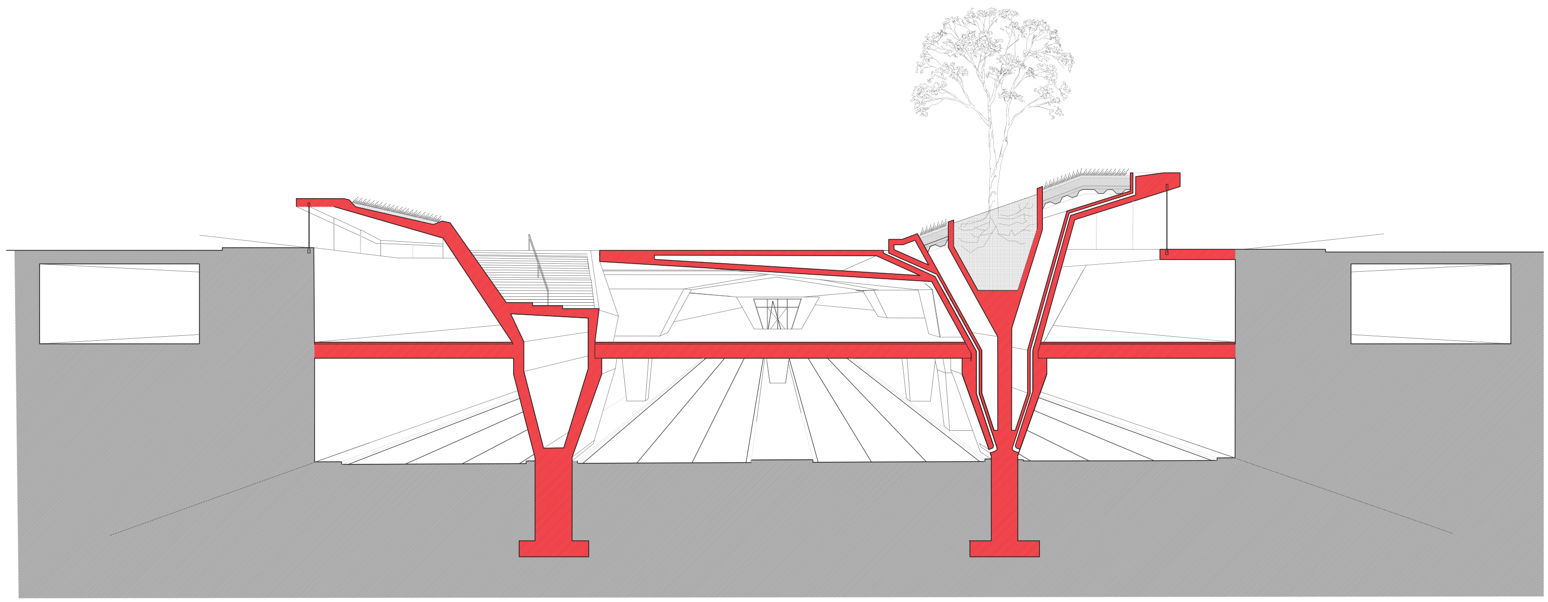


COMPARTMENTAL

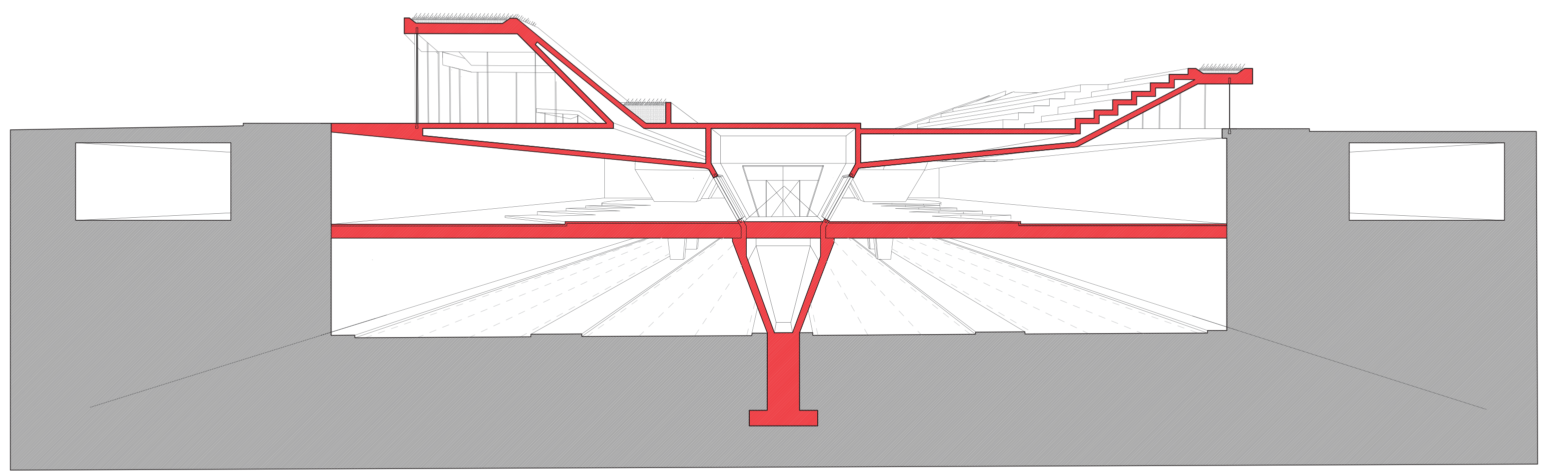
01 SPATALIZE COLUMNS



PROPOSED PLAZA
SHOWING EXPRESSWAY FILTRATION COLUMNS

