SHAPING TIME LIGHT AND MOVEMENT A Modern Rail Station for Boston

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After a century of neglect, due to investment in worldwide road construction and enlargements of airports, there is a renewed incentive to revive rail travel within the continental US. This motivation is derived from both the environmental benefits of the electric train as well as the ease of urban travel between regional city centers. The topic of the thesis is to investigate a new major rail stop at the site of Boston's North Station. The new station will be developed as a stop on a future high-speed rail line connecting Portland, Maine to Washington D.C. and to points beyond. On the local level, the station will serve as an urban gateway organizing the complex convergence of lines including subway, commuter, and long-distance railways. These factors should be actively controlled and made visibly and functionally comprehensible to the visitor. The incentive lies in creating a functionally simplistic pedestrian experience enhanced by a conscious recognition of the underlying historical and programmatic complexity.

This thesis will embrace modern concepts of space-time in the practice of architectural design. This involves sensitive consideration of the perception of space relative to position and speed, light and movement. The design of a modern train station will be exploited as a means to making explicit the above issues in an architectural context. The goal is to create both organizational clarity as well as a dynamic aesthetic based on an explicit recognition of the movement of time through physical space.

As the station will be located underground, a heavy emphasis must be placed on creating a strong connection between interior and exterior spaces. Much of the design is concentrated on the introduction of light to deep concourses and waiting platforms at all times of day with the intent to create temporal diversity of vibrant spaces for dynamic users. At the urban level, the building will attempt to convey a legible reading to the complex network of tunnels beneath the city street level. A building that acts much as urban sculpture will serve to bind a severed neighborhood and provide a public space that North Station deserves. In addition to being urban landmarks, rail stations are often the place of arrival and departure for visitors and residents alike, they are complex places where diverse functions and people intermingle, organize and get orientated. The thesis strives to resolve all these purposes in an architectural expression of space, light, structure and movement.

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CONTENTS

film stills from Lucerne station in Switzerland - moving bodies modulate light as much as structure or any architectural element. frames 5-7 illustrate the meeting of two innocent strangers





The history of articulated space, the special space conceptions of different periods, has been determined by the grasp of one, two, three or more dimensions. The magnificence of the Egyptian temple could be comprehended by walking through a basically one-dimensional straight line, the sphinx alley, leading towards its façade. Later the Greek architects of the Acropolis designed a two-dimensional approach to the temple so that visitors had to move through the Propylaen, between the Erechteion and Parthenon, around the colonnades toward the main entrance. The gothic cathedral also applied this concept most intriguingly to the interior. The spectator was placed in the midst of the nave, vaults, balcony and choir, and became the center of coordinated space cells of all directions.... In our age of airplanes, architecture is viewed not only frontally and from the sides, but also from above.... The bird's-eye-view, and its opposites, the worm's and fish-eye-views, have become a daily experience. Architecture appears no longer static but, if we think of it in terms of airplanes and motor cars, architecture is linked with movement. The helicopter, for example, may change the entire aspect of town and regional planning so that a formal and structural congruence with the new elements, time and speed, will manifest itself.[1]

Laszlo Moholy-Nagy

Architecturally, the thesis seeks to incorporate modern conceptions of space-time through a sympathetic understanding of unique and diverse user perceptions based on position and speed, light and movement. The opportunity arises to design for different types of populace: for those who are waiting, to those who commute each day, to the tourist who is visiting Boston for the first time. Specifically, a new major rail stop at the site of Boston's North Station will be developed as a stop on a future high-speed rail line connecting Portland, Maine to Washington D.C. and to points beyond. The motivation lies in creating a functionally simplistic experience enhanced by a conscious recognition of the constantly changing perceptions resulting from a dynamic program and user interaction. The

design intent is to create an elegantly exposed and pragmatic aesthetic resulting from the isomorphic integration of architecture and engineering; the result being an architectural expression of space, light, structure and movement.

The approach to the design is formulated in three levels of inquiries. The first is to establish a modern understanding of space and time as relative to the spatial experience of built form. Secondly, an effort will be made to integrate both space and time within the programmatic context of the train station via light, structure, and movement. Third and lastly, the representation of architectural information will be questioned as it relates to the visualization of space-time relationships.

MODERN CONCEPTIONS of SPACE and TIME

> *"The temporal sequence is converted into a simultaneous co-existence, the side-by-side existence of things into a state of mutual interpenetration... a living continuum in which time and space are integrated."*[2]
>
> *Tibetan monk Lama Govinda*

With confidence in Einstein's theory of relativity, our very understanding of space-time has been revolutionized.[3] "Both Aristotle and Newton believed in absolute time. Time was completely separate from and independent of space. This is what most people would take to be the commonsense view. However, we have had to change our ideas about space and time."[4] On the contrary, it is the speed of light that we know to be a constant measurement. Light is now known to travel at a very high, and finite speed. The relativity theory states that "the speed of light is constant; it is the absolute speed in

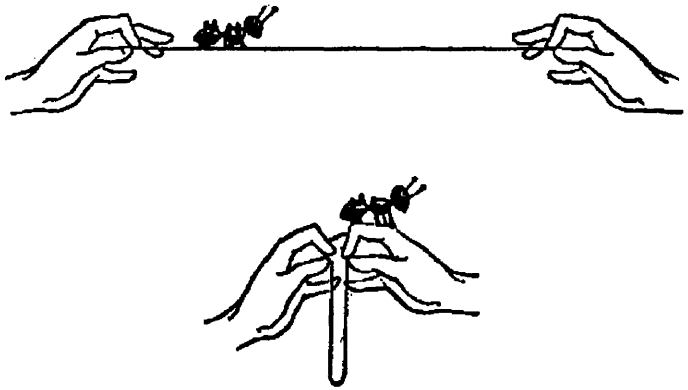
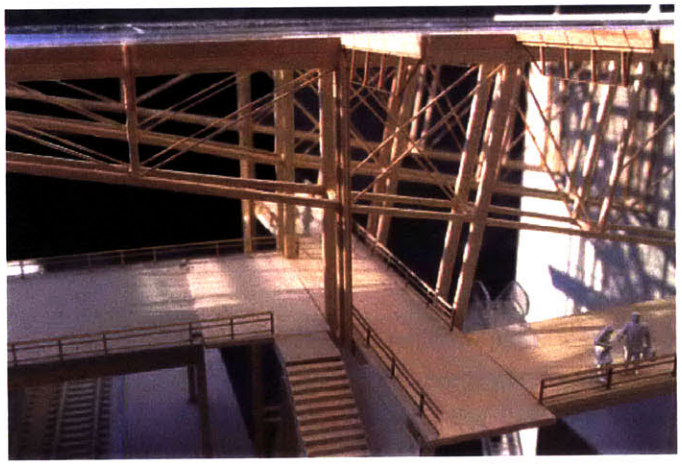


figure 1 - Both in books and in reality, travel commonly demonstrates the management of both space and time.

the universe. However, motion of objects can be measured relative to another motion. Time is a coordinate of space. It is the "fourth dimension" – a physical measurement."[5] When one begins to discuss time as it relates to architecture, it is unavoidable to point out light as the means by which we experience time. The play of and variations of quality of light are crucial to a building's inhabitants to understand the time of the day. Consequently, our experience of time is inextricably related to the perceptual experiences of the dynamic relationship between light and form. Further, considering the above interpretation of the theory of relativity, time is physically dependent on light.

In addition to time, perceptions of speed are in state of constant change. In recent years, speed is ever present. Media related items such as movies, TV shows, and games are intensified and increasing in speed. From a very young age, a child is taught to appreciate a quick attention span. The very idea of travel, or motion in the modern era is an intriguing and complicated notion. Be it virtually, where one can travel from one part of the world to the next in a flash of a second, or physically, by plane, train, or car – the concept of space seems to disintegrate. In the children's book, *A Wrinkle in Time*, Madeleine L'Engle describes a tesseract, "You add that to the other four dimensions and you can travel through space without having to go the long way around. In other words, to put it into Euclid, or old-fashioned plane geometry, a straight line is *not* the shortest distance between two points."[6]

The speeding up of time has resulted from technological advance. In James Gleik's book, *Faster: The Speeding Up of Just About Everything*, he writes about the standardization of time, "Railroads demanded punctuality - they forced people to be "on the clocker" or even "on time." Until they could ride on trains, few people traveled fast enough to notice clocks set differently at their destination."[7]



proposed North Station – traveling through space – in four dimensions

Now, seconds matter to designers in all fields. For example, the automobile airbag designer is concerned with milliseconds. Gleik described that "you may find yourself punching eighty-eight seconds instead of ninety because it is faster to tap the same digit twice. You face new dilemmas: does standing at the microwave for a minute and a half make you feel that you are wasting time?"[8] It is important to realize that in many programs of buildings, the primary motivation is to move people efficiently throughout the space. This is no truer than in the programmatic context of the train station. How they perceive spatial elements is dependent on the speed in which they move. As an architect, one can make an effort to direct movement patterns in a building, but there is little control over the motions of a building's inhabitants. Their interactions with each other, with light and with shadows affect the experience of space as much architectural elements such as columns and walls. Thus, the designer can be sensitive to provide legibility and definition for many different scenarios of movement. Experiential activities might include running, walking, standing, sitting, lying, or flying above. Legibility, programmatic and other, is critical at various speeds.

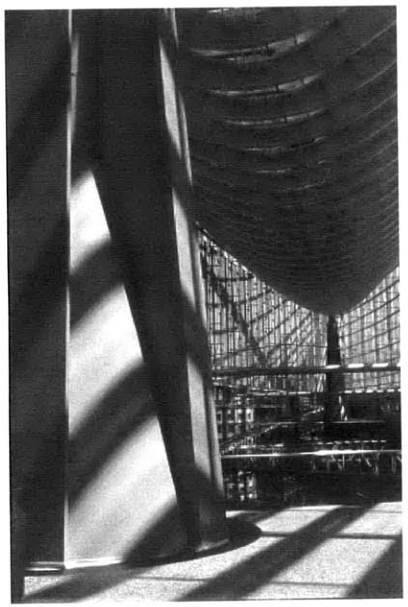
We are now able to travel through space virtually. We can shrink space and travel to Africa or Europe; and we can play games with someone in the same room or in another country. It is like the fifth dimension that L'Engle talks about – a space, which is not really physical, though it certainly exists to be experienced. On the new high-speed trains, one can travel physically and virtually simultaneously. These faster trains will incorporate technologies that will allow travelers to plug in laptops and switch between the tangible world outside the window and the virtual world within their computers. As a result of this and due to the culture of today, users of trains are able and skilled to focus between two different types of worlds. Likewise within buildings such as offices, inhabitants must shift focus between

computer screens and the outside world in order to preserve their vision. Lawrence Shapiro, in an article entitled "Architecture, History and the Embodiment of Speed" talks about the speed and "the perception of travel without actual movement" as "a perfect analogue to ideology that convinces us that we are doing one thing while in fact we are doing quite another. We are held raptly in a state of attention – or distraction, ... the sense that the speed of travel offers a kind of mastery of time and space....As the redemption through technology presents itself: offering to collapse time and space, promising to unite us in one community, we should wonder about the social dimensions of the re-mapping of individual and environment."[9]

IMPLICATIONS for ARCHITECTURE

> *"Architects have been taught to eliminate questions of flow and motion from the rigorous description of space, thus these qualities have been relegated to personal taste and casual definition. Architecture's present lack of experience and precedent with motion and force make it necessary to raise these issues from within the technological regimes of the tools rather than from within the history of architecture."*[10]
>
> *Greg Lynn*

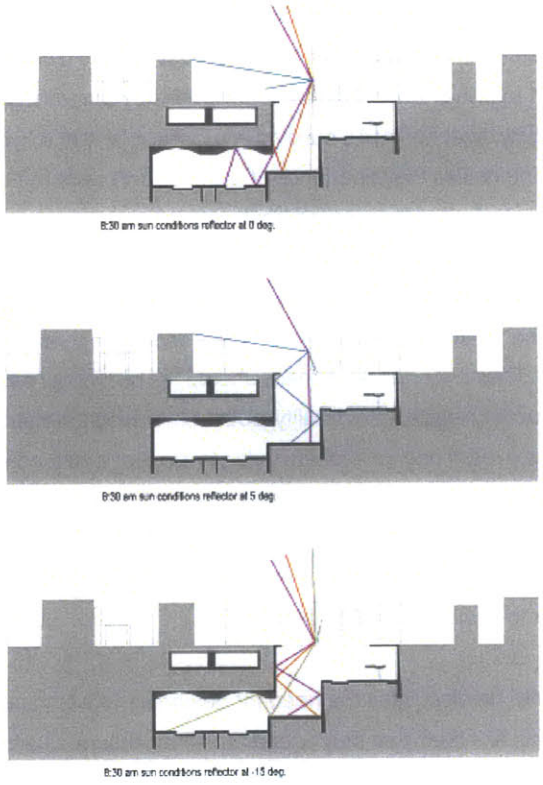
There are few architects who have succeeded in providing a constantly changing environment to appreciate experiencing a building 4-dimensionally. One example is Frank Gehry. Frederic Jameson writes of Gehry's work, "... the world vanishes to a multitude of points, and he does not presuppose that any are related to the standing human being. The human eye is still of critical importance in Gehry's world, but the sense of center no longer has its traditional symbolic value."[11] His approach to



Tokyo Forum - users perceive scales of both near and far

design is quite different to those of the past discussed in the first paragraph quoted in this paper. We begin to inhabit space vertically, within the framework of many layers, and demand an experience that is unique to the task that we perform. In Bilbao Guggenheim, visitors climb around the building. Rafael Vinoly makes manifest these ideas in the Tokyo Forum Complex. The building has a perceivable registration plane, yet people are given the framework to visit from several angles and every possible elevation. Exhibition-goers queue up at the lowest level, while conference attendees mingle at the above-grade level. Perched on the highest level are lookout areas for visitors to see the city of Tokyo. A single ramp wraps around the perimeter of the building and multiple ramps criss-cross the upper space connecting convention areas with bridges over to other buildings. Like Gehry, there is no single view of the space. Architectural photographs do not begin to convey the spatial experience of the building.

With this argument, the design at North Station prioritizes light and movement as the agents to allow inhabitants to experience both space and time. In plan, a zone of movement and light 80 feet wide by 100 feet tall separates the two areas. This is to be developed as the focus of the building interior. At the exterior, the roof of the building is designed as a habitable horizontal façade, a space for Boston residents and visitors alike. Above the circulation zone, moving reflectors are erected in order to deflect light to the ground level 100 feet below grade. The orientation of the reflectors responds to daylighting conditions. In the morning, those that face east deflect at a prescribed angle in order to divert light. The result is provides a rich diversity of lighting conditions to the space below. At the plaza level, the angles of the reflectors signify the time of day as well. To the rider who is running to the train station, or to the office worker in the building next door, the position of the light-directors is an indication

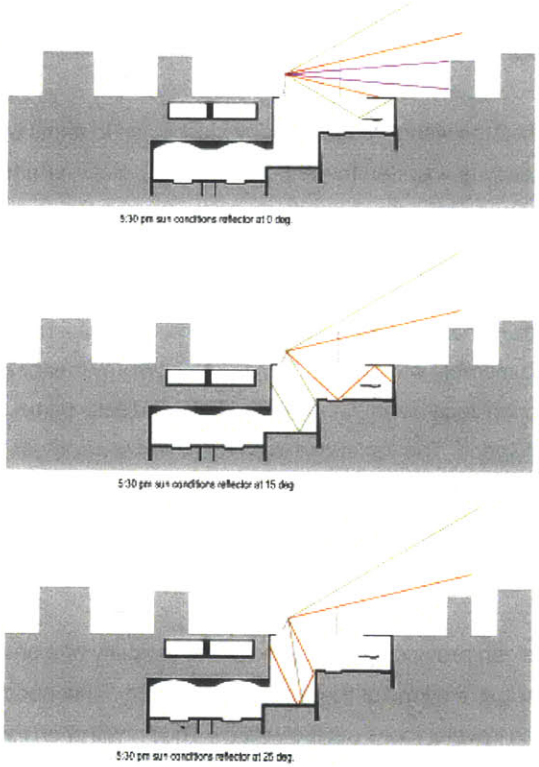


Diagrams showing angling of reflectors in morning (8:30 am) to deflect light into the station. Lines represent times of year - December 21, March 21, June 21, and September 21.

of the time of day. These objects further signify when the building is closed or experiencing inclement weather by retracting into the surface of the floor.

Gyorgy Kepes, in *Language of Vision,* writes that "the visual image of today must come to terms with all this: it must evolve a language of space, which is adjusted to the new standards of experience. This new language can and will enable the human sensibility to perceive space-time relationships never recognized before."[12] The language of design in this building is its structure. Architecture, though confined by gravity and other such forces, is not bound to the plane, but has space as its limit. Architecture can also be considered a language in that it contains an inherent grammar. "Just as the letters of the alphabet can be put together in innumerable ways to form words which convey meanings, so the optical measures and qualities can be brought together in innumerable ways, and each particular relationship generates a different sensation of space. The variations to be achieved are endless."[13] Architecture's analogies to the parts of speech in grammar are the structural members of a building. Instead of letters being organized into words, sentences, and paragraphs, the structural elements of architecture combine to form a system.

This rhythmic repetition of structural elements can provide a framework for the legibility of a grand space, similar to those present in great passenger stations of the nineteenth century. This need is also apparent while sitting on the train; when the traveler looks out the window. Riders will often try to focus on objects in the distant background, and not on trees and railroad ties moving very quickly in front of the eye. This applies to fields outside of architecture. The fact that people perceive objects depending on speed has formulated an entire field of advertising. In a book entitled *Vision in Motion*,



Diagrams showing evening (5:30 pm) lighting conditions. By angling the reflectors, changes in lighting qualities become evident.

Moholy-Nagy writes, "motion, accelerated to high speed, changes the appearance of the objects. There is clearly a recognizable difference between the visual experience of a pedestrian and a driver in viewing objects. The difference is produced by the changed perception caused by the various speeds."[14] The changing depth of field perceived by inhabitants of a building is successful in the Tokyo Forum. The repetition of large swelling trusses intensifies the experience of a unified and celebrated space. At the same time, objects that may be located in the foreground are highly articulated.

Attention versus distraction is exemplified within the program of a train station. Travelers generally fall into two categories – those that are waiting, and those that are moving. There ensues a constant dichotomy between these different populations. Their experience of space should not be discounted as similar. At times, it is necessary to read the building legibly in its totality, both from a programmatic sense and an aesthetic or conceptual sense. The eyes of one traveler are trying to focus at a distance, another may seek out distraction in the mundane, by reading newspapers and advertisements they have seen many times before, or doing anything to divert their attention. Consequently, the train station can be a very impersonal space. In addition to signage and advertising, architectural details can try to attract the attention of those that seek to avoid others travelers.