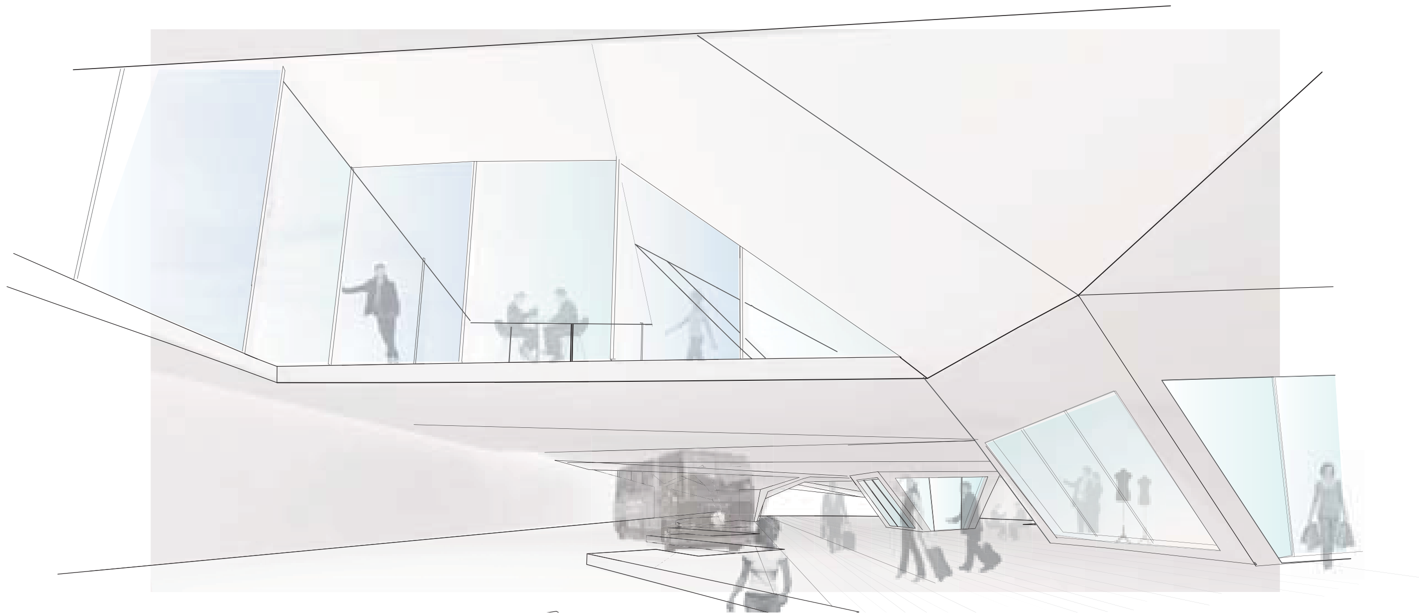


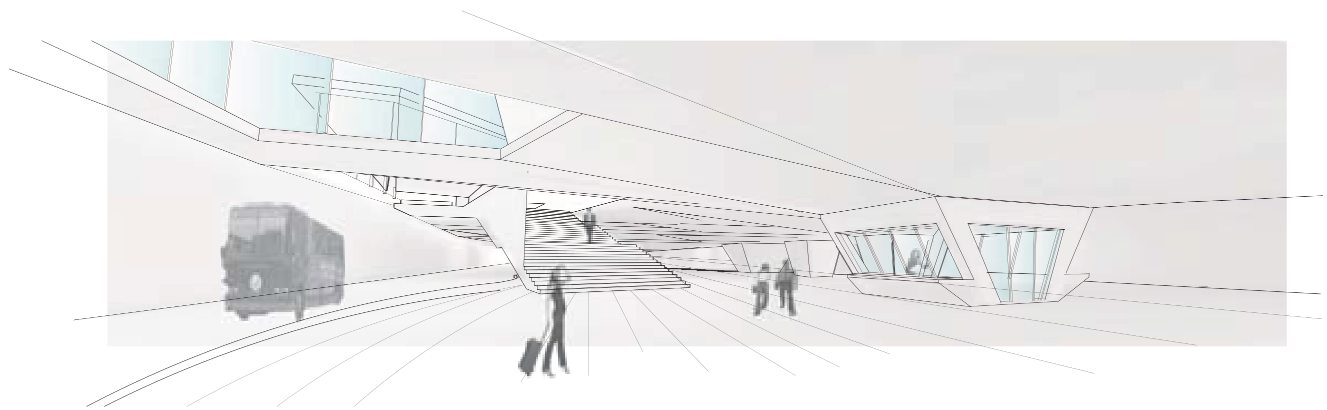
CIRCULATION COLUMN | EXPRESSWAY VENTILATION , WATER COLLECTION, AND PLANTER COLUMN