In Greg Lynn's article entitled "Geometry in Time" he discusses the need for designers to welcome motion in architecture, "The dilemma for architects has been that they understand their cultural role to be providers of shelter, stasis, and permanence. Unfortunately, most architects separate force from form because they assume that an ethics of motion is contradictory to the central tenet of architecture: that it is timeless, inert, and static"[15] The design at North Station will certainly not be viewed as static.

train-riders do not typically stare at railroad ties, objects nearby appear to be moving faster than those far away

Depending on the combinations of arrival and departure times of eight different train lines, there exist infinite possibilities of scenarios throughout the course of the day. Many dynamic forms are occupying the building at any given time, including trains, people, and light. In response to this vibrant character, efforts have been made in order to give the building an existence in the works of space and time. Summing up in the words of Laszlo Moholy-Nagy, "Step by step the necessary changes are coming. But even the most modern architecture of the static type is only a transitory step toward the future architecture of kinetic character. Space-time is now the new basis on which the edifice of future thoughts and work will be built."[16]

RENDERING in SPACE and TIME

> *"The appetite for architecture today, therefore – about which I am on record as agreeing that the postmodern certainly revived, if it did not outright reinvent it- must in reality be an appetite for something else. I think it is an appetite for photography: what we want to consume today are not the buildings themselves… what we take for color in the outside real world is nothing but information on some inner computer program, retranslating the data and marking it with the appropriate hue, like the tinting of classical Hollywood movies. The real color comes when you look at the photographs, the glossy plates, in all their splendor…. Many are the postmodern buildings that seem to have been designed for photography, where alone they flash into brilliant existence and actuality with all the phosphorescence of the high-tech orchestra on CD…. It is like the transition from precious metals to the credit card: the 'bad new things' are no less expensive, and you no less consume their very value, but, it is the value of the photographic equipments you consume first and foremost, and not of its object."*[17]
>
> *Fredric Jameson*

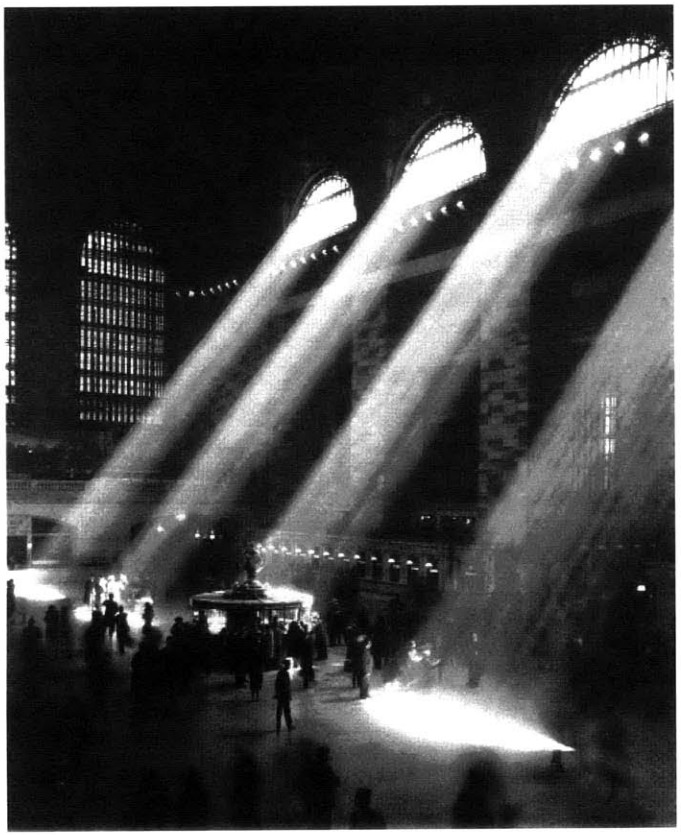
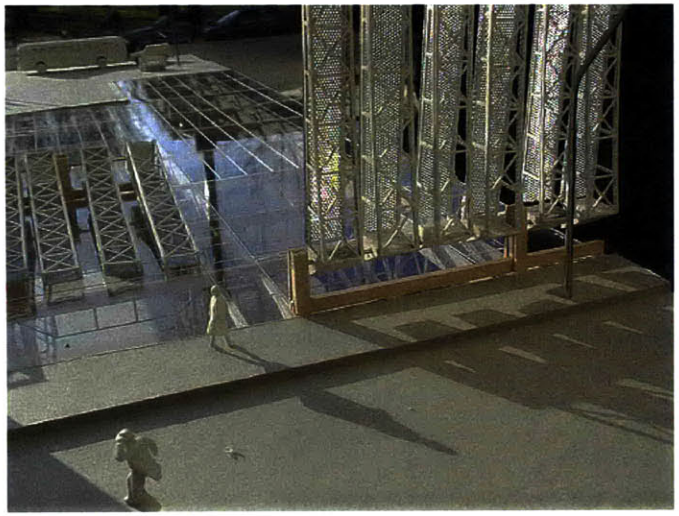


figure 2 - Grand Central Station – Integrating Time and Light

In addition to the effect of space-time understandings on the discourse of architectural design, I would like to discuss its effects on the actual documentation of space and architecture. Our primary method of representation has been photographs. The need to document the building has often encouraged immobile points of views at singular points in time. A building may be designed to let in a sharp glare of light at 4:30 PM on March 21st so that this single moment can be glorified in books and magazines. The result is picture-perfect memories and associations with buildings that do not match our own experiences. Though there is always a limit to how much one can predict before construction, modern tools allow us to visualize what we can afford to see.

These advances have been shaping both architectural schools and practices; no longer are schemes shown only with plans, sections and elevations; final proposals are shown complete with models to perceive 3-dimensional space. Video and animations further demonstrate simulations of user's perception of moving through a building. In some cases, architectural books have given way to interactive CD-ROMs. In such a scenario, an interactive floor plan might allow one to click on a location and specify both camera and target locations, which will in turn generate a rendering of the space. Further, animations can render temporal simulations of actual interaction with the architectural space, complete with up-to-date daylighting conditions.

Laszlo Moholy-Nagy described the importance of the skill of rendering as a step in visual perception, "The mass construction of war planes ... called for complex working instructions. But the workers could not comprehend their tasks through references contained in the customary blueprints. Factories had to resort to new methods of visualization called 'production illustration'... tried to translate the



proposed North Station – Integrating Time and Light

space-time sequence of production into a visually perceivable language. Photomontage, superimpositions, diagrams, explosion, phantom, x-ray, cut-away techniques, stroboscopic motion projects and other combinations may enlarge its scope tremendously."[18] This was written in 1954. Architecture has since looked to other disciplines such as the movie, or gaming industries, where scenes are rendered in real-time to allow for an infinite number of animations. Newer technologies and methods have in fact been developed; in 1998 Bill Mitchell, the dean of the School of Architecture at MIT, writes, "this new, silicon-powered, network-enabled, high-speed intellectual style is now remaking architectural discourse.... We can employ increasingly powerful geometric modeling software, simulate performance in every imaginable way, routinely produce extremely sophisticated visualizations and computer-generated physical prototypes..."[19] Boston's Central Artery Tunnel Project, to which I will refer to later, could not have been completed without computation "which permeates every aspect of the project from 3-D animation to the 'smart' drawing linked to scheduling and construction sequencing, as well as tracking commitments through monitoring the rat population and measuring air quality throughout construction."[20]

The accelerating pace and inclusivity of technological development is not limited to rendering architectural simulations or images, but architecture must adaptively consider the rapidly changing patterns of human interaction with the built environment. New architectural types are emerging and evolving within today's technologically developing society. These new programs present practical architectural situations for unique and wholly unexplored applications that address today's dynamic, flexible and constantly changing activities.

1 Laszlo Moholy-Nagy, *Vision in Motion*. (Chicago: Paul Theobald and Company, 1961) p. 245.

2 Paul Davies, *About Time – Einstein's Unfinished Revolution*. (New York: Orion Productions, 1995) p. 25.

3 Stephen Hawking. *A Brief History of Time*. 10th anniversary ed. (New York: Bantam Book, 1988) 21-22.

4 Hawking, p. 18.

5 Moholy-Nagy, p. 266.

6 Both image and text are taken from - Madeleine L'Engle, *A Wrinkle in Time*. (New York: Ariel Books, 1962) pp. 76-78.

7 James Gleik [Online] Available: http://fasterbook.com/cgi-bin/faster/fchapter.pl?5

8 Gleik. [Online] Available: http://fasterbook.com/cgi-bin/faster/fchapter.pl?5

9 Lawrence Shapiro. "Architecture, History and the Embodiment of Speed: Mapping the Spaces of Here and There." *Thresholds 16: Speed Impact Change* (Cambridge: 1998) pp. 67-69.

10 *Greg Lynn, "Geometry in Time,"* Anyhow *(New York: Anyone Corporation, 1998) p.171.*

11 Fredric Jameson, "The Cultural Logic of Late Capitalism" *Postmodernism: A Reader*, ed. Thomas Docherty, (New York: Columbia University Press 1993) p. 117.

12 Gyorgy Kepes. *Language of Vision*. (New York: Dover Publications, Inc., 1995)

13 Kepes, p. 23.

14 Moholy-Nagy, p. 245.

15 Greg Lynn, p.165.

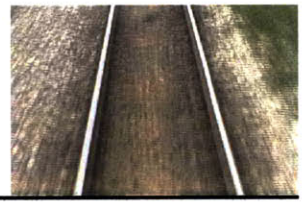
16 Moholy-Nagy, p. 264.

17 Jameson, pp. 98-99.

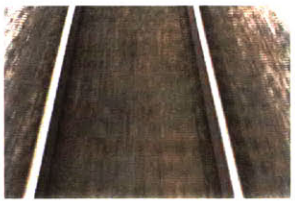
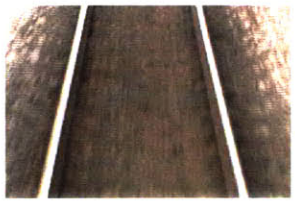
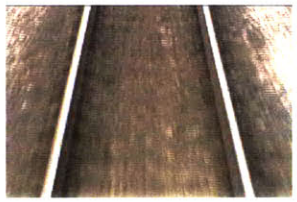
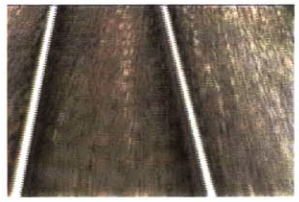
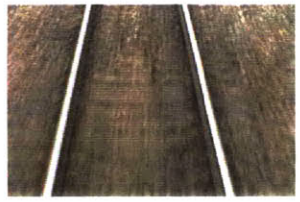
18 Moholy-Nagy p. 245.

19 William J. Mitchell, "Speed, Impact, Change" *Thresholds 16*, (Cambridge, 1998) pp. 7-8.

20 Murray, Herbert. "Il Grande Scavo Continua" *Spazio e Società*. Volume 73. P. 35.



film stills from Tokyo to Takayanagi - parallel lines dictate the movement pattern of trains.

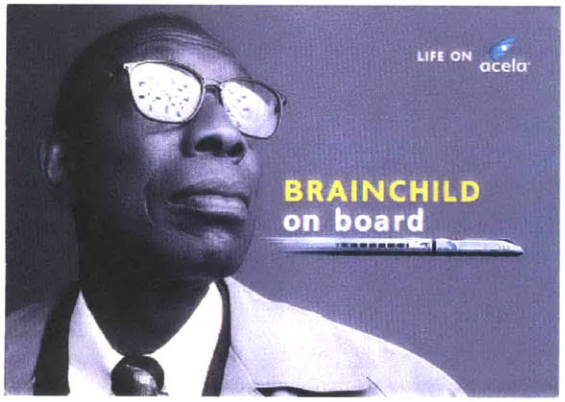






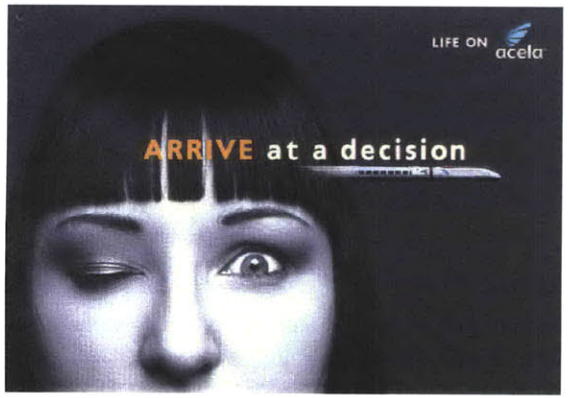
"Few buildings are vast enough to hold the sound of time, and now it seemed ... that there was a superb fitness in the fact that the one which held it better than all others should be a railroad station. For here, as nowhere on earth, men were brought together for a moment at the beginning or end of the innumerable journeys, here one saw their greetings and farewells, here, in a single instant, one got the entire picture of the human destiny."[1]

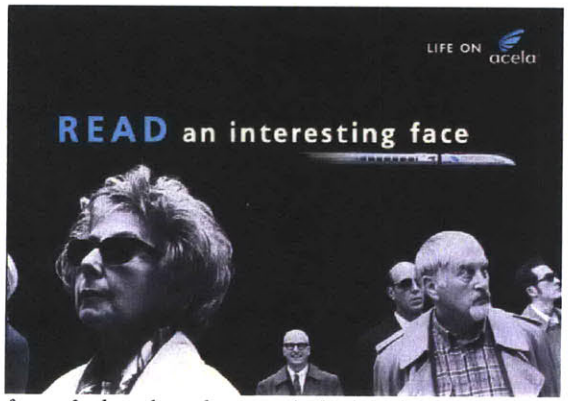
Thomas Wolfe

Hailed as the crossings of the world, where people with nothing in common except that they are about to embark on a journey, meet for single fleeting moment - the railway station, from its conception has been romanticized and been enamored by many. Great passenger stations of the nineteenth century were engineering miracles of their age, as well as high points in urban design. These self-contained cities represented the fusion of architecture and engineering culminating in celebrations of powerful social, economic and cultural force There is no end to the quotes and movie clips and photographs which have tried to capture the essence of the these grand railway stations.

Railway termini "are to the nineteenth century what monasteries and cathedrals were to thirteenth century. They are truly the only representative building we possess.... Our metropolitan termini have been leaders of the art spirit of out time."[2] "Since the world's first railway station, Darlington, opened in 1826, stations have always maintained a special place in the public's affection. The lure of the great railway terminus has always been especially strong: the breathtaking grandeur, swagger and opulence



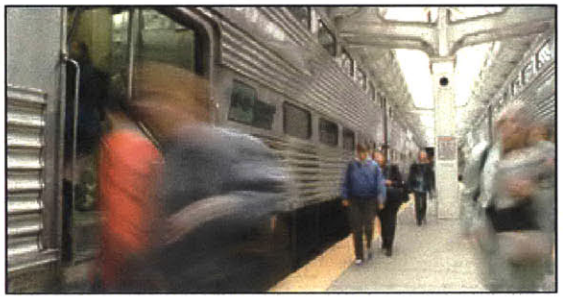


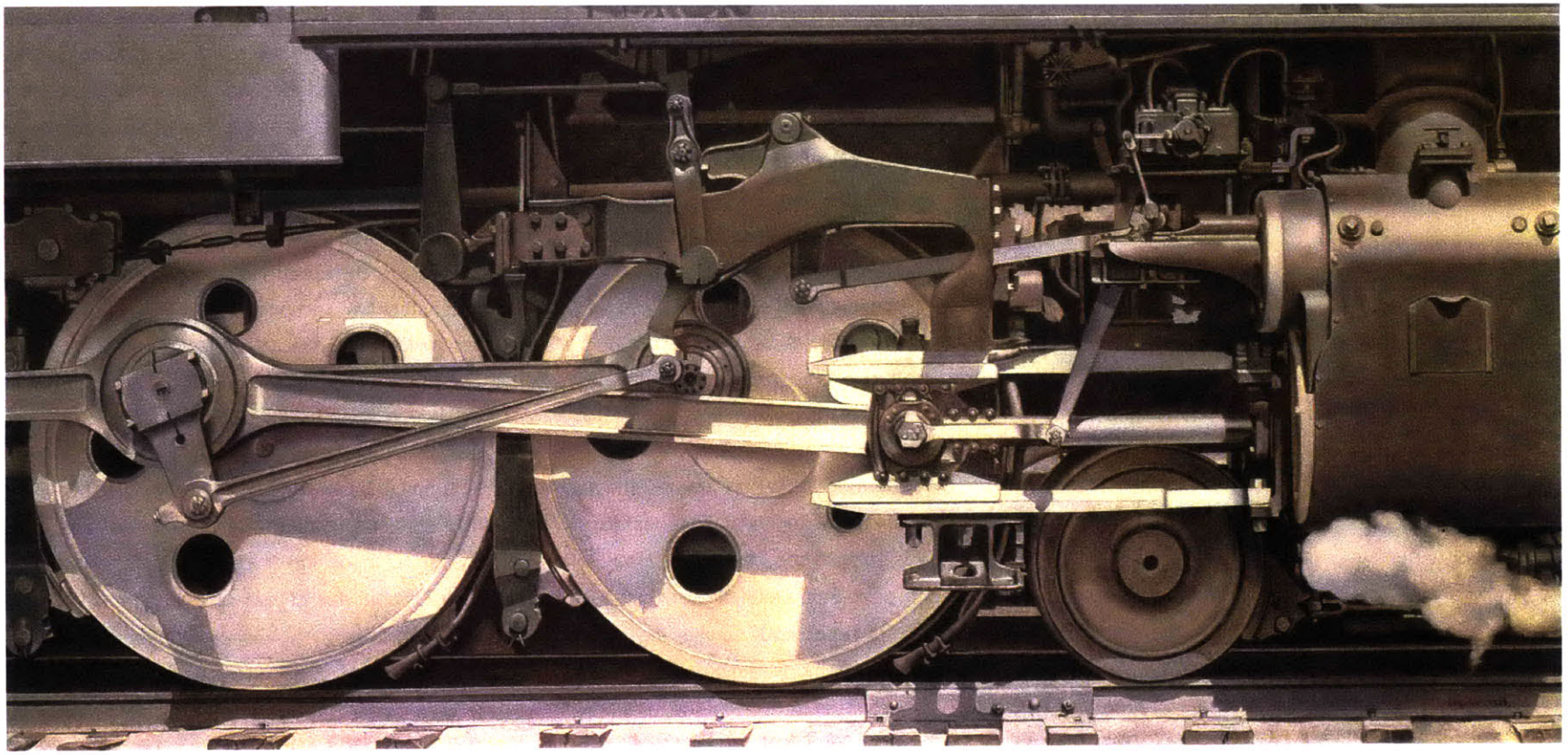


figures 3a, b, and c - advertising Acela, Amtrak's high speed train with eye catching billboards and postcards

of the architecture inextricably fused with the dizzying prospects of adventure, romance, escape or challenge offered by far-flung destinations."[3] To Théophile Gautier large stations were "cathedrals of the new humanity" and "the center where all converges," which constituted "the meeting points of nations".[4] They offer both a "recurrence of ritual" and "the opportunity for "quietude and consolation."[5] To Kasimir Malevich they were "volcanoes of life" and to Cendrars they were "the most beautiful churches in the world" and "palaces of modern industry where religion of the century is displayed." [6]

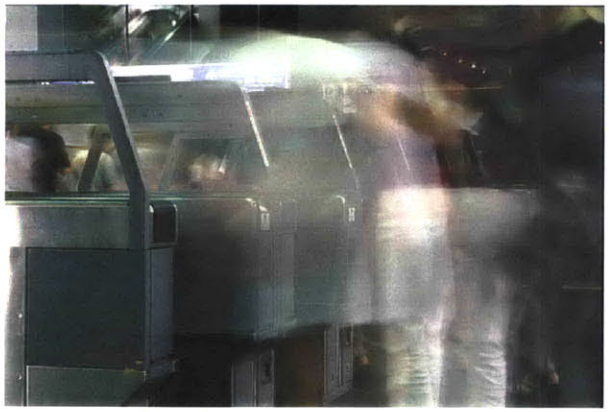
Following an unprecedented station-building boom, the railroad industry began to collapse. In 1914, the extravagant era of station building almost halted. Competition to the rail industry came in many forms. "They beat the train at every point. The door-to-door flivver gave travel a new convenience, the bus cut fares, the plane was many times speedier; in fact it is astonishing that the passenger train has survived at all."[7] The growing popularity of airlines and automobiles crippled the railroad industry in the middle of the century, and cities like Chicago, once the hub for national rail traffic, saw the demolition of almost all its terminals. By cutting costs and offering both comfort and safety, the train station endured. The cost of building terminals was a big expense, and accounting for too much of commuter ticket profits. One result was the abandonment of separate stations for each company and gradual consolidation of their services. In addition, psychologically satisfying strategies were introduced. From airports, rail stations borrowed a public address system, allowing passengers to relax while waiting for the train. Waiting rooms were opened up so that one could catch sight of approaching trains and determine when to move to the platform.





top - figures 4a, b, and c - images from Chicago's NorthWestern Station

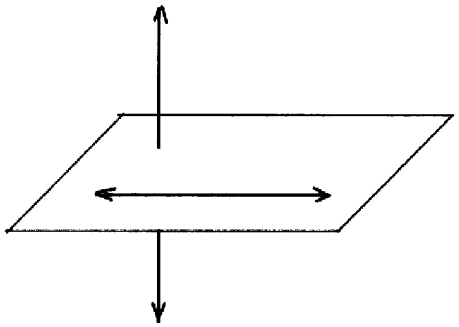
bottom - figure 5 - a painting by Charles Sheeler illustrates the romanticism of the rail



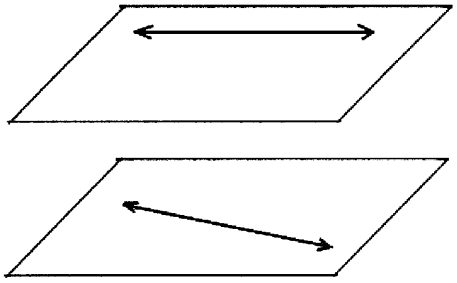
turnstiles and escalators - point places of movement within a station

In the twentieth century, romantic notions of the railway station gave way to real estate endeavors. In the United States, we demolished Pennsylvania Station and replaced it with Madison Square Garden. Chicago's Union Station's concourse building was torn down in 1969 and replaced with the office tower that stands there now. The Great Hall was spared, simply because developers had no immediate plans for the land.[8] The Chicago and North Western Station was razed in 1984, and has since been replaced with a new sleek station designed by Helmut Jahn in 1997. North Station in Boston has seen three versions since its original construction. We are now in a position to revive rail travel with the advent of high-speed travel and its environmental benefits. By replacing short, inefficient commuter flights between cities, high-speed trains might ultimately link sections of the country, ease traffic congestion on the highways and help alleviate overcrowding at airports. Many efforts are being made in the USA to construct a second network for electric trains linking peripheral residential and commercial nodes to the city centers.