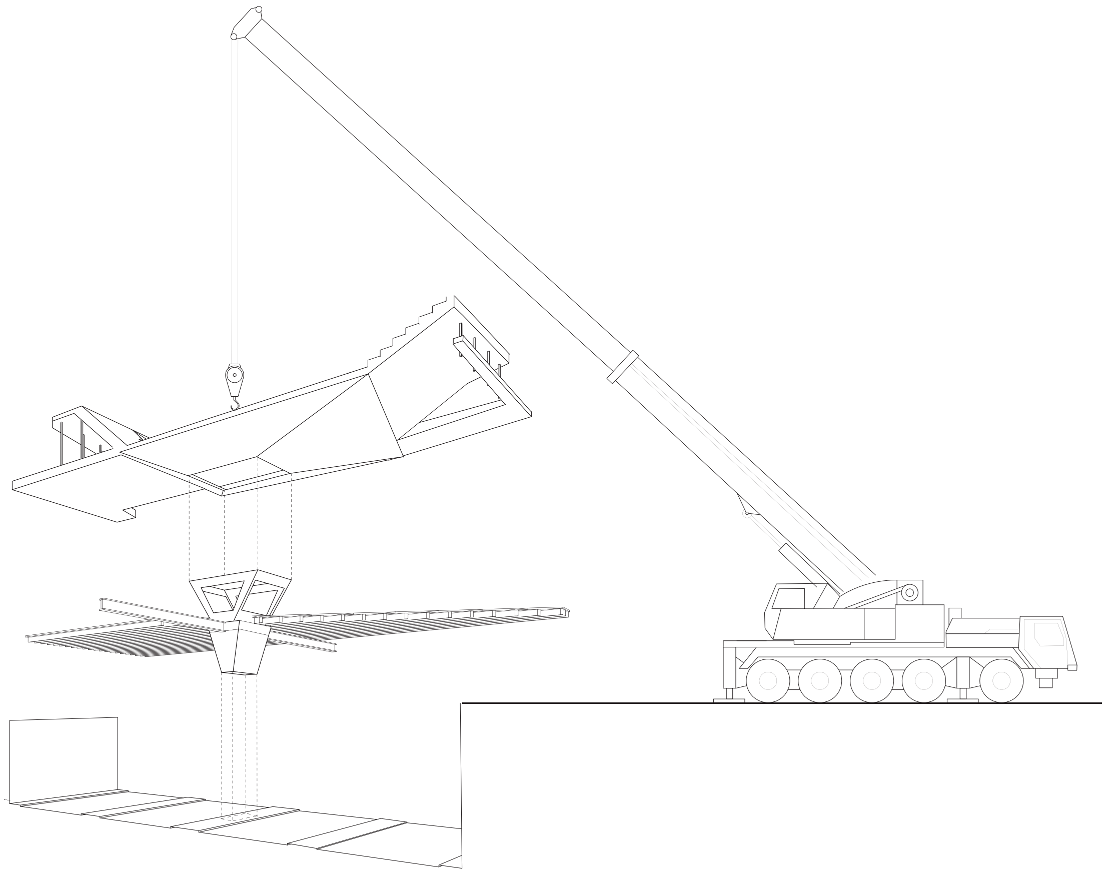
CAFE COLUMN

NERVI BUS TERMINAL | DARK AND HEAVY STRUCTURE





PROPOSED BUS TERMINAL | LIGHT AND AIRY

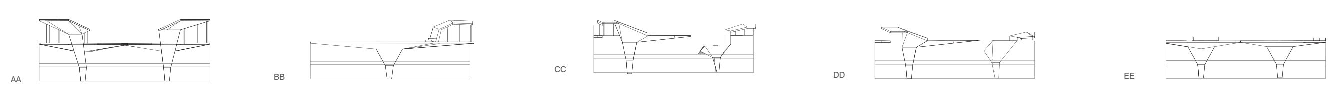


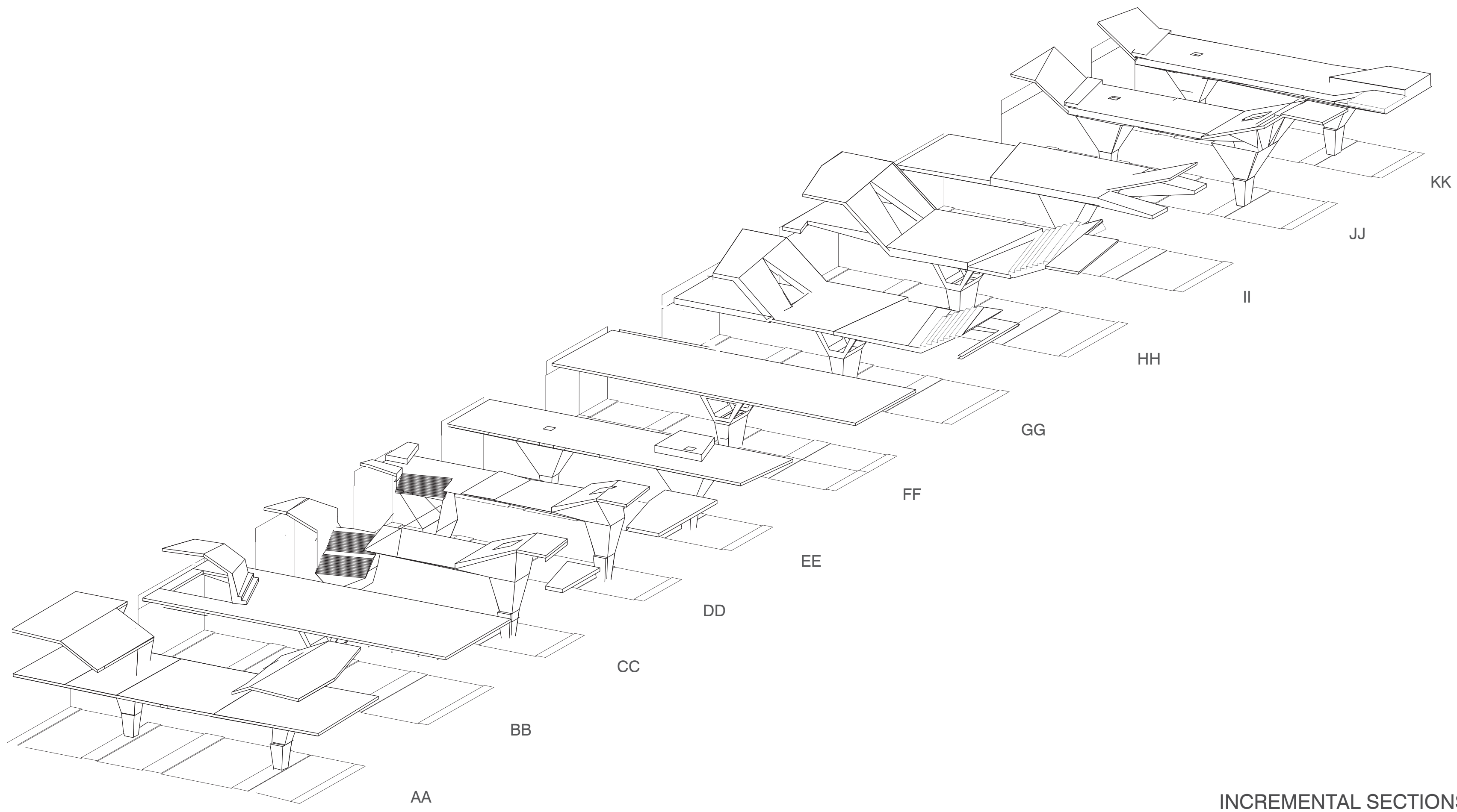
PRECAST UNITS

The proposed plaza and bus terminal is divided into a series of incremental sections. Each of these sections are precast concrete components, constructed off-site and assembled on-site, with minimum disruption to the roadways below. Whereas Nervi cast the George Washington Bridge Bus Terminal in place, when no vehicles where traveling below, the new plaza and bus terminal can be assembled in place with minimum disturbance to the expressway below.

The pre-cast structure of the plaza and bus terminal is also more structurally efficient than the cast-in-place George Washington Bridge Bus Terminal. This efficiency allows for greater transparency minimizing the need for structural mullions, permitting the greatest amount of light to penetrate the bus terminal.

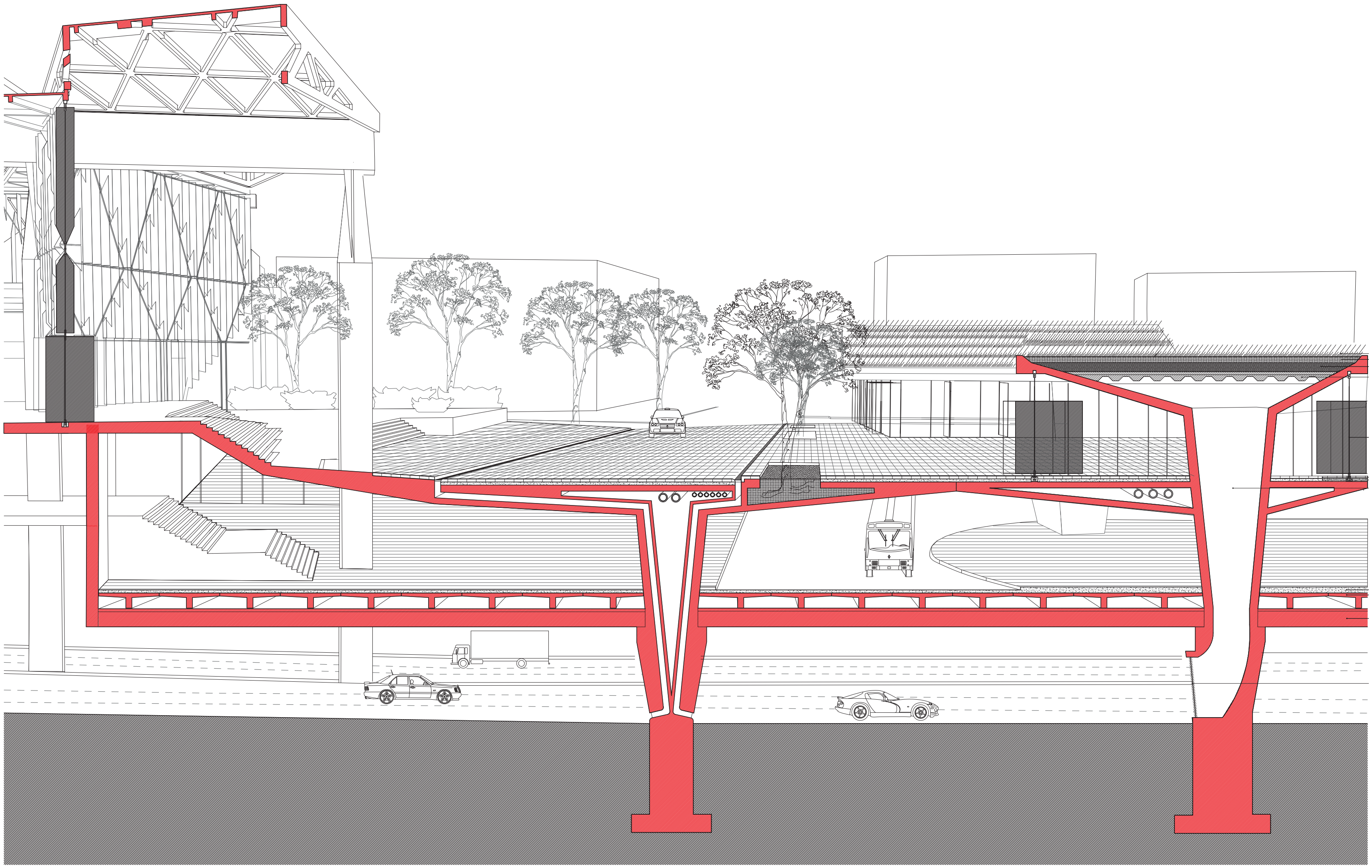
This construction strategy further reinforces the potential of this system to be used universally on discontinuous infrastructure sites. The entire plaza and bus terminal can be constructed off-site and assembled on-site in little time. This strategy can adapt to independent conditions of any site, providing an economical yet strategic solution to readapting discontinuous infrastructure sites in urban environments.