In Siefried Giedeon's *Space Time and Architecture*, first published in 1941, he "identifies two of the main characteristics of the modern style: simultaneity of effects made possible by transparency of the defining shell, and the relativity of three-dimensional composition which to be apprehended must be seen from a multiplicity of vantage points."[9] Our traditional view of the train began with the view of two railroad tracks, diminishing to a single vanishing point. This is the example mathematics teachers used to demonstrate parallel lines. The two lines in turn defined a plane in two dimensions. Together, they are perceived as a line, very one-dimensional. The modern urban train stations often represents the confluence of at least 4 train lines, colliding at different elevations and angles. The lines in North Station fall at different elevations and slightly different angles. These lines would be defined as "skew



traditional diagram of skew lines – lines do not define a plane



condition at North Station

lines" in a geometry class – lines that cannot define a plane. The Green line and orange line occupy a higher plane, 50 feet below grade. The Amtrak and Commuter Rail lines are 120 feet below grade. Each set of lines has a mezzanine level above to cross the tracks. With this basic notion that the infrastructure of the building begins with dynamic conditions such as multiple vanishing points and reference planes, one has the opportunity to exploit this in the architectural form. In an article by Lawrence Shapiro, he writes that there exists a "seductive power of motion and its capacity to blur the structures of modern life.... The adventure of movement as such is thrilling, and slipping out of accustomed spaces and times into as yet unexplored realms arouses the passions: the ideal here is to roam freely through the dimensions."[10] Mezzanine levels and walkways necessary to navigate the 100 foot descent provide vantage points to witness the experience of space.

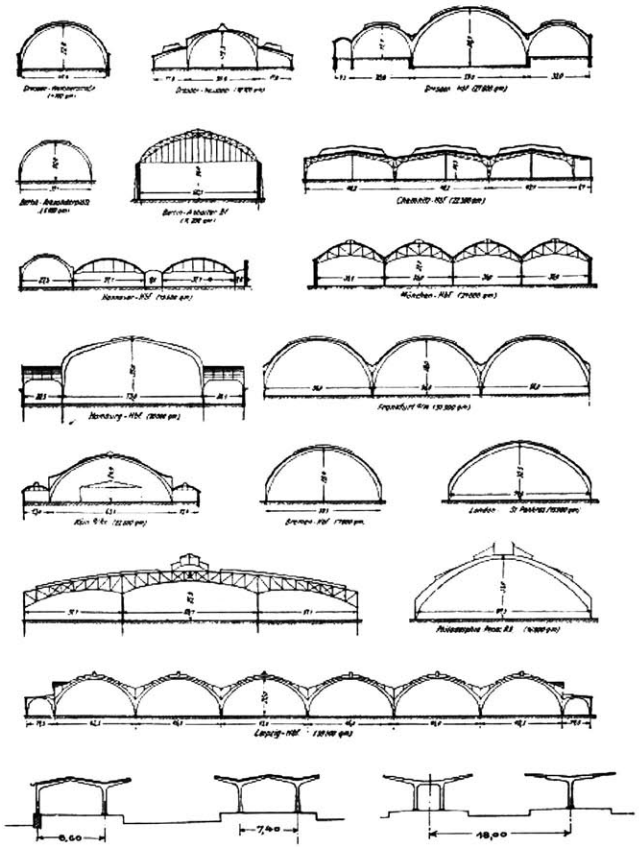
The train is actually a mobile building. On the train, the people inhabiting the cars vary greatly. This variety depends mostly on location or position. In Boston, travel along a subway line such as the red line provides different experiences from one stop to the next: such as Harvard Square, Central Square, Kendall, or Charles/MGH. Further, the character changes greatly with time. Trains become very crowded at Rush Hour. Within a static building – where the location is set, the experience of an architectural space and one's interaction with others is relative to the time of day.

In Caroll Meeks' book, *The Railroad Station, an Architectural History,* the character of more than twelve decades of architecture is analyzed through the sampling of a particular type of building, the railroad station. The validation of the model is that "stations do not represent only the work of exceptionally able architects... many outstanding architects never built a railway station.... Its value

figure 6 - Pennsylvania Station - concourse level

as a sample derives in part precisely from the fact that it reflects a solid core of taste and talent, one that was neither riddled by excessive conservatism nor tinged with the ephemeral fancies of the extremist. Stations are, therefore, representative. The second basis for accepting stations as typical of the building activity of the last century is their connection with one of the tormenting problems of the period; the resolution of the relationship between architecture and engineering. Railway stations were in fact one of the chief scenes of this drama."[11]

In *An Architectural History,* there is an exhaustive catalog of the types of built and unbuilt train stations since the nineteenth century. Though there are certainly categories of styles, there are infinite varieties. Each, especially intermodal, train station has a unique situation, and building form is often representative of the conditions. The newly constructed Eurostar station at Waterloo resembles the train that it houses. Some examples of train station types are international and mainline, airport, town, suburban, underground stations, and light-rail stations. The underground station is the type that is investigated in the scope of the thesis design project. In a book entitled *Underground Architecture*, David Lawrence wrote about London, "Beneath our feet, below the streets and buildings of this teeming metropolis, there runs a complex network comprising many miles of tunnels. While the roads above through with traffic, hundreds of trains run through these iron and concrete arteries, carrying millions of night workers, commuters, shoppers, tourists and theatre or cinema-goers from the suburbs into and around the city – keeping it alive."[12] Boston is no different. The underground station is unique in that it doesn't divide towns physically as many stations did before. As more stations are linked into an underground system of termini, rail transportation will not be associated with boundary or edge conditions, but will be embraced as part of the city center.



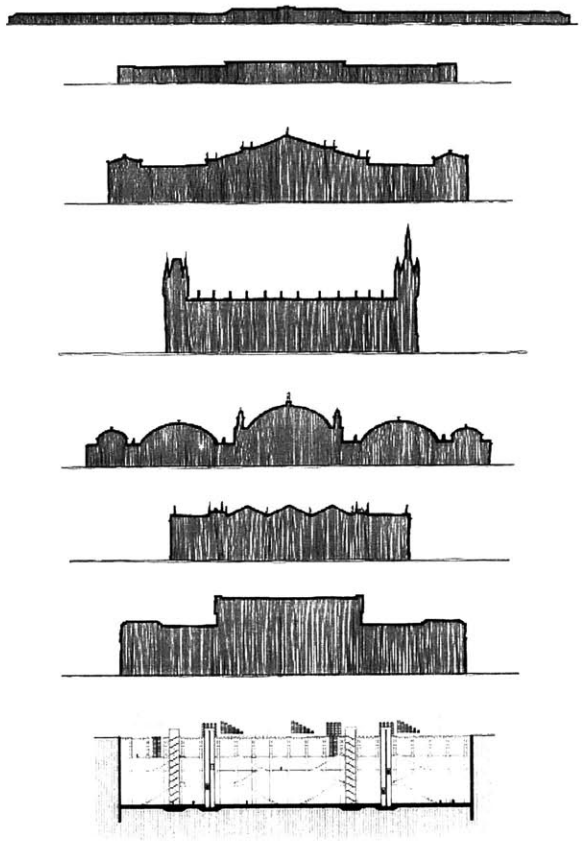


figure 7 - sections of train sheds

figure 8 - Silhouettes of a sequence of large railroad stations: Derby, Trijunch STation, 1839-41; Newcastle, Central Station, 1846 - 55; Paris, Gare de Nord II, 1861-65; London, St. Pancras Station, 1863-76; Frankfurt am Main, Hauptbahnhof, 1879-88; Chicago, World's Fir Terminal, 1893; Washington D.C., Union Station, 1903-07; author's proposal for North Station

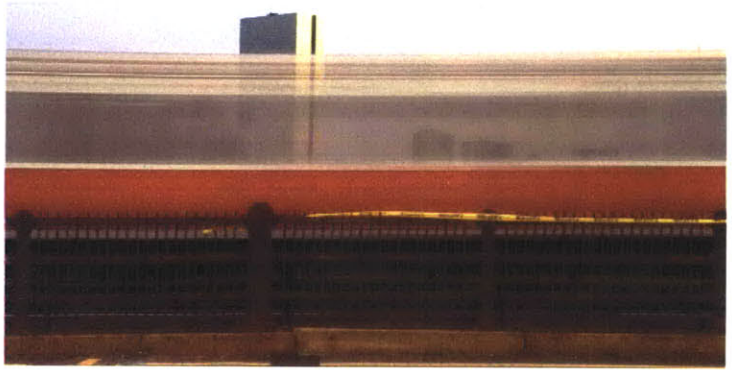


a series of images taken in Rotterdam, a train disgorges it passengers at non-peak times.

Another increasing variety is the mall station. In order to survive, many stations have a large shopping component added to the train station. One example is Chicago's Northwestern station, where the tracks are elevated, and one has to walk by tens of shops and fast food eateries in order to reach the tracks. At the beginning of essay from *Great Railway Journeys,* Rachel Heaton-Armstrong's memorable impression of Waterloo Station in London was that its "elegance has been swamped by the inevitable flood of high street shots that provide everything except what you really need – the opportunity to sit and have a drinkable cup of coffee. In their determination to get to work on time frenzied commuters mow down holidaymakers either fleeing from or returning to their own stressful lives."[13] South Station has a similar condition where tables are located directly below the main timetable for trains. It is crammed with eateries and shops, and the announcement of the boarding of a train inevitably makes for intersections between those who are seated and those who are moving. Another type combines station and sports facility, such as New York's Pennsylvania station, which is buried under Madison Square Garden, or the existing condition at North Station's commuter rail facility, which is beneath the FleetCenter. There are plans to bury Boston's South Station under a skyscraper.

In a paper by Peter Hall entitled, "Moving Information: A Tale of Four Technologies," he makes the comparisons between high-speed rail and air travel – which vie for the movement of people, and alternatively, postal service and electronic mail – which compete for the movement of information."[14] The high-speed rail connections, particularly on Amtrak's Northeast Corridor stand to change the way people move about in the city. The new *Acela* line will transport people from Boston to New York in 3 hours, and to Washington DC in 5+ hours. Assuming calculations for a city-center-to-city-center journey, passengers "can reach the station in 15 minutes and can then reach the train in another five

figure 9 - image from Acela homepage



minutes' at the other end, 15 minutes are allowed to reach the destination. For air, we assume a 45-minute journey to the airport and another 60 minutes check-in and waiting time, plus 5 minutes exit and another 45-minute journey at the destination. The total access and waiting time penalty is thus 35 minutes by air and 155 minutes by air."[15] Thus a trip from Boston to New York on a high-speed train would take the same amount of time as the airplane, about 3 hours 35 minutes.

Train travel resurrection in the US becomes may have potentially profound implications on city centers. In cases like Japan, the *Shinkansen* line has generally accelerated the "growth of major cities along the line, and speeded up the development of a megalopolis."[16] The thesis will consider the train station as the nexus or harbinger of development in urban areas. A network of trains should allow a citizen to walk out their door to the nearest subway stop, ride to a train station and then move on another city or state.

1 *Thomas Wolfe,* You Can't Go Home Again, *(New York 1945).*

2 *Building News*, 1875 quoted in Carroll L V Meeks, *The Railroad Station, An Architectural History,* Preface.

3 Stephen Parissien, *Station to Station.* (Hong Kong: Phaidon Press Limited 1997), p. 7.

4 Quoted in Jean Dethier, *All Stations* (1981), p. 6.

5 GK Chersterton, *Tremendous Trifles* (1909), p. 219.

sequence of photographs from the North Station Green Line - the movement of bodies resembles the aura from old photographs

6 Quoted in Jean Dethier, *Les Temps des Gares*, (Paris 1978).

7 Carroll L V Meeks, *The Railroad Station, An Architectural History*, (New Haven: Yale University Press 1956) *The Railroad Station.*

8 [online] available http://chicago.sidewalk.citysearch.com/E/V/CHIIL/0027/13/68/

9 Meeks, p. 163.

10 Shapiro pp. 66-67.

11 Meeks, pp. 162.

12 David Lawrence, *Underground Architecture.* (Middlesex: Capital Transport Publishing 1994), p. 9.

13 Rachel Heaton-Armstrong, "London to Arkadia." *More Great Railway Journeys.* (London: Penguin Group 1996), p. 133.

14 Peter Hall. "Moving Information: A Tail of Four Technologies," *Working Papers, University of California Institute of Urban and Regional Development*, 515: (University of California at Berkeley), p. 5.

15 Peter Hall, p. 8.

16 Peter Hall. p. 14.

figures 10a, b, and c - film stills from Union Station, describing such activities as getting information, anticipating and waiting on the platform, and meeting people.

figure 11 - the general waiting room at Pennsylvania Station - considered the world's largest and monumental single room. The station was demolished in 1964 after having operated on a 1.5 million dollar loss. A 1962 rally attracted two hundred architects - including Phillip Johnson who remarked that McKim's design showed "that man can build nobly," and claimed that "New Yorkers deserve these bits of grandeur in their lives." quoted in Pennsylvania Station : McKim, Mead and White.

above left - image from Kyoto Station, illustrating the difference between those moving quickly, and those standing still

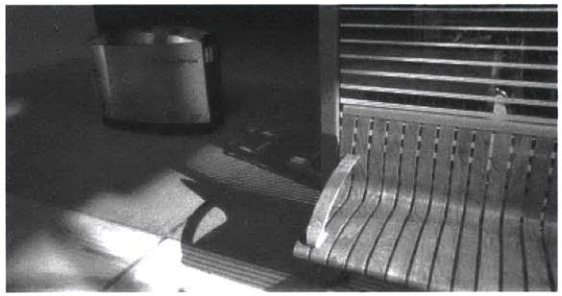
left - Bilbao Abando Station - "Goodbyes" in a modern train station at the transition between paid and unpaid. Unlike the film stills from Union Station, friends must part at turnstiles.

The location of timetables is a large determinant of circulation patterns. In Frankfurt, there is one large timetable in addition to smaller ones. In South Station, the timetable is located in front of a of tables and chairs. The result is a collision of interests.

purchasing tickets - This interface should change greatly in the years to come. In Japan, much of this process is automated. One can buy tickets at any various different vending machines. In European stations, the transition between paid and unpaid is not absolute. One can often just walk right to the platform without purchasing a ticket. Tickets are then checked on board routinely.

There are several types of left luggage today as well. Due to heightened security measures, some stations require that items left in storage be first examined by an x-ray machine. Some stations have lockers, and others have man-operated locking stations.

figure 12 - Escalators are a very important component of the modern train station, allowing people to get where they want quickly. The direction can respond to the fluctuation and usage during the day.



Furniture is generally easy to clean, carefully located, and not too comfortable.

signage - easy to read, and well situated, signage is very important in navigating passengers to their correct position. Advertising is strategically placed after the decision-making process, typically where people wait for trains.





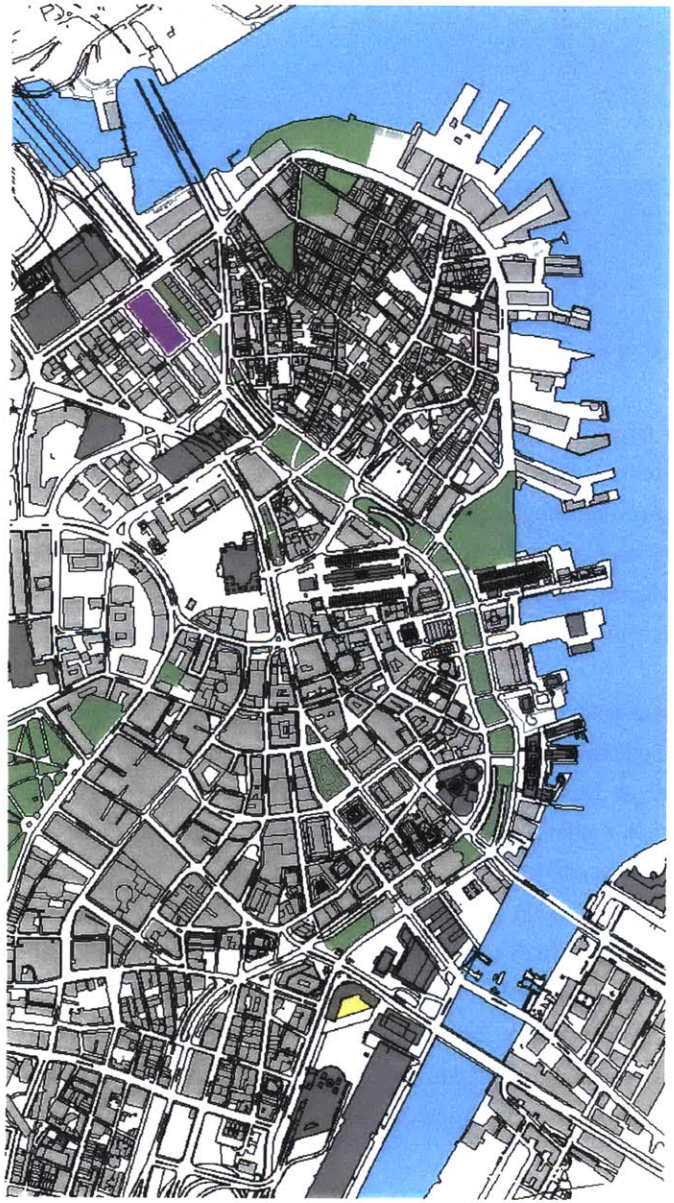
film stills from Stadelhofen in Zurich - showing the ease with which people move within the same space as trains. tram cars are integrated into the city so that pedestrians do not perceive the boundary conditions typically associated with the train.