INCREMENTAL SECTIONS

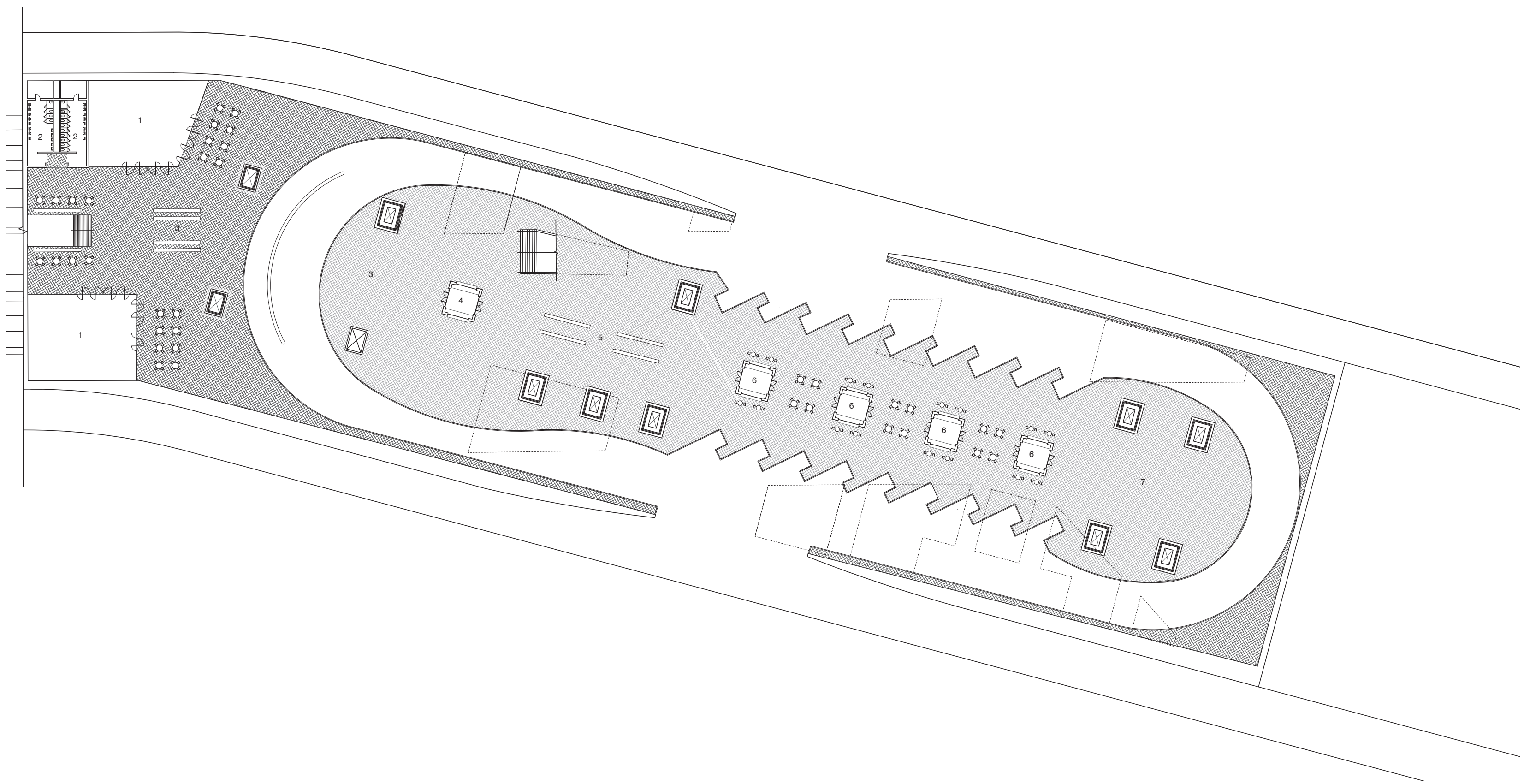
EXISTING BROADWAY AVENUE AND TRANS-MANHATTAN EXPRESSWAY



PROPOSED BROADWAY AVENUE AND TRANS-MANHATTAN EXPRESSWAY

PLAZA LEVEL