Boston is unique in that its growth has largely been shaped by its transportation systems. Bold projects such as filling in 3500 acres of harbor to develop a radial railroad system and Logan International Airport have resulted in a constantly evolving image of the city, but at the same time have threatened existing neighborhoods and communities. A prime example of an area in Boston where transportation infrastructure has shaped a place, is North Station. Its complexity, history, and diversity - of road and rail networks, land use, and geography in a dense urban fabric, are what drew me to this site.

In the 1700s Mill Pond, a brackish backwater covered the area. A canal was dug making use of the tides to operate a nearby sawmill and gristmill. In the 1800s, Charles Bulfinch designed the triangular pattern known to day as Bulfinch Triangle. Designed in 1807, it was implemented in 1840 with Canal Street used to carry water from Mill Creek. At that time, manufacturing and warehouse uses dominated the area. It was not until 1820 that rail service from the north began, gradually increasing to four separate lines in 1850. These lines were joined in 1894 to form Union Station, the largest railroad station in the country, serving 500 trains daily. 1928 saw the construction of a new North Station and Boston Garden, launching a period of revitalization for the area. With the construction of the Central Artery in 1953, the North Station Area took its existing form. Manufacturing companies left downtown, leaving room for wholesale trade businesses. In recent decades, little improvement has taken place except for the construction of the new Charles River Dam and the removal of the Orange Line elevated structure in 1975.



drawing showing connection between North and South Stations and network of open spaces and close up of Bulfinch Triangle.

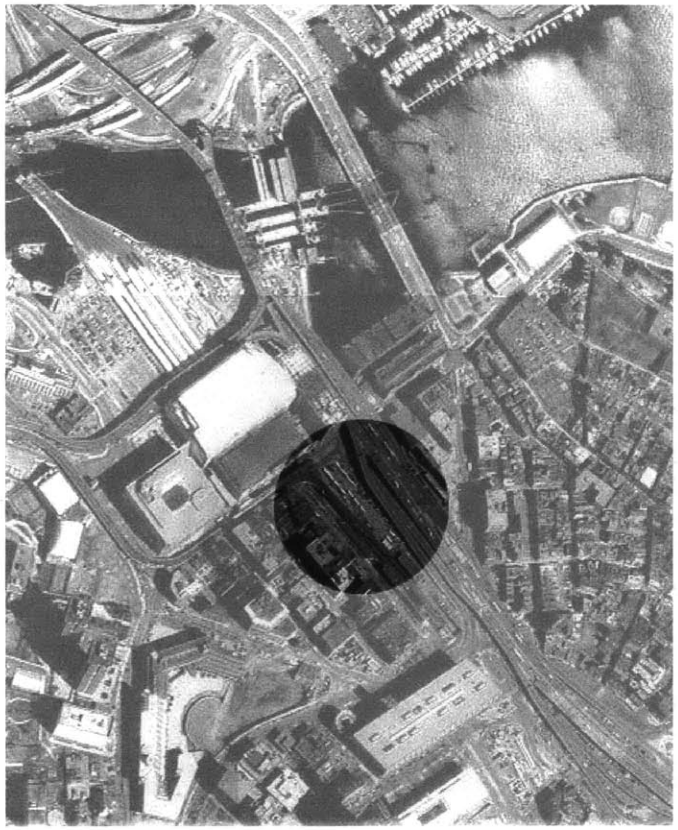
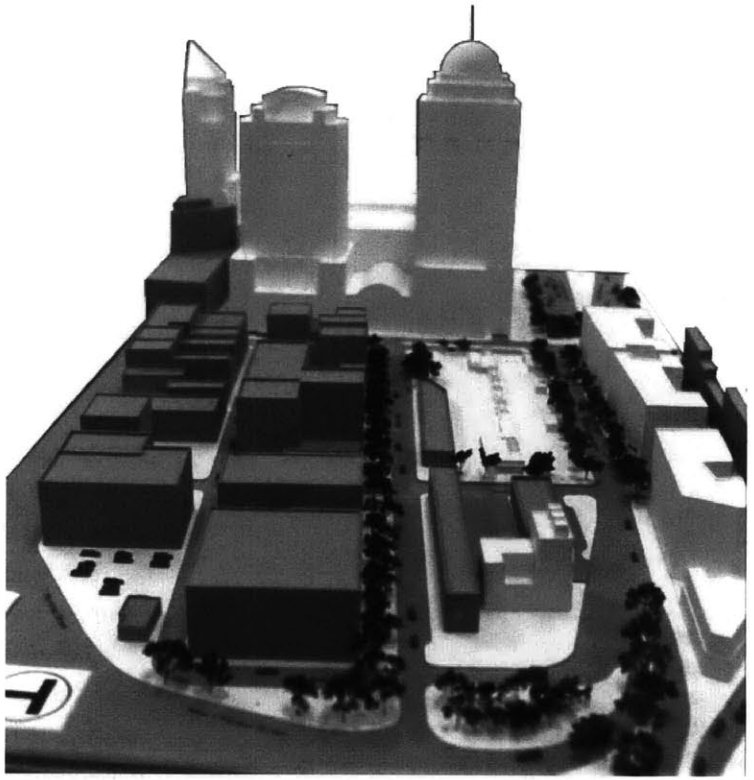


figure 13 - aerial view of North Station Area

Vehicular, transit and rail connections are abundant as the Green Line, Orange Line, access to Storrow Drive, Central Artery, Commercial Avenue, are all located here. "Transportation systems, initially rail and later the elevated transit lines and Central Artery, have been the catalysts shaping North Station's physical character and land uses. Between 1800 and 1920, the economic vitality of the area occurred as a direct result of the exchange between the transportation activity and the manufacturing and wholesale businesses that required excellent accessibility."[1] However, since the 1940s, the area has seen hindered development owing to these very auto, rail and transit systems. Following the 60s and 70s urban renewal of Government Center and the West End, North Station was the last major undeveloped parcel in downtown Boston.[2] Currently we are in a position to make the most of transportation and commercial development forces to make improvements to benefit the city of Boston.

Specifically, my site is bordered by Canal and Haverhill Streets, between Causeway and Traverse Streets. Located nearby is the newly built sports area, the waterfront and Charles River, the area is a crossing of a diverse conditions. North Station is less than fifteen-minute walk from City Hall and Faneuil Hall Marketplace. It lies between Haymarket Square, the Charlestown Bridge, Leverett Circle, and borders the North End, Government Center, and the West End district. Since the 1800s, the North Station Area, which lies primarily on fill, has been gradually added to. As a result, the topography is virtually flat. There have been several proposals for this and the neighboring parcel. One proposal sees the plot as dedicated light scoops for the North Station SuperStation that is currently under construction. There are however, provisions for these to be torn down when need arises for development. On the parcel nearby, there are also several proposals, as it is part of system of new

figure-ground representation of North Station, North End, Bulfinch Triangle, and downtown Boston.



MBTA model of North Station SuperStation and surrounding context

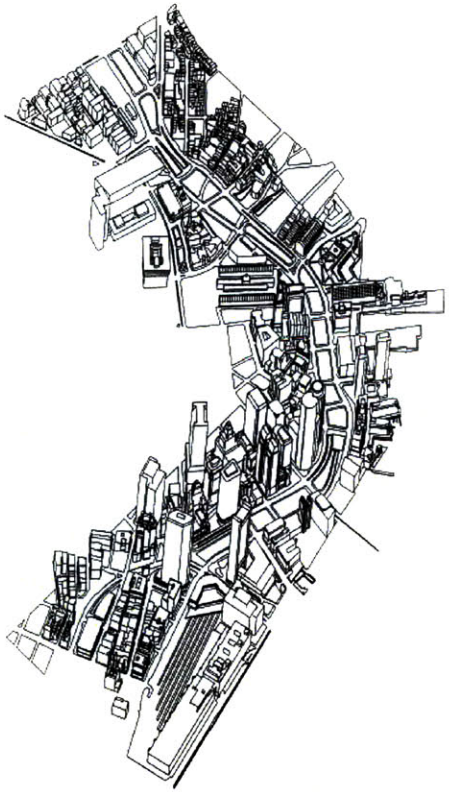
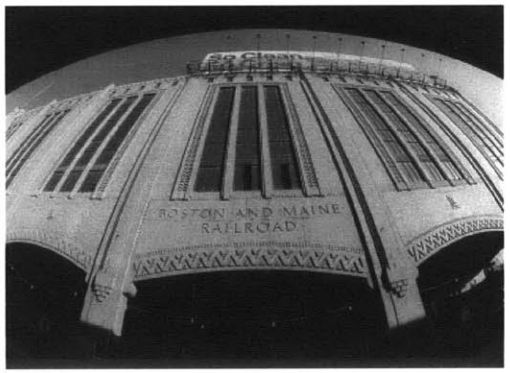
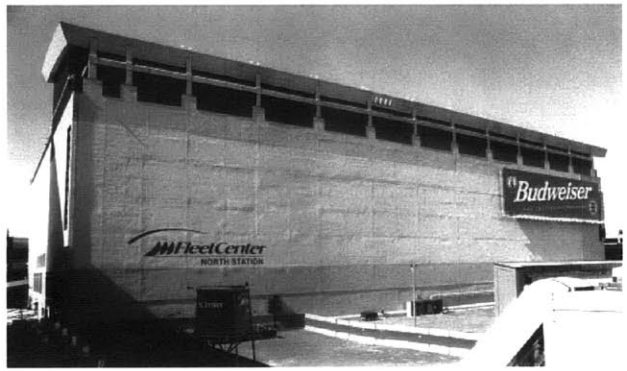


figure 14 - axonometric of link between North Station and South Station.

diagram representing Boston's MBTA subway system. North Station is located at the top, where the Green Line and Orange Line converge..





figures 15a, b and c - the three North Stations

a. built in 1893 with triumphal arch by Shepley, Rutan, and Coolidge
b. built in 1928 to house rail station and colosseum, by Fellheimer and Wagner
c. built in 1995 for commuter rail and sports facilities by Ellerbe Becket

below right
figure 16 - demolishing Boston Garden in the summer of 1998

above right
figure 17 - construction of new North Station Superstation and demolition of Central Artery

open spaces that will be created due to the depression of the Central Artery. Tunnel construction can support 5-10 stories of construction.

In 1896, the first subway in America was opened at Park Street. South Station, terminus to trains from New York and other points south opened in 1989. [3] The original North Station was constructed in 1893, as part of the Boston Maine Railroad by Shepley Rutan and Coolidge. North Station has since lost its prominence, as ridership has declined, and passenger trains to Maine were terminated. This is changing as Amtrak proposed to reopen a service to Portland Maine. In 1928, North Station was demolished, and in its place, Boston Garden was erected. This was home to the Boston Celtics and Bruins for many years. In this second North Station, "there was little opportunity for external architectural effect since the head-house backed up on a train-yard and faced elevated railway tracks.... The main concourse was forced into corridor proportions, 40 feet wide and 275 feet long, with an insignificant height of 22 feet." [4] Today exists the third version of North Station. The legendary Boston Garden fell to demolitionists in the summer of 1998. Conceived by Ellerbe Becket, the FleetCenter, or North Station number 3 measures 755,000 square feet and rests above a new five-story MBTA parking garage. Construction began on the 3.2 acre development site in April of 1993 and was finished in September of 1995. The current commuter rail station still resembles a corridor, with similar dimensions, no natural daylighting, and lack of entrance grandeur or sense of arrival. It is located very far from transfer points, forming a triangle with the existing Green Line and Orange Line Stations.

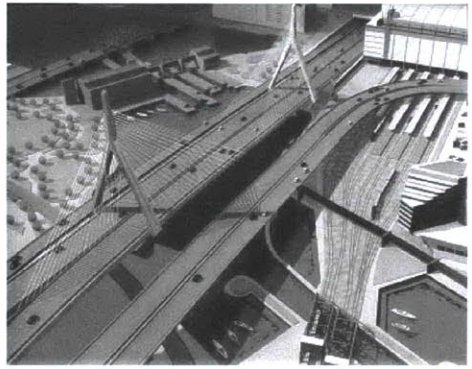
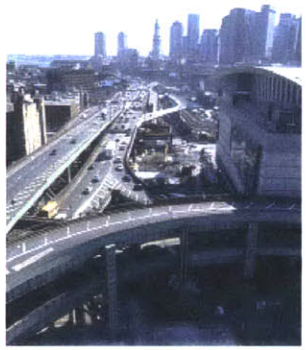
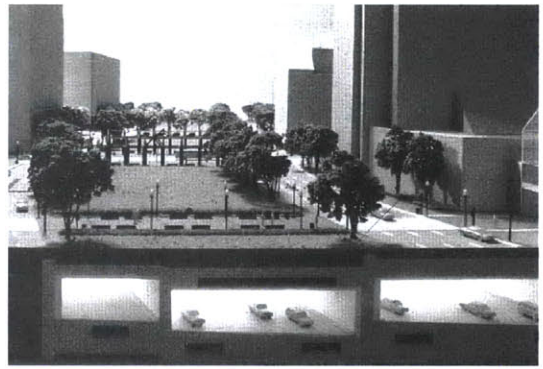
Boston Redevelopment Authority's model of park space above the Central Artery and new highrise buildings to built at North Station

lower left
figure 18 - image of Tobin Bridge at the Charles River Crossing and existing Commuter Rails; the building of the North South Rail Link would eliminate the need for these rails.

CENTRAL ARTERY / TUNNEL PROJECT AND WATERFRONT DEVELOPMENT

The newly constructed Central Artery/ Tunnel project is a unique urban highway project because it does not destroy pieces of urban fabric or set up barriers that divide neighborhoods and communities. Instead, it tackles traffic issues while reknitting the city physically, socially, and economically. Other advantages include substantial environmental improvements and unique urban design projects that will shape the Boston's downtown. The project is an opportunity which will be as significant as other memorable design and development undertakings such as Bulfinch's Triangle, Olmstead's Emerald Necklace, Lynch's High Spine and Walk to the Sea or Sears' Back Bay. It was conceived as an idea in the 1970s following a popular revolt that halted the construction of an eight-lane Inner Belt that would have circled downtown Boston, cutting through Somerville, Brookline, Roxbury, and Cambridge. After the conducting a study looking at Boston's transportation objectives, decisions were made to promote rapid transit, depress the Central Artery and created a Third Harbor Tunnel which would link Logan Airport to the regional highway system. At the time of writing, the Big Dig is nearly two-thirds complete.

The Big Dig will result in 27 acres of new land in a dense urban center, three quarters of which will remain open. The rest will be set aside for modest development, including housing, retail, and commercial uses in low-rise buildings. The hope is that these parcels of land can form an open-space network with plazas, gardens, and recreational facilities in efforts to reconnect sections of the city severed by the building of the Central Artery in the 1950s by uniting visually and functionally the city's urban fabric. This system of parks is to end at Haymarket, or at the tip of Bulfinch Triangle. Defined by Merrimac, North Washington, and Causeway Streets, the triangle was cut in two with the construction of the elevated Central Artery. The neighborhood consists of late 19th and early 20th-

from left to right

figure 19- photograph of bridge under constuction

figure 20 - computer rendering of new suspension bridge at the new Charles River Crossing

figure 21 - view of FleetCenter and existing Central Artery Expressway

figure 22 - view of green space above the Central Artery Tunnel

century industrial and warehouse buildings. Buildings range from four to six stories, and are of masonry construction and cast-iron storefronts. There are plans to build a multi-tower office complex and parking lot on the site of the old Boston Garden.

Soon to be realized is the completion of the Charles River Crossing just north of my site, which has been envisioned as a major urban landmark. At North station, all lanes of traffic from the Central Artery will climb from below onto what will be the world's widest cable-stay bridge. Complementing the construction of the river crossing, large efforts are being made to realize a system of parks and pedestrian experience along the Charles River just north of the FleetCenter. Further changes include the demolition of the elevated Green Line at Causeway Street to be replaced by the North Station SuperStation, which combines both Green and Orange Lines underground. As a result, the three streets bordering Bulfinch Triangle will be widened and developed to a boulevard dimensions. Causeway Street, located at the end of my site will have a completely new character once the Green Line elevated is razed.

NORTH SOUTH RAIL LINK

Much needed is a connection between North and South Stations to complete a network of train travel covering the Northeast, expanding a regional and national multimodal transportation system. This noticeable gap in the regional system is less than ½ of a mile. This thesis assumes the completion of the North South Rail Link, which was part of plans for the Central Artery Tunnel Project, but later delayed for financial reasons. Benefits to the plan are improved downtown distribution and reduced need for people to transfer between modes of transportation – speeding up trips. Commuters and

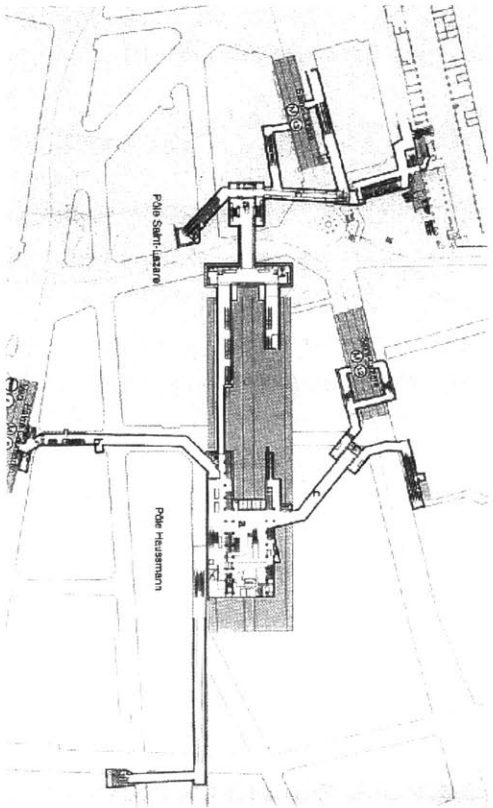


figure 23 - head-houses in underground Paris disperse passengers far from the station

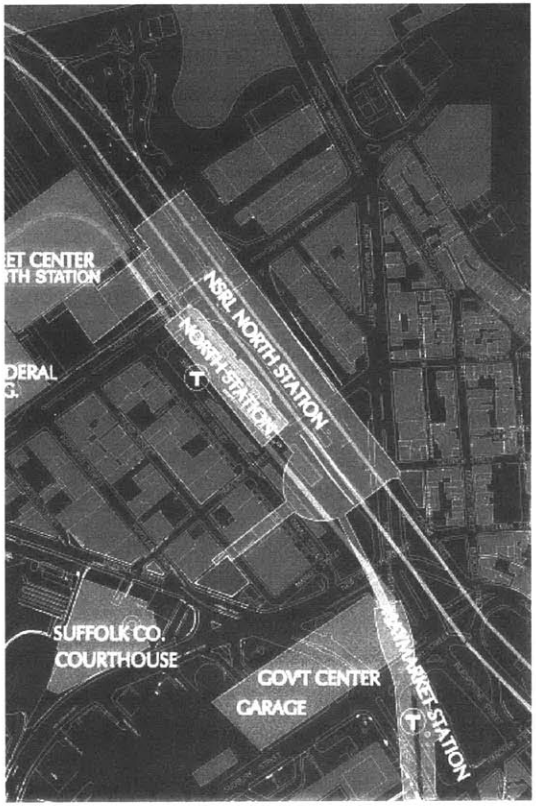


figure 24 - plan of North South Rail Link at North Station

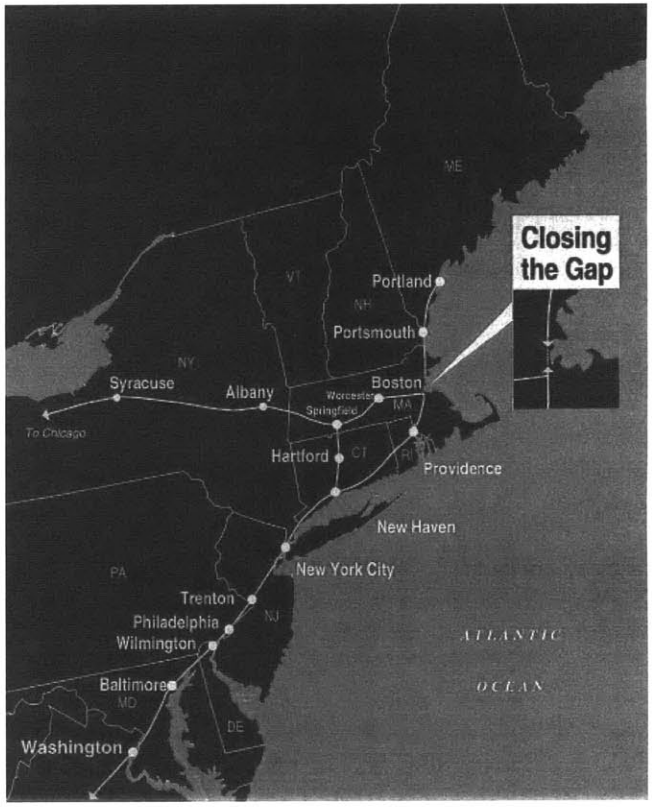


figure 25 - map demonstrating the need for the 0.5 mile connection between North and South Stations

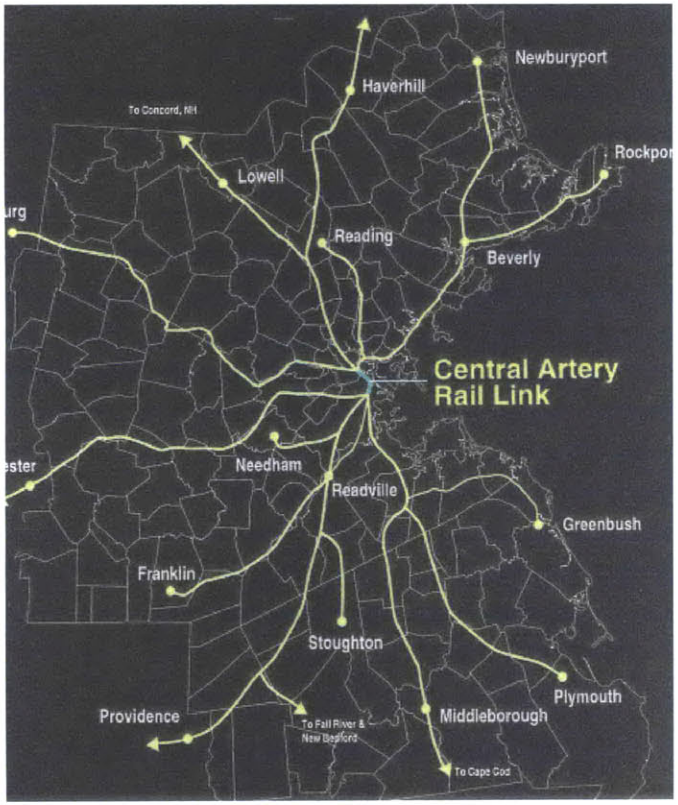
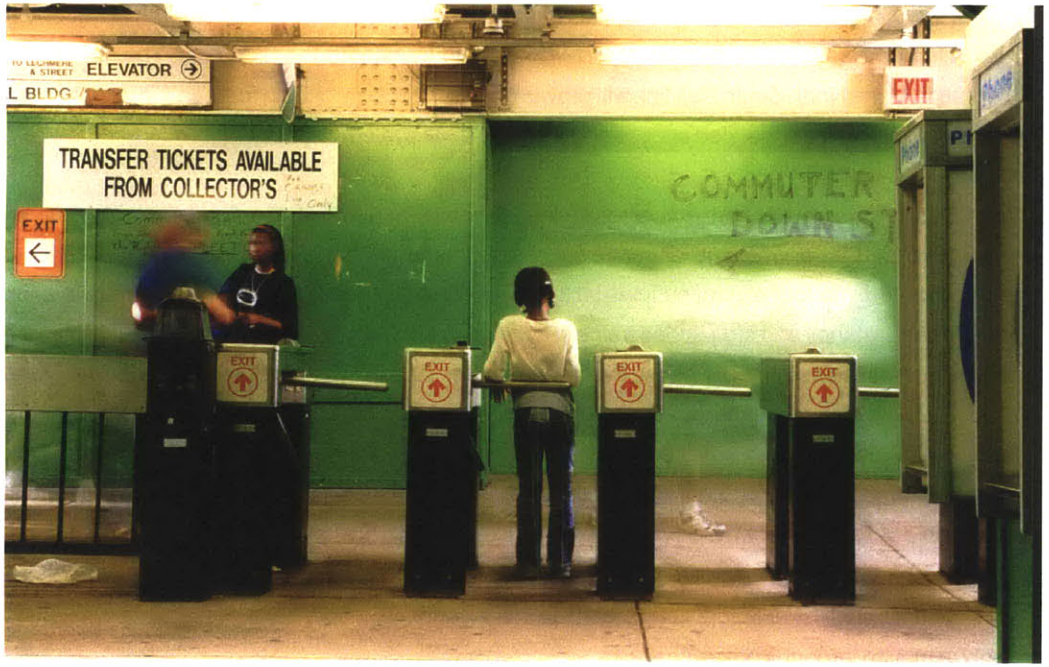
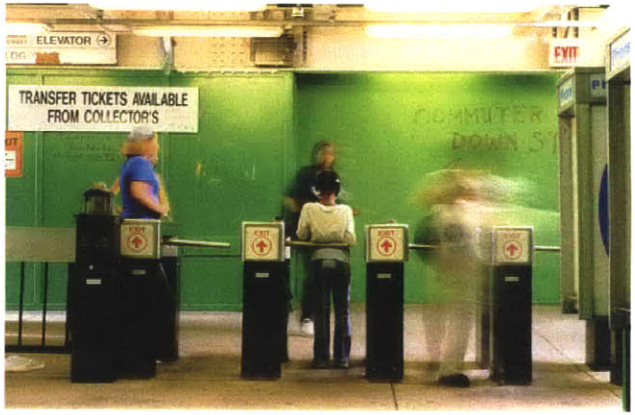


figure 26 - regional map of the Boston area

visitors traveling on the Rail Link can exit at North Station for the Green and Orange Lines, at South Station for the Red Line, or at a new Central Station, to transfer to the Blue Line. The successful integration of the North South Rail link will provide interconnectivity of both local and regional transit systems, allowing for enhanced access and increased rail system capacity.

North Station thus would change in program from terminus to terminal. The 8 lines that come to an end at the FleetCenter would no longer be necessary; these and the 13 lines at South Station would be transformed into four electrified lines built 120 feet below grade. They would facilitate travel on Amtrak long-distance and high-speed trains in addition to MBTA commuter rail trains. This group of 4 parallel lines is located directly below the Central Artery Tunnel. The proposed plans for the North South Rail Link provide head-houses for entrances to the deep train concourses below. Passengers are let out in various places within buildings far from the actual station, with little notion of orientation or legibility of space. The proposal to follow in the design of North Station is trying to navigate this level change in a very different way. Circulation will take be ordered so that visitors remain in the station, moving within a zone of space located between the subway station and the lower Rail Link. All the while, visitors shall have visual connections to the exterior, and both parts of the station, creating clarity in motion through vertical space.





North Station Green Line entrance/exit - Illustrating difference in motion patterns of passengers, these images witness the behaviors of a young girl and a woman. In the last image, both sneak through the turnstiles. Also of note is all the signs necessary to direct passengers to the correct destination.

on the next page, right - sequence of images from North Station Orange Line SuperStation

upper right - North Station Commuter Rail Train Station, designed with corridor dimensions

EXISTING CONDITIONS

At the time of this writing, there exist three layers of travel. The green line is elevated. The orange line is submerged. The MBTA commuter rail lines stop at a terminus that ends at the bottom floor of the FleetCenter. This provides for many problems, as transfers become difficult and very confusing. Passengers arriving on morning commuter rail trains transfer to the Green and Orange lines, stopping traffic in efforts to cross the street.[5] Signs are everywhere, directing the passengers to either the commuter rail or green line.

As mentioned earlier, the North Station SuperStation will help to move people more efficiently by combining Orange and Green Lines. The location of the orange line is depressed to a level of 50 feet below grade. Because the orange and green lines become parallel at this point, the green line inbound is also located at this elevation to allow passengers to wait for either green line or orange line inbound trains. The green line outbound is located 20 feet above the other three rails.

1 Development Plan for North Station District. 1980. p. 1.0.

2 Development Plan for North Station District. 1980. summary.

3 Carroll L V Meeks. *The Railroad Station, An Architectural History*, (New Haven: Yale University Press 1956) p. 129.

4 From *Railway Age*, 85 (1929) 337 ff.

5 Interview with Dino Diferente, MBTA North Station Superstation.





film stills from Stadelhofen in Zurich - a group of children congregate after exiting the train - and then run off to their next destination. in this instance, I become an obstacle around which students move.





The design process began in the summer with travel to many modern and old train stations in Europe and Japan. Particularly memorable and striking examples were Stratford Station, for making simple the chaotic, Stadelhofen Station in Zurich for its dramatic range of scales, and Zurich Central Station for its sense of public space. In visiting these stations, I never tired of watching people and noticing sounds, smells, and changing fluctuations of energy throughout the day. I had a video camera in one hand and a normal camera in the other. I made every attempt to capture video while moving and while still. While photographing, it was the first time I had made no effort to wait until people vacated my frame. Included in this section and throughout the text are images from the footage and photographs.

Stratford Station is exciting due to the fact that four different lines, in addition to a bus route, all converge here. One of the lines actually penetrates the building, forcing passengers to cross above this line. The canopy that forms the space is simple, and provides an elegant covering for the station. In Stadelhofen, I was struck by one's ability to look and find something of interest at all scales and in all directions. While waiting for the train, there existed articulation of detail at the top of column, base of column, and handrails.

I found that in order for the station to function as a symbol and impetus for revitalization, it is essential that the space provide for un-programmed space, in addition to required train station functional programming. At Zurich's Central Station, I witnessed a weekly market. A similar occurrence of un-programmed public use of a station was experienced in Grand Central Station in New York

a small sampling of stations visited

United States
Penn Station (New York)
Grand Central Station (New York)
Union Station (Chicago)
Northwest Station (Chicago)
North Station (Boston)
South Station (Boston)
New Haven (Connecticut)
Hartford (Connecticut)
Route 128 (Massachusetts)
Providence (Rhode Island)

Western Europe
Zurich Central Station (Switzerland)
Lucern Station (Switzerland)
Chur Station (Switzerland)
Stadelhofen Station (Zurich)
Waterloo Station (London)
Stratford Station (near London)
Canning Town Station (near London)
Amsterdam CS (Netherlands)
Sloterdijk station (Rotterdam)
Duivendricht (Rotterdam)
Rotterdam CS (Netherlands)
Bilbao Abando (Spain)
Gare du Nord (Paris)
TGV Station, Roissy Airport (Paris)
TGV Station, Lyon Airport (France)

Japan
Tokyo Station
Shinjuku Station (Tokyo)
Shibuya Station (Tokyo)
Kyoto Station

Zurich's Central Station is transformed into a market during the weekend.

Norman Foster's Bilbao subway entrance is a distinct intervention that announces the threshold from exterior to interior and existence of subterranean life

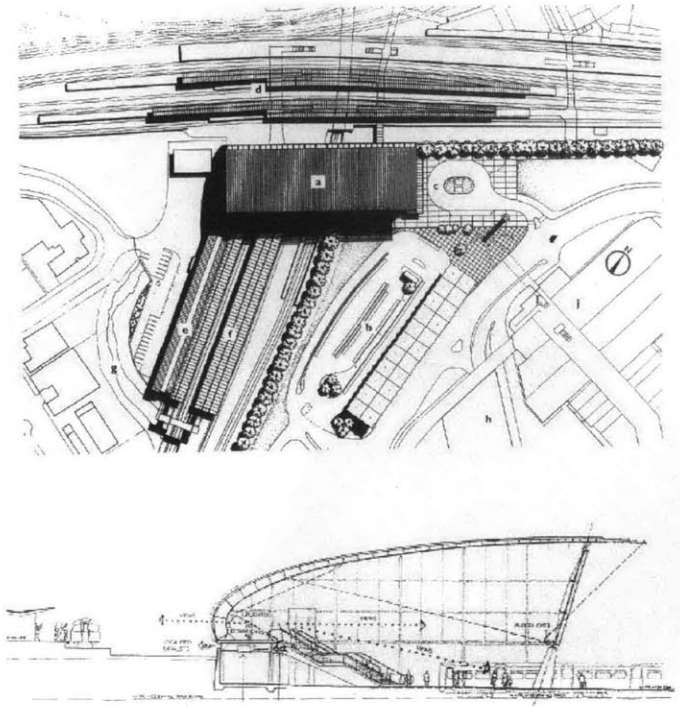


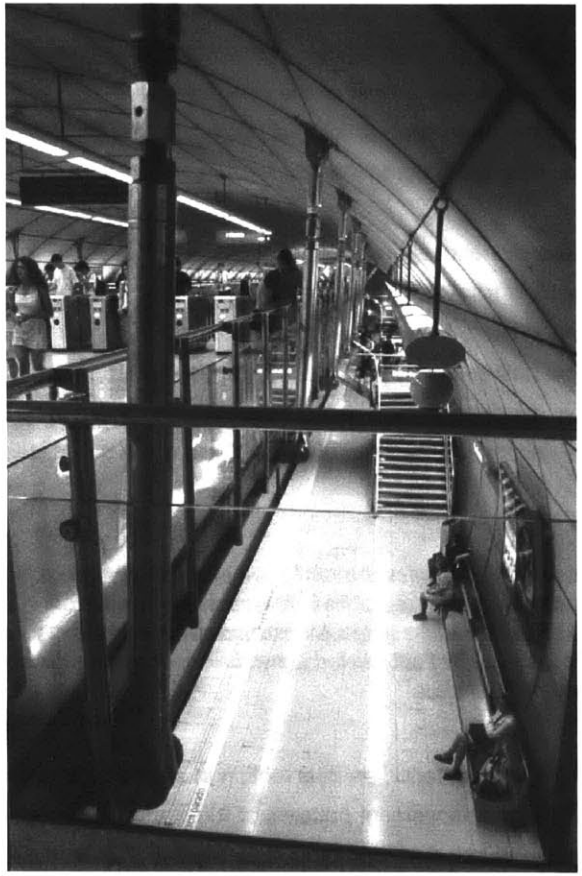
figure 27 - plans and sections of Stratford Station outside of London. The roof organized a complicated network of trains

where I attended the 1996 New Year's Celebrations. The station had been converted into a ballroom, with live bands, and several dancing areas. At North Station, I have not included a specific program that dictates the usage of the circulation levels, neither at the concourse level nor on the catwalks above. The intent however is to create a large open space that can facilitate such events as gallery openings or concerts without disturbing the programmed circulation.

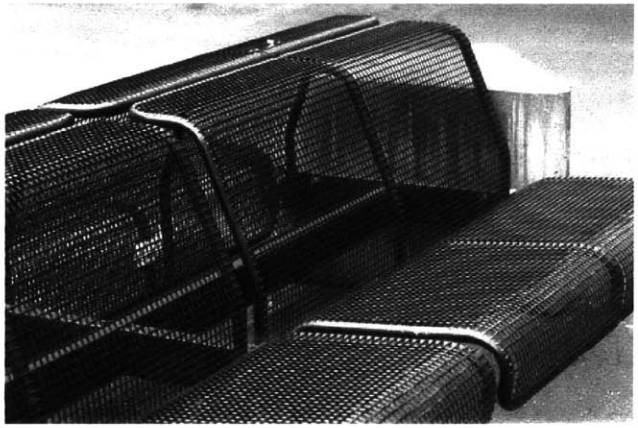
In addition to the ideas articulated in the above-mentioned stations, the thesis will examine three systems important to the program of a train station: movement, illumination, structure, and their integration into a clear and legible system. Movement will be explored through directing people vertically from above ground to below, between exterior and interior, and in the programmed circulation from point-to-point within the station. Illumination, both daylighting and artificial, are to be considered as the medium with which people understand the time of day. Structure will be articulated as the organizing physical framework.

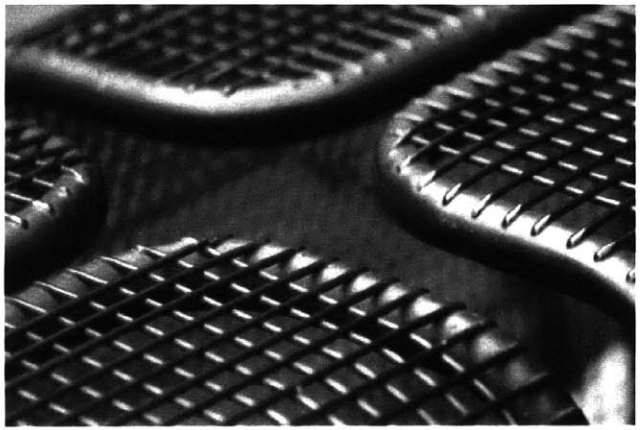
> *"How do we know the railway is there: how can we catch a train? This is a function of the station: to advertise, to attract and welcome travelers, and to offer all the facilities necessary for making a journey. It serves as a shopfront and entrance to the system, and must make the transition from street to train safe and comfortable. As far back as the Euston Arch, designers have been concerned with the concept of the station as gateway and urban focus."*[1]
>
> *David Lawrence*

In considering the transition from exterior to interior, an intervention in a systematic method allows people to pass perpendicular to the actual movement patterns of the station. This movement into the building takes place between structural elements placed to span the short distance of the

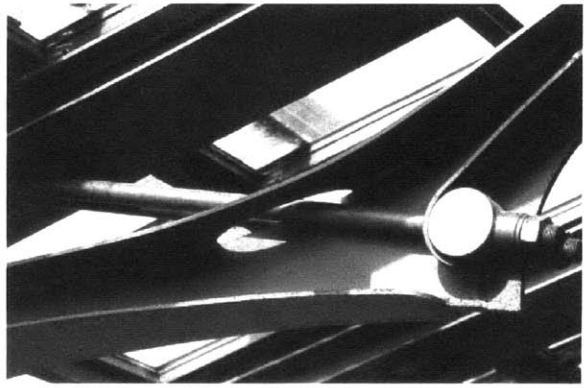


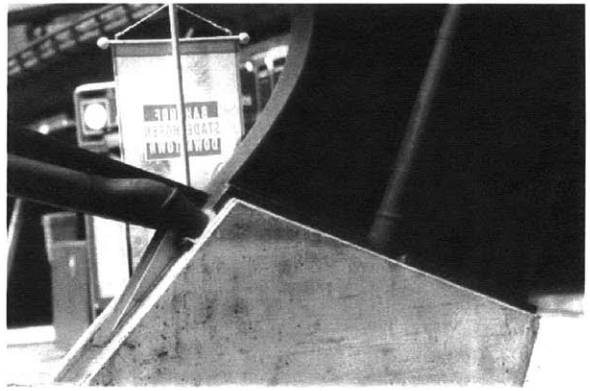
Bilbao subway - being able to see see your destination is an important factor in the design of a station.