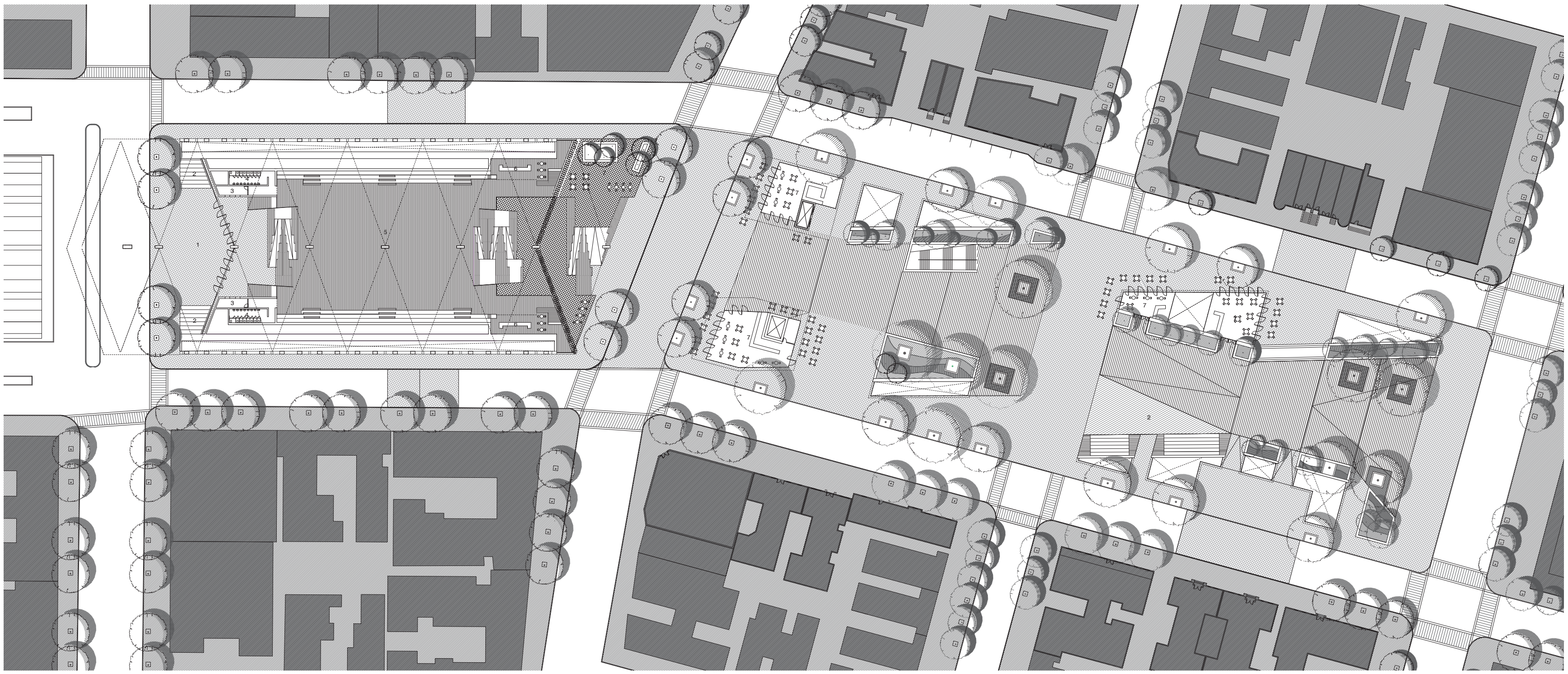
2 AMPHITHEATER
7 CAFE



BUS TERMINAL LEVEL

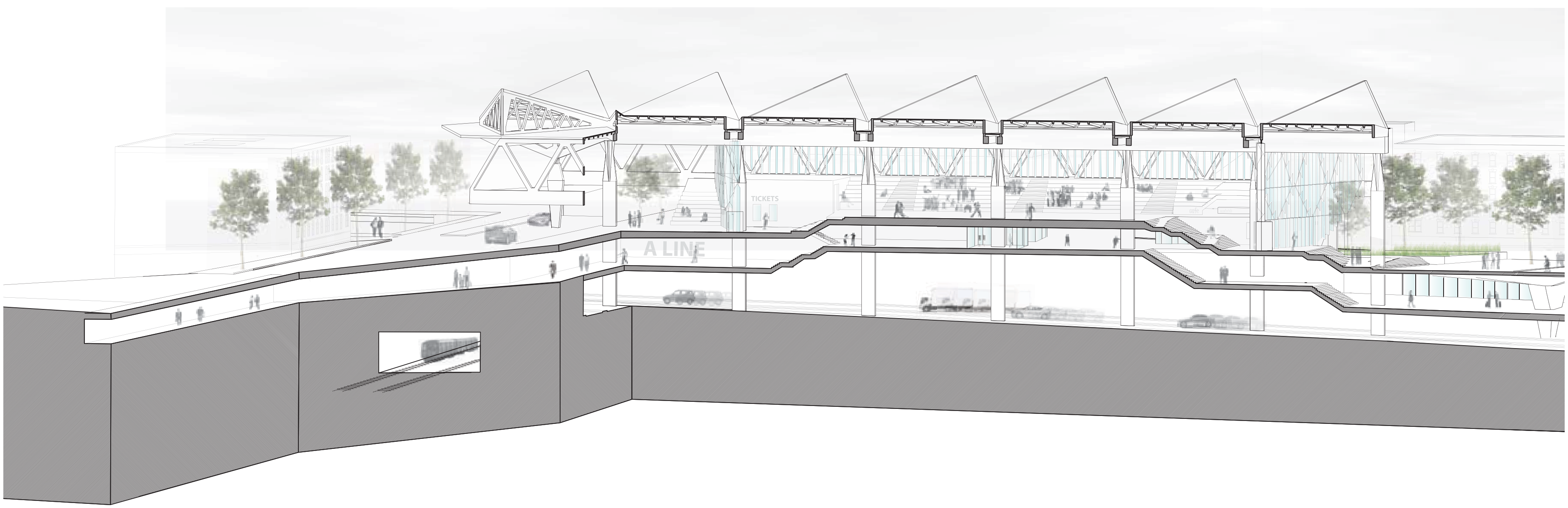
1	RETAIL
2	RESTROOMS
3	PICK UP AREA
4	TICKET SALES
5	WAITING AREA
6	CAFE
7	DROP OFF AREA