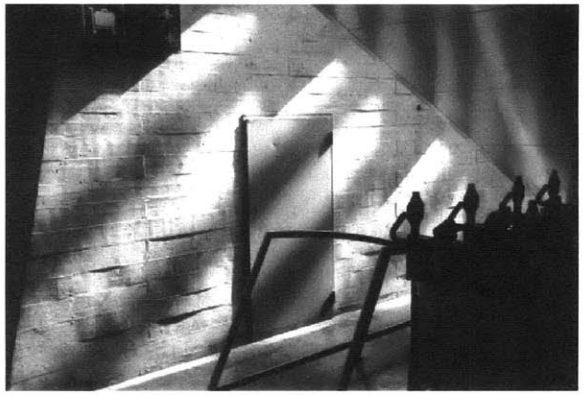


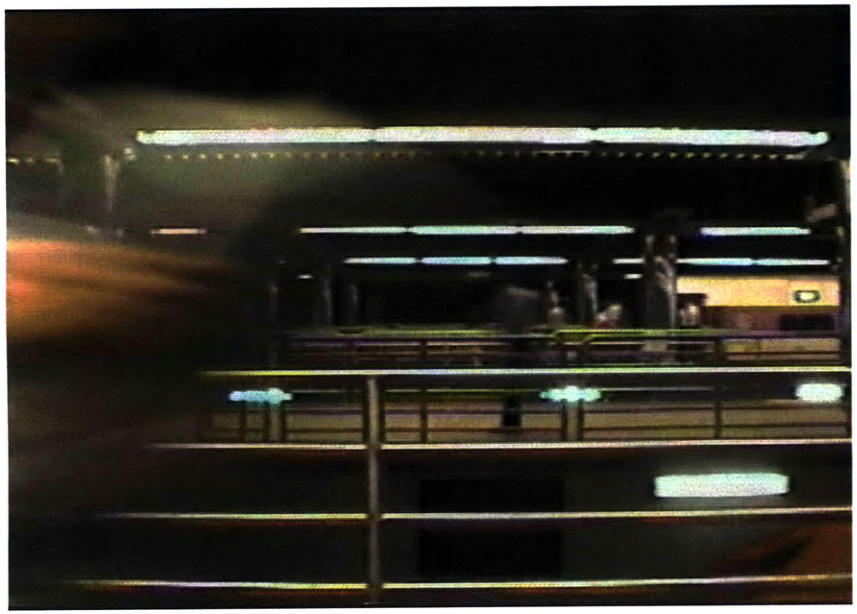


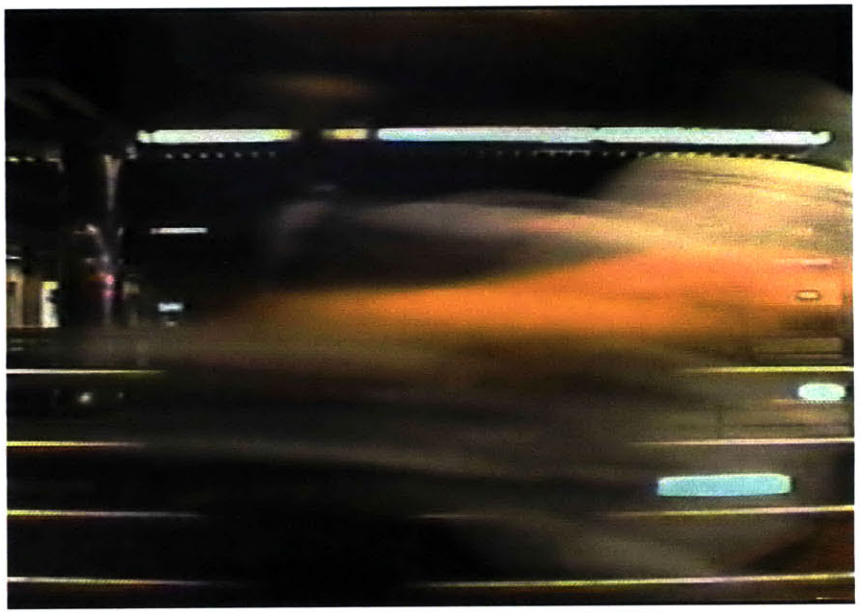
Santiago Calatrava's stations have an infinite palette of views by the careful articulation of details and material connections. While waiting for a train, one can find interest in furniture, an overhead detail, the base of a column, or the underside of a stairwell.





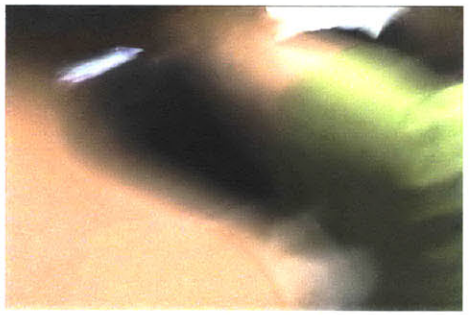






A man reads the newspaper while running to catch the train at North Station Awareness is a sense that is both heightened and muted. In the station, one must be incredibly aware, so as not to bump into the multitude of people traveling in different directions. While on the train, because of the close and shared intimate space, one must dull their senses - not notice the person sitting next to me.

In Amsterdam, I passed a store – walking at a brisk pace. I noticed something of interest, something metallic, vertical stripes over about a foot high and 1.5 meters from the ground. Spaced at a regular density at a particular speed, the stripes blocked my view of what was in the store. I need only slow down, back up, and walk more slowly to see what was behind the mystery. However I decided the piqued curiosity of what might lay behind along with the mixed messages was what intrigued me most.



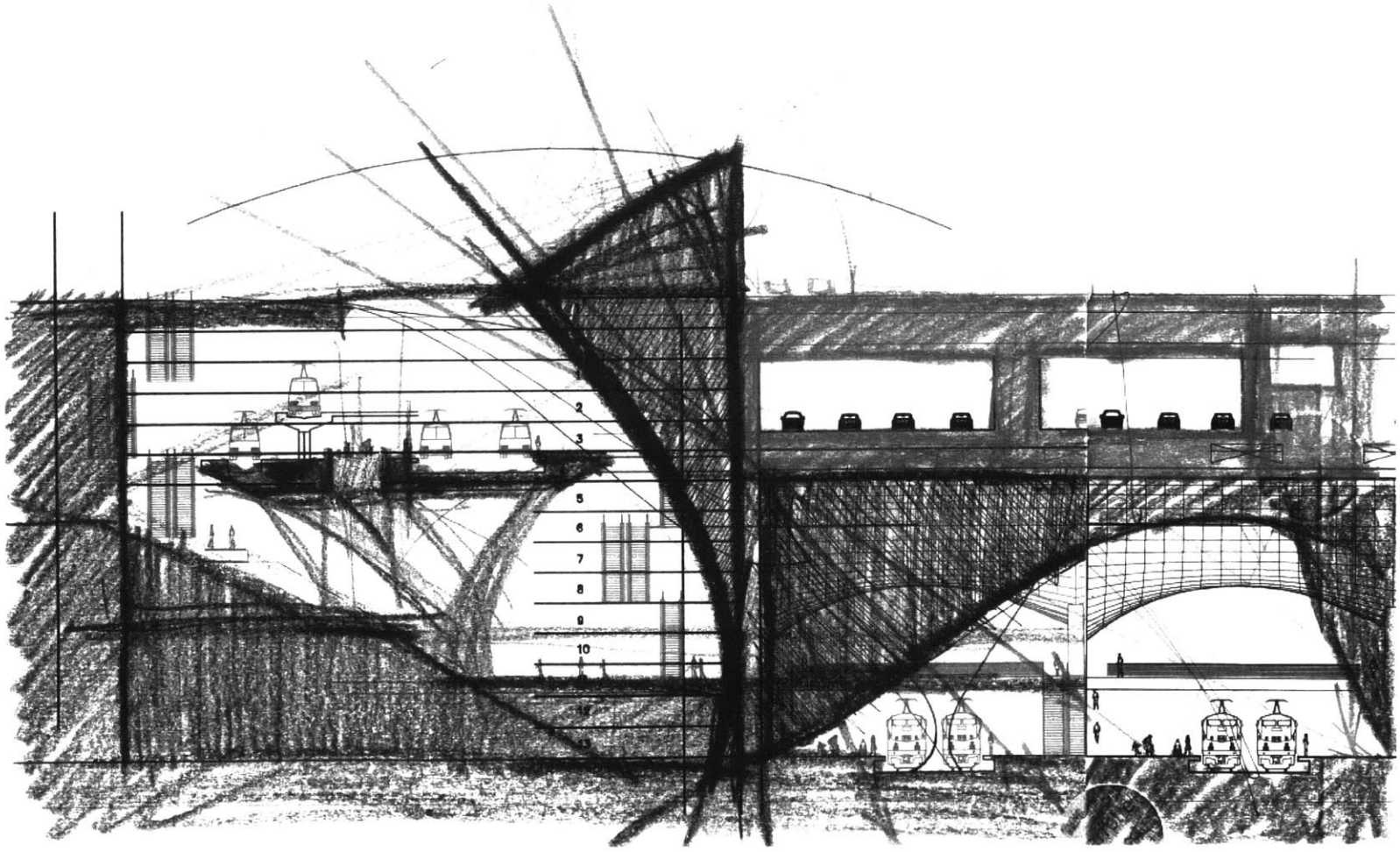
Her hair on his shoulder frame my view
For another it is different
Perceptions are infinite; landscapes are created
Soothing sound – I want to sleep
Clothing texture skin ear hair
.....to focus on each....

station. This also facilitates straightforward access for those moving in and out of the station. Rather than focusing attention at the ends, smaller entrances, separated into functions such as entrance and exit, or elevators and escalators, allow people to freely disperse. The plane that defines the transition from interior to exterior is a horizontal façade that users can walk upon. At points of entrance, the thresholds are symbolized by interventions to the horizontal façade/roof.

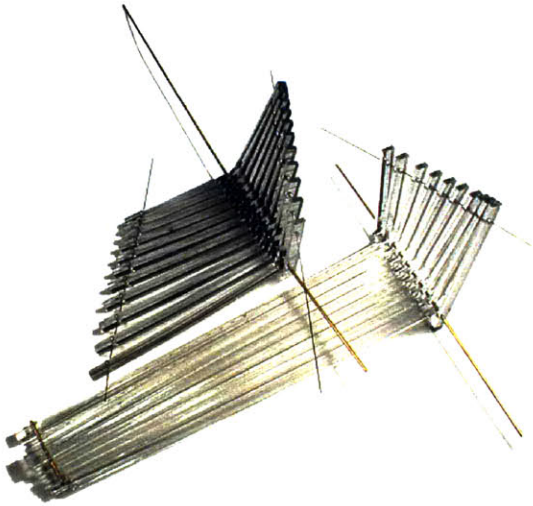
A goal in the circulation programming is to separate physically the fast-paced commuters from the slower-moving Amtrak passengers who are typically less familiar with the station. Commuters can enter the station and board their suburban-bound train a few minutes, with direct routing and separation of up and down traffic. Programmatically, the building caters to users in many different circumstances, from those that work there, to those that are waiting or hurrying, to those already on the train. The architecture must be malleable to these different demands. It is scale with the dimension of time. An object that is partially screened to a person rushing by, might become transparent to one who sits and different again to the one who stands and paces.

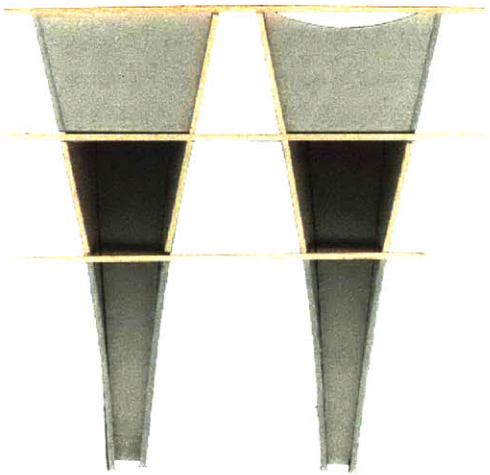
> *"Or perhaps what matters is not the human pain or joy at all but, rather the play of shadow and light on a live body, the harmony of trifles assembled on this particular day, at this particular moment, in a unique and inimitable way."*[2]
>
> *Vladimir Nabokov*

The psychological benefits of light will be especially important in the scheme for North Station to counterbalance the ominous nature of being underground. Initial studies into the architectural



initial sketch - light scoops are oriented to provide vantage points for people on the NSRL platform.





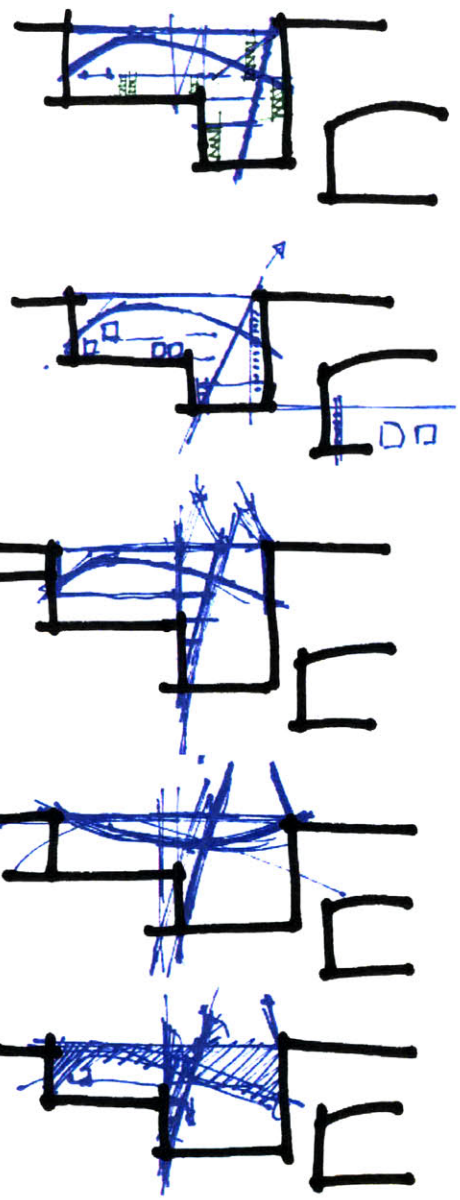
top image - figure 28 - initial sketch model made of mirrored plexiglass

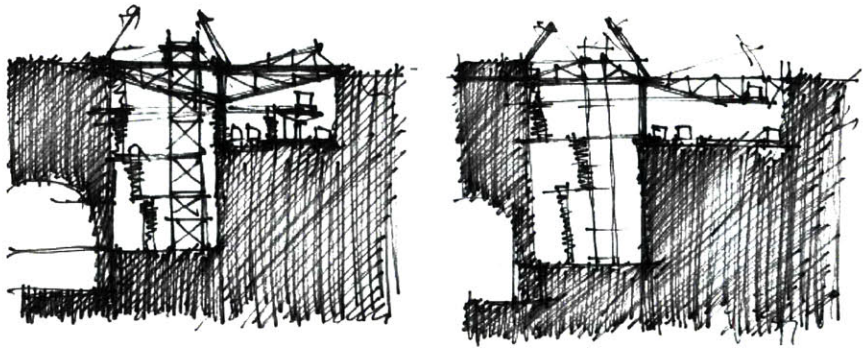
bottom image - initial study of light scoop form

expression of space attempted to allow people at the lowest level to perceive their position in the city and in the station through light scoops, which would allow them to see the sky. After a re-examination of structural difficulties with the Central Artery Tunnel, I decided to incorporate an existing proposal for the NSRL at South Station, a barrel-vaulted ceiling. As an alternative, the slurry wall that separates this area of the station from the rest is penetrated where concourse level platforms cross the tracks at the NSRL. After much time spent underground, arriving passengers have a sense of where to go by seeing the movement of people and the introduction of natural daylight.

The focus of the scheme resides in the transition between the two main areas of the station. This area, referred to as the circulation/light zone, will be articulated as the place where people perceive the context of the city and time of day and year. The building is to function at all times of day as well as during the night. After dusk, artificial lights will serve to light up the urban space above. Historically, the rail station has performed such a role in the urban fabric. "Carefully planned lighting of the pre-war and immediately post-war periods was integrated within the general design, but the subsequent installation of fluorescent strip lighting and associated trunking has spoilt many interiors by its insensitive application. Modern illumination equipment cannot give an impression of the night atmosphere present in the 1930s and 1940s Underground stations when first opened."[3]

In a 1973 essay entitled 'Structure, Construction, and Tectonics," Eduard Sekler defined the tectonic as a "certain expressivity arising from the statistical resistance of constructional form in such a way that the resultant expression could not be accounted for in terms of structure and construction alone."[4] Much time was devoted to the design of such a "tectonic." Site and programmatic constraints





defined a large aspect of the structural design, however the form is developed to demonstrate a system that comprises a singular coherent building responsive to the conditions of its existence. The arching structural canopy covers the two spaces, so that a transition that begins with movement into the station continues into passages between the spaces.

There are three distinct zones in the building for three varying programs and occupants. These are the Green Line - Orange Line station, the North-South Rail Link, and the space between them. People on the subway are not aware when their train is coming and are therefore constantly ready to move. Those on the NSRL platforms follow a schedule; they know when the train will arrive and depart. Thus, they have the choice of waiting either on the relatively intimate platform zone or in that of the circulation/light zone. The circulation/light zone serves primarily as a space for motion. The concourse level offers places to stop and wait for a train; where passengers can sit at benches, drink a coffee, purchase tickets, see art, and receive information. The canopy seeks to unify all of the three above areas into one coherent building. The confluence of these three ideas – movement, light, and structure - into an architectural program is demonstrated in the final documentation.

1 David Lawrence, *Underground Architecture.* (Middlesex: Capital Transport Publishing 1994) p. 9.

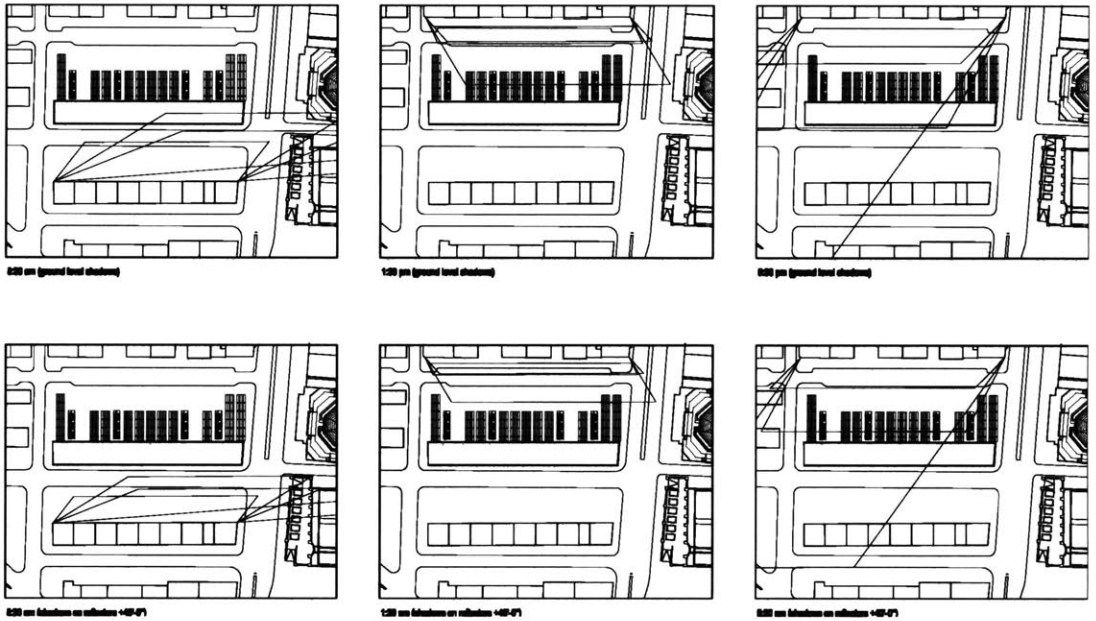
2 Vladimir Nabokov, from "The Fight".

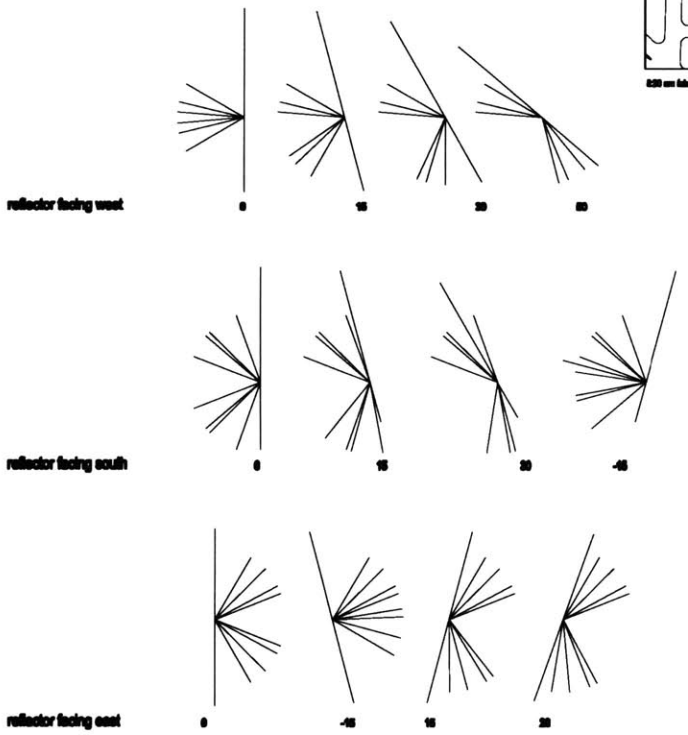
3 Lawrence, pp. 116-119.

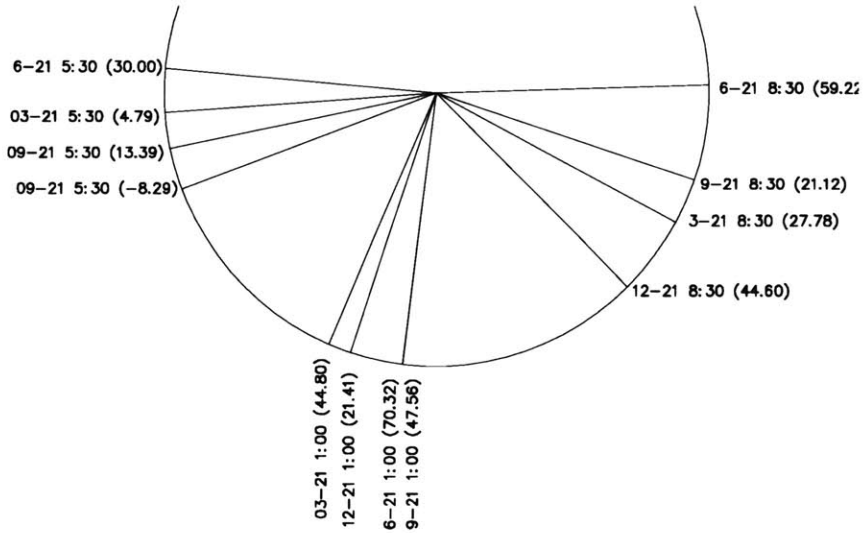
4 Kenneth Frampton, *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture.* (Cambridge: MIT Press 1996) p.19.

previous page - preliminary structural sketches

this page - daylighting studies led to the the design of the façade/roof. Depending on the time of day and year, the reflectors can move in a way to deflect light to the lowest level of the station. Studies were calculated for Boston, at 8:30 am, 1:30 pm, and 5:30pm - on dec. 21, mar. 21, jun. 21, and sep. 21. Typically, reflectors move in the range of 0-15 degrees.







A man at the Green Line North Station waits patiently for his train. His head begins upright, and then slowly ducks down to see who else will be exiting. Passengers leaving the train are actually running, to catch their commuter rail train.



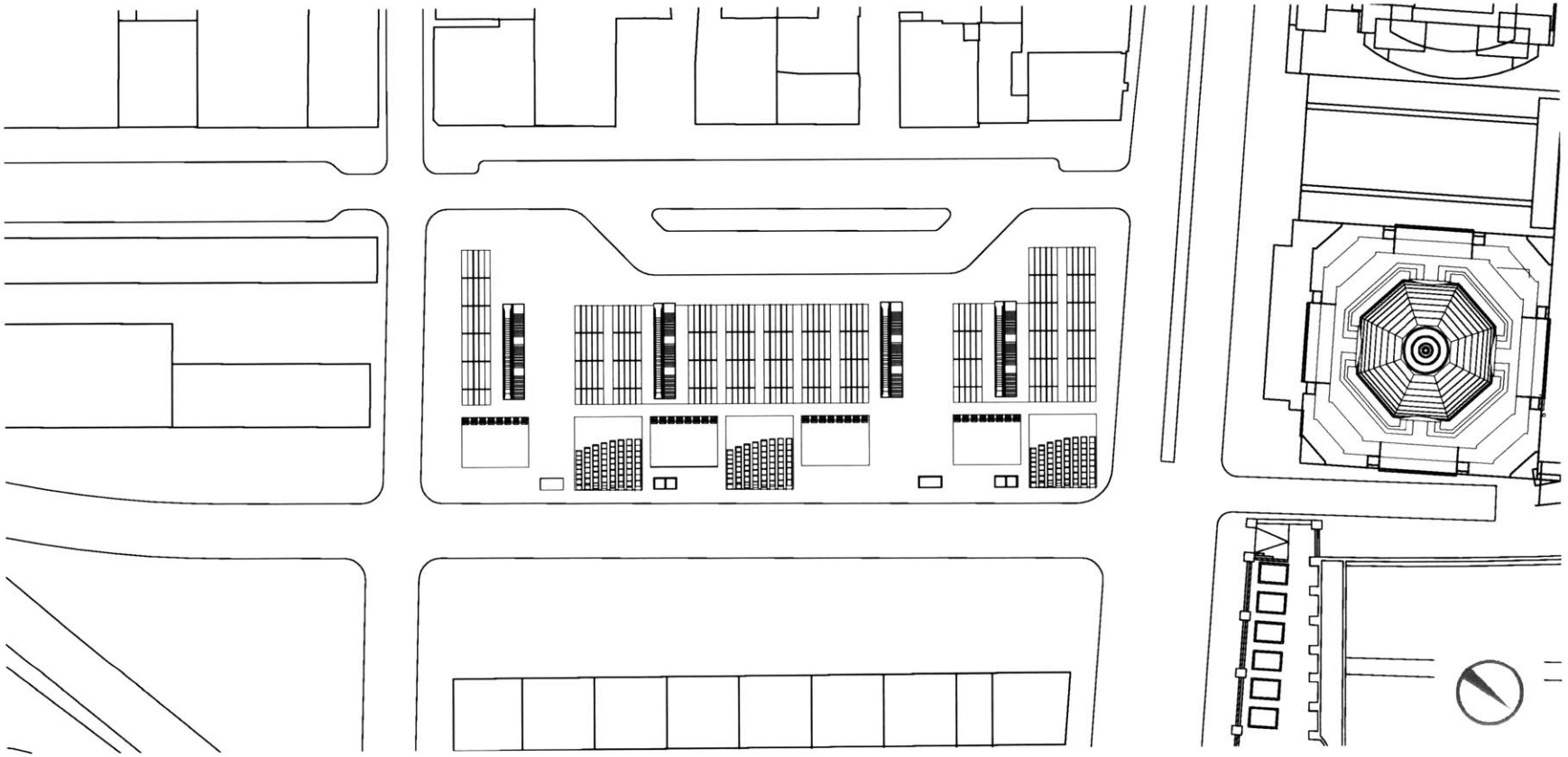
film stills from the Tokyo-Ikuta line. Auto-focusing video camera changes depth of field depending on shifting bodies in front of the subject.





The following drawings and images of models are selected from the final thesis presentation. Drawings convey the entirety of the space, while models are primarily sectional due to the nature of an underground project. In addition, models communicate materials, light qualities, and details in construction. Drawings were made from a virtual 3D model, because the building is difficult to comprehend 2-dimensionally. Due to the fact that they were made in AutoCAD, the scale of study was not so relevant; models however were built at five different scales during the course of the semester in order to study a visitor's perceptions in many situations.

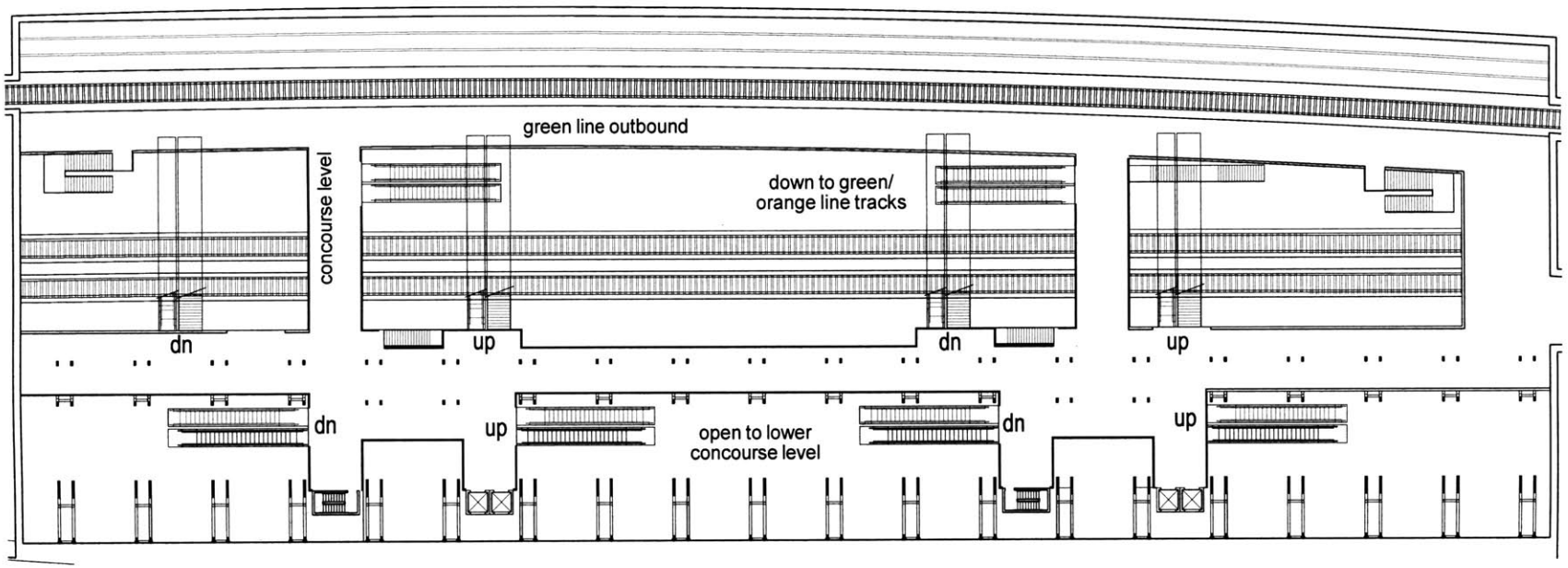
The models are static and do not display the full fluctuation of usage throughout the day in a station. For this reason, I included as part of my thesis presentation a video which attempts to show the movement patterns of people and trains. The footage was shot during the summer - mostly at slow shutter speed so that bodies begin to lose their familiar shapes and blur depending on speed. Film stills from the final presentation are located throughout the book.



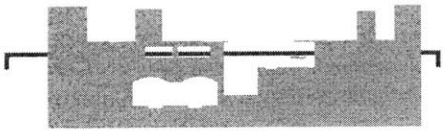
SITE PLAN 1"=120'0"

previous page - Reference plan shows underground levels and rail lines superimposed on the block organization of the neighborhood.

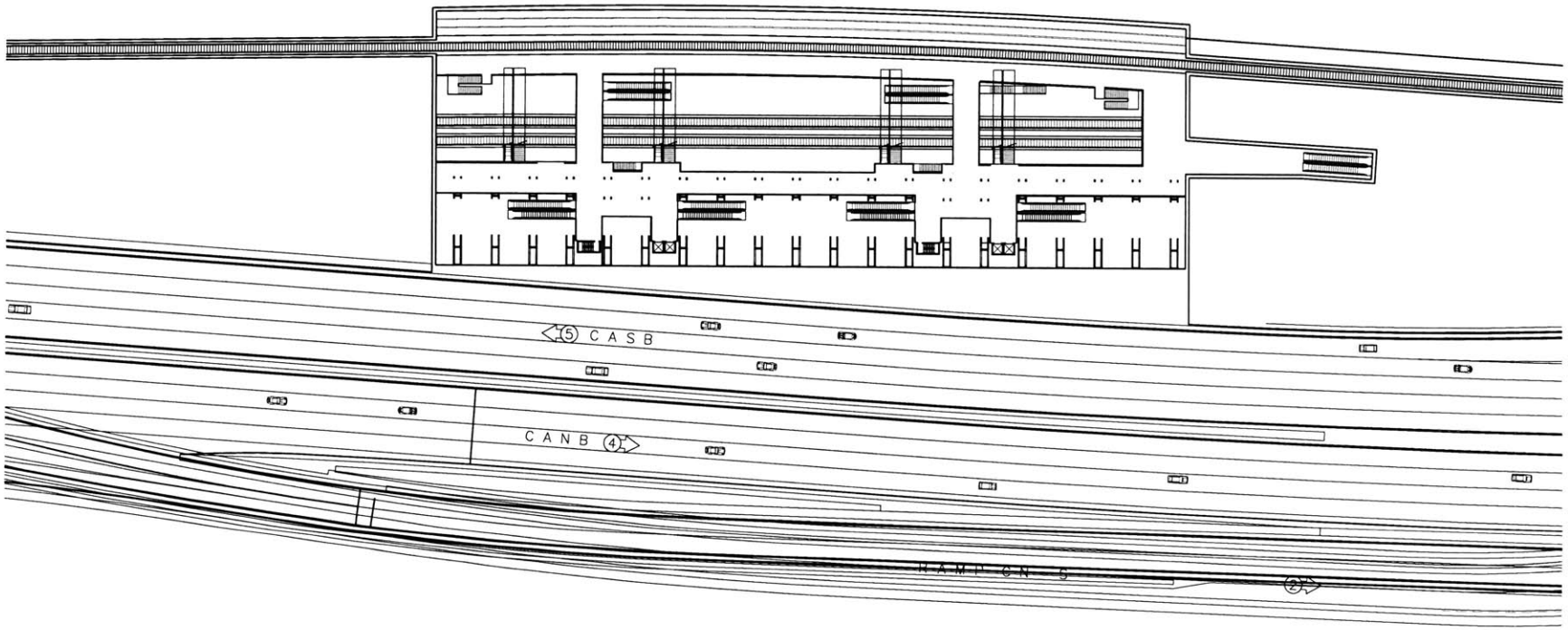
this page - Site plan shows the building within the context of the North Station area. At the plaza level, there are two entrances and two exits. These move passengers and visitors below the level of structure. There is an additional entrance/exit in the office tower to the northwest, on the other side of Causeway Street



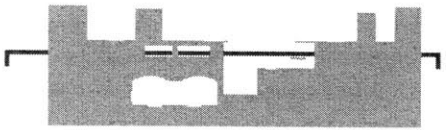
PLAN at -25'-0" 1"=80'-0"



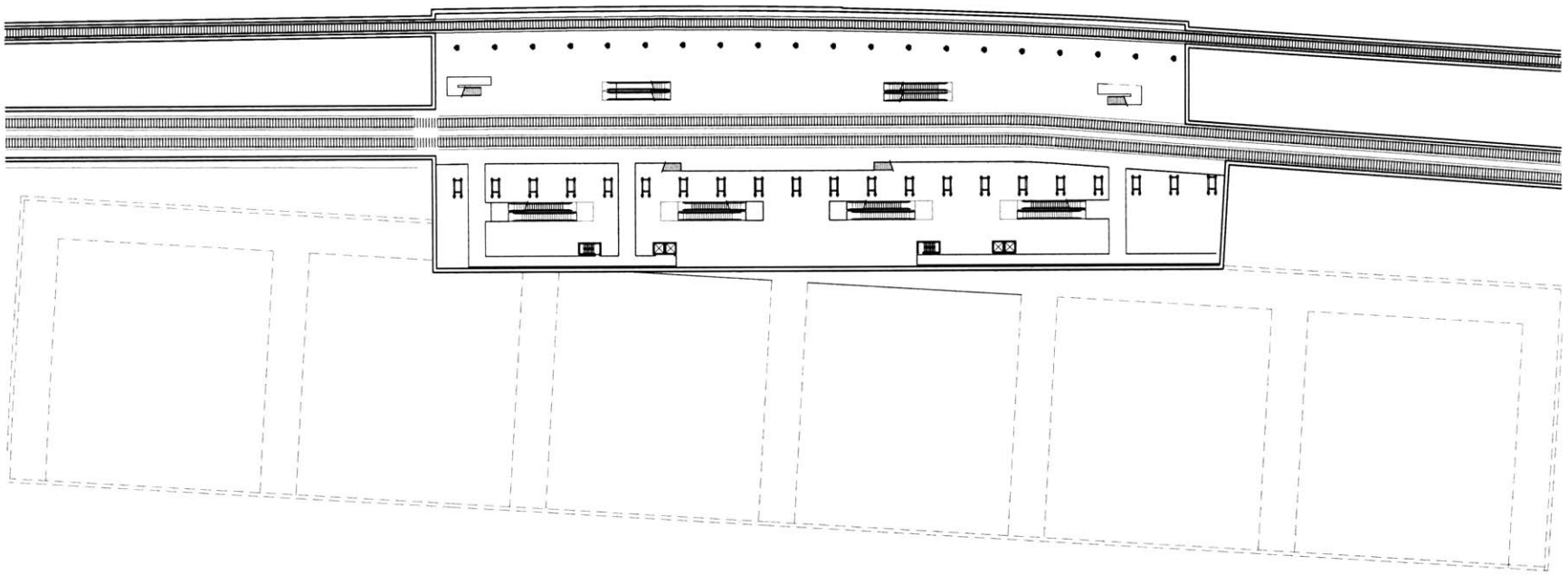
This plan shows movement paths at the upper concourse level. Passengers entering the building penetrate the surface parallel to the structure. Once inside, movement turns to run in the direction of the length of the building. This is to give a moment for visitors - who have not yet familiarized themselves with the station - to orientate themselves. Passengers exiting the building use a different path, slightly more direct.