OVERALL CONCEPT

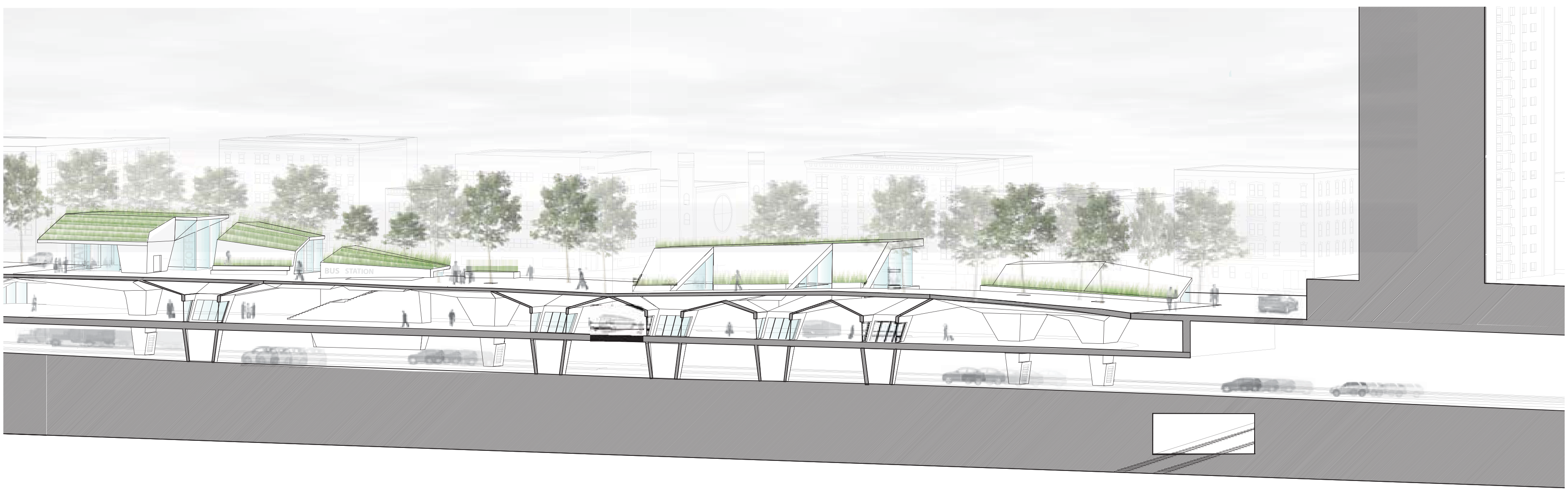


OVERALL PLAN | MAIN LEVEL

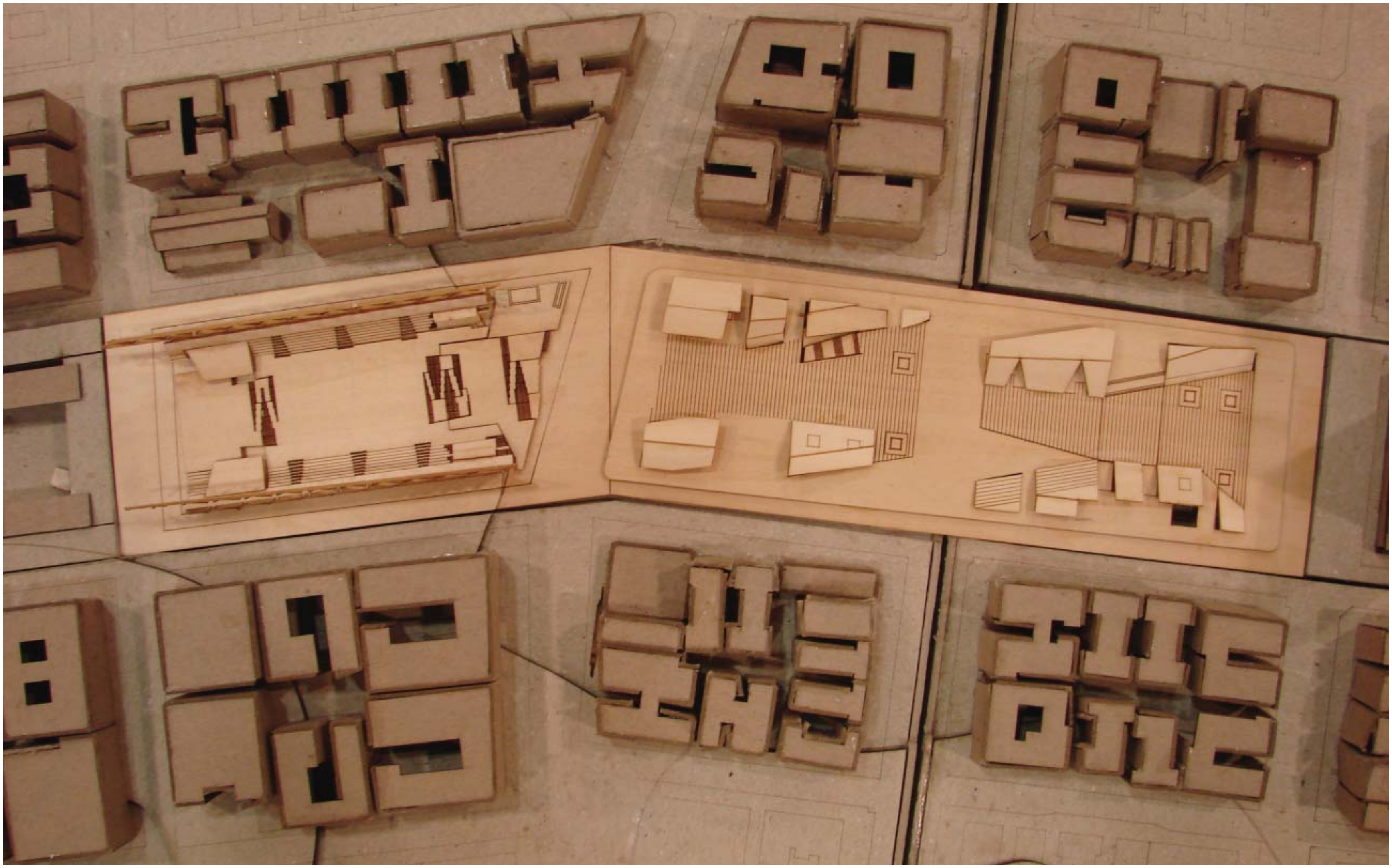
OVERALL PLAN | LOWER LEVEL



LONGITUDINAL SECTION


BUS STATION

DESIGN MODEL TRANS -MANHATTAN EXPRESSWAY



DESIGN MODEL

BIBLIOGRAPHY

American Association of State Highway and Transportation Officials. A Policy on Geometric Design of Highways and Streets. Washington D.C: American Association of State Highway and Transportation Officials, 2001.

Bird, David. "Kennedy Warns of Air Pollution 'Disaster'." New York Times. June 20, 1967.

Bird, David. "Expressway Plan Called Air Peril." New York Times. December 24, 1968.

Black, William. Transportation a Geographical Analysis. New York: The Guilford Press, 2003.

Bjarke Ingles Group. http://www.big.dk/.

Ferriss, Hugh. The Metropolis of Tomorrow. Princeton: Princeton Architectural Press, 1986.

Easterling, Keller. Organization Space Landscapes, Highways, and Houses in America. Cambridge: The MIT Press, 1999.

Engel, Heino. Structure Systems. Obertshausen: Max Dorn Presse, 1997.

Foreign Office Architects. Phylogenesis: foa's ark. London: Actar, 2004.

Foreign Office Architects. The Yokohama Project. Barcelona: Actar, 2002.

Hickok, Beverly. Development of Interstate Highway Program: 1916 to Date. Berkeley: University of California, Berkeley, 1980