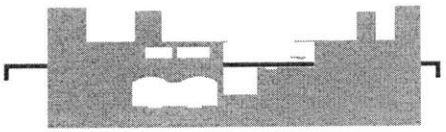
PLAN at -25'-0" 1"=120'-0"



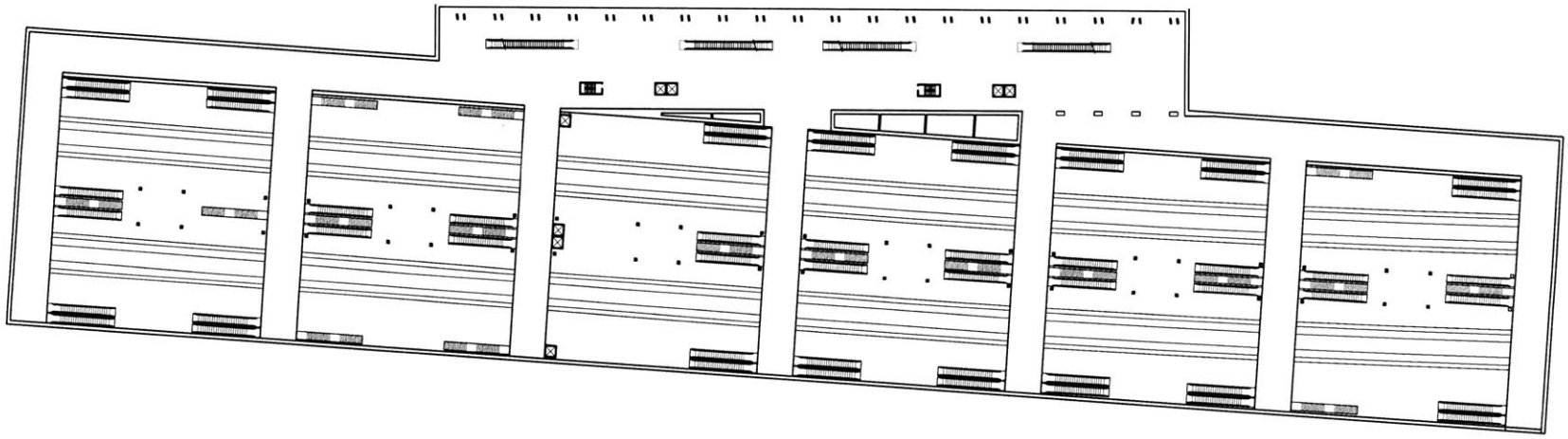
This plan cuts through the first plane at which visitors arrive - the upper concourse level, where subway-riders purchase tickets. Passengers can board the Green Line Outbound at this level. It is the same plan as the the one on the previous page, but shows more context, including the Central Artery Tunnel, which is located at the same level, and the entrance on the other side of Causeway Street.



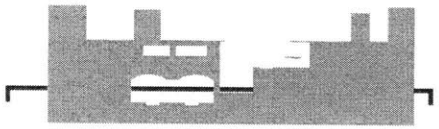
PLAN at -40'-0" scale = 1"=120'-0"



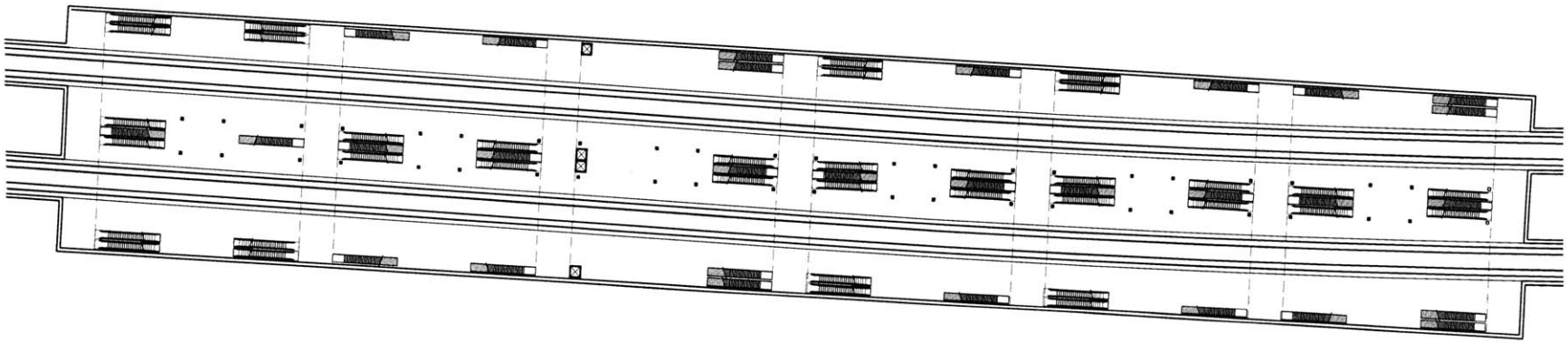
Plan is cut at the level of the Green Line and Orange Line transfer level. All subway rails are reached at this level, except the Green Line Outbound, which is located on level above in order to facilitate ease of transfer between Green Line and Orange Line inbound trains.



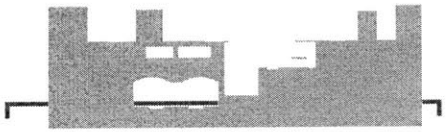
PLAN at -95'-0" scale = 1"=120'-0"



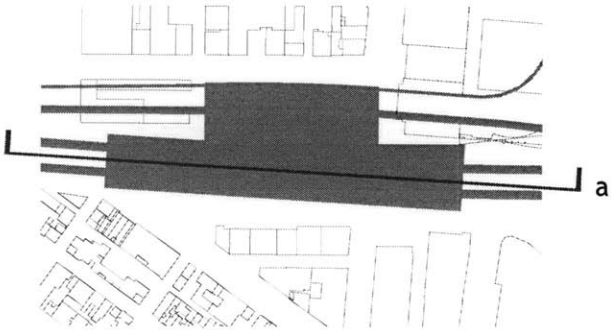
Plan is cut at the lower concourse level. At this level, passengers may cross the tracks to reach the appropriate NSRL platform or may mingle in designated spaces in waiting zones in the concourse level.



PLAN at -105'-0" scale = 1"=120'-0"

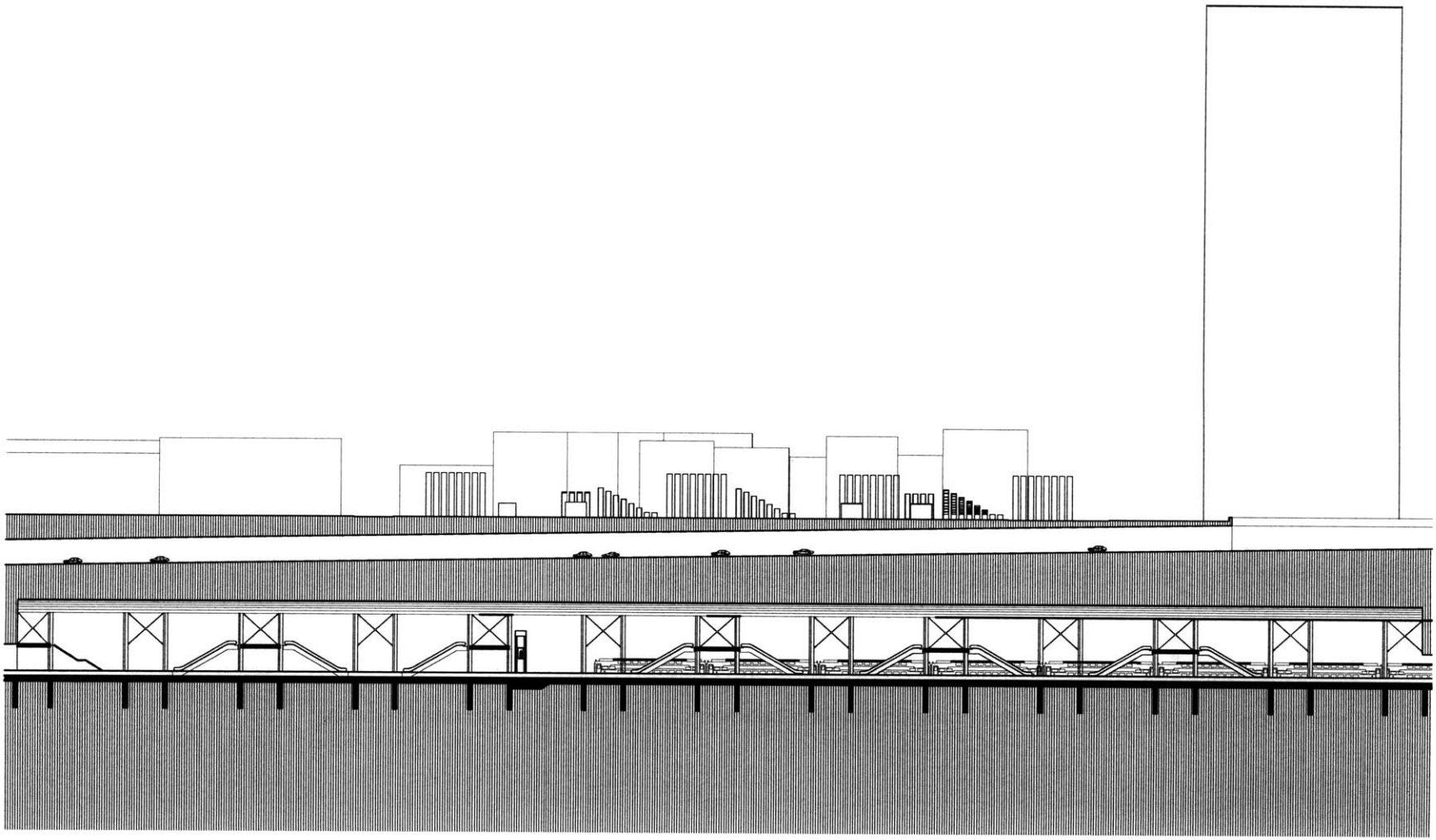


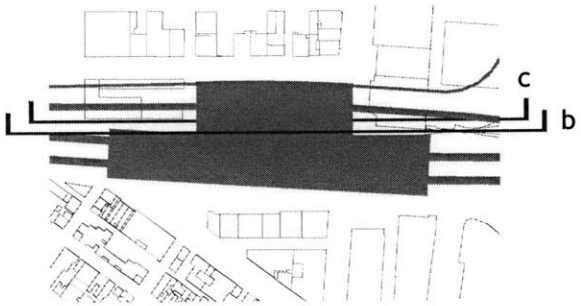
Plan shows the North South Rail Link platform level.



LONGITUDINAL SECTION A scale = 1"=120'-0"

Longitudinal section is cut through the North South Rail Link Station and the Central Artery/Tunnel. The urban intervention developed in this proposal is shown in elevation.

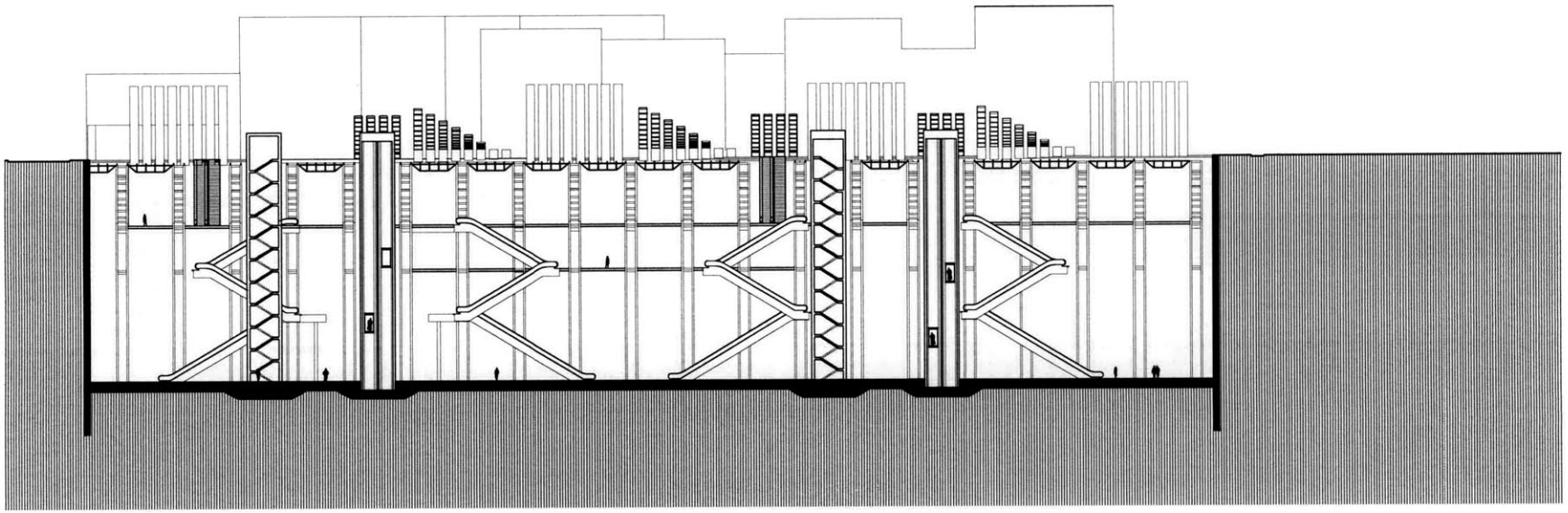


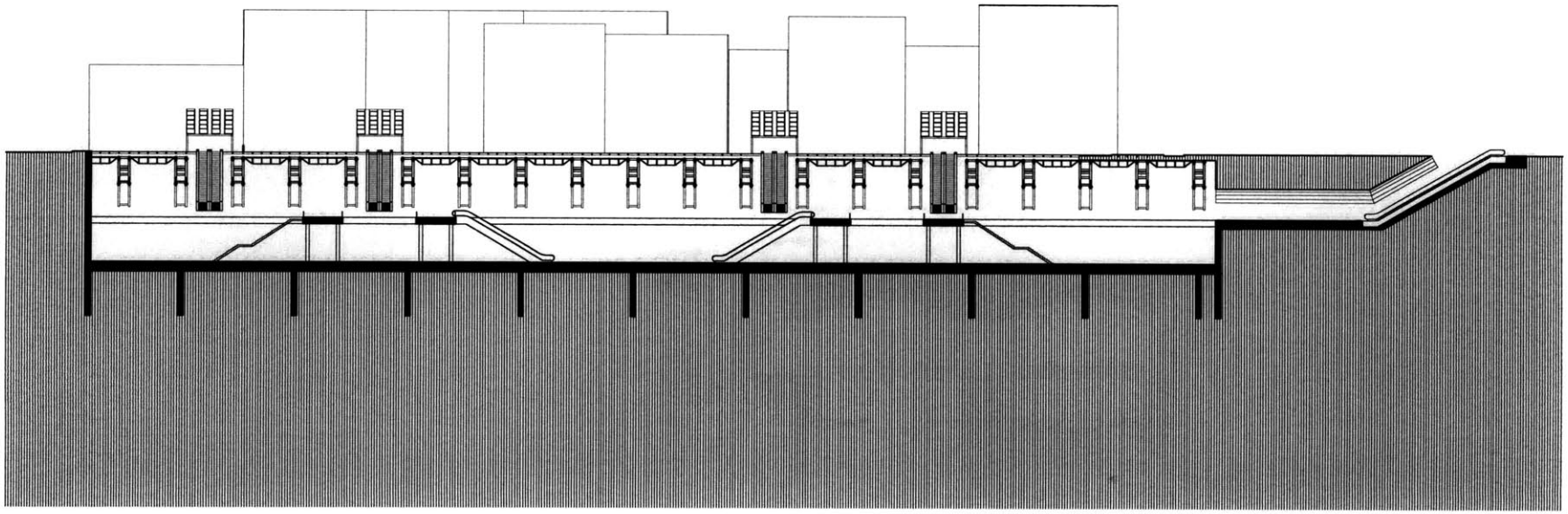


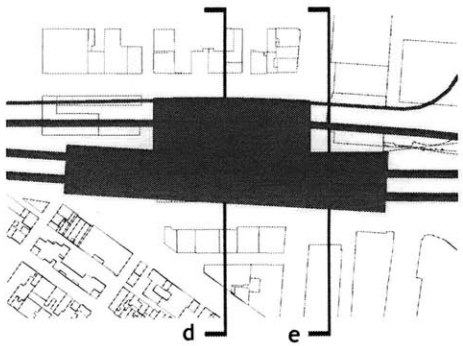
LONGITUDINAL SECTIONS B and C scale = 1"=80'-0"

Longitudinal Section B is cut through the circulation/light zone - showing means of vertical circulation and scale of space.

Longitudinal section C is cut through the Green Line/Orange Line Station - showing the four plaza entrances/exits, and entrance at Causeway Street North.



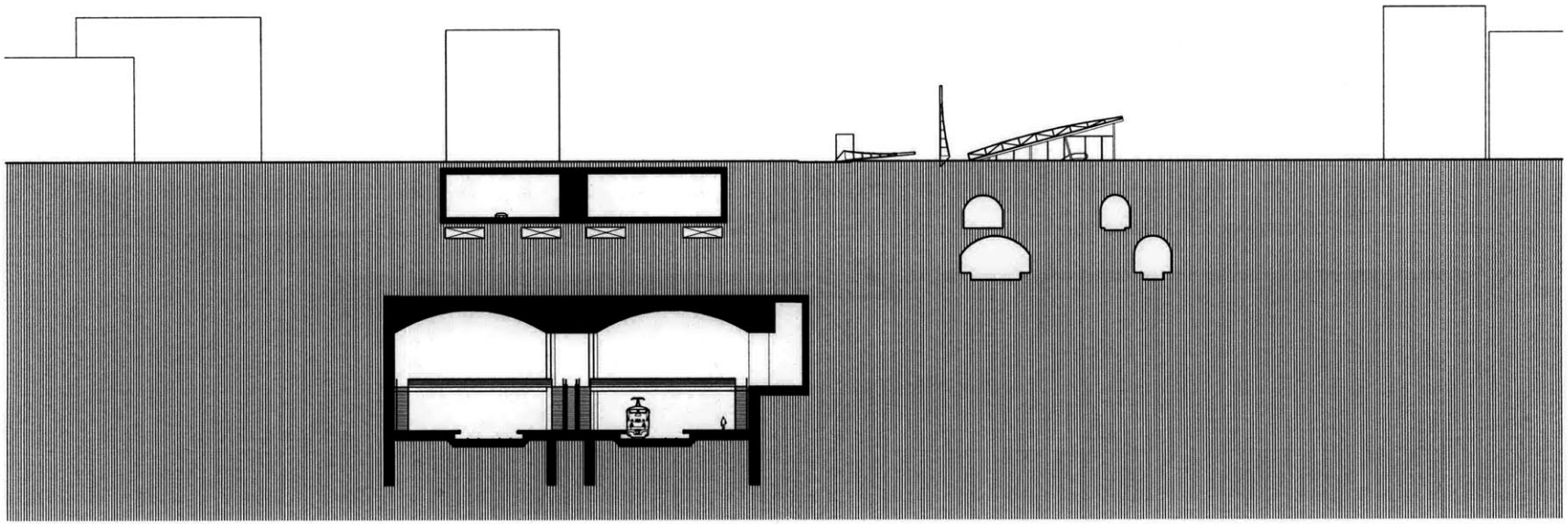