Houck, Oliver. The End of the Road. Washington D.C: National Wildlife Federation, 1977.

Huxtable, Ada Louise. Pier Luigi Nervi. New York: George Braziller, Inc., 1960.

Knechtel, John. Fuel, Alphabet City no. 13. Cambridge: The MIT Press, 2009.

Le Corbusier. My Work. London: The Architectural Press, 1960.

Motta Architettura. Pier Luigi Nervi. Milan: Motta Cultura, 2009.

New York City Department of City Planning. Manhattan Community District 12. http://www.nyc.gov/.

NYCRoads.com. http://www.nycroads.com/.

Rapuano, Michael. The Freeway in the City. Washington D.C: U.S. Government Printing Office, 1968.

Reiser + Umemoto. The Atlas of Novel Tectonics. New York: Princeton Architectural Press, 2006.

Rodrigue, Jean-Paul. The Geography of Transport Systems. New York: Routledge, 2006.

Sadler, Simon. Archigram: Architecture Without Architecture. Cambridge: The MIT Press, 2005.

Stern, Robert A.M.. Raymond Hood. New York: Rizzoli, 1982.

Solomon, Jonathan D.. 13 Projects for the Sheridan Expressway, Pamphlet Architecture 26. New York: Princeton Architectural Press, 2004.

The Port of New York Authority and the Triborough Bridge and Tunnel Authority. Joint Study of Arterial Facilities. 1955

Weiss/Manfredi. Surface Subsurface. New York: Princeton Architectural Press, 2008.

Yoon, Meejin. Public Works: Unsolicited Projects for the Big Dig. Hong Kong: MAP, 2008.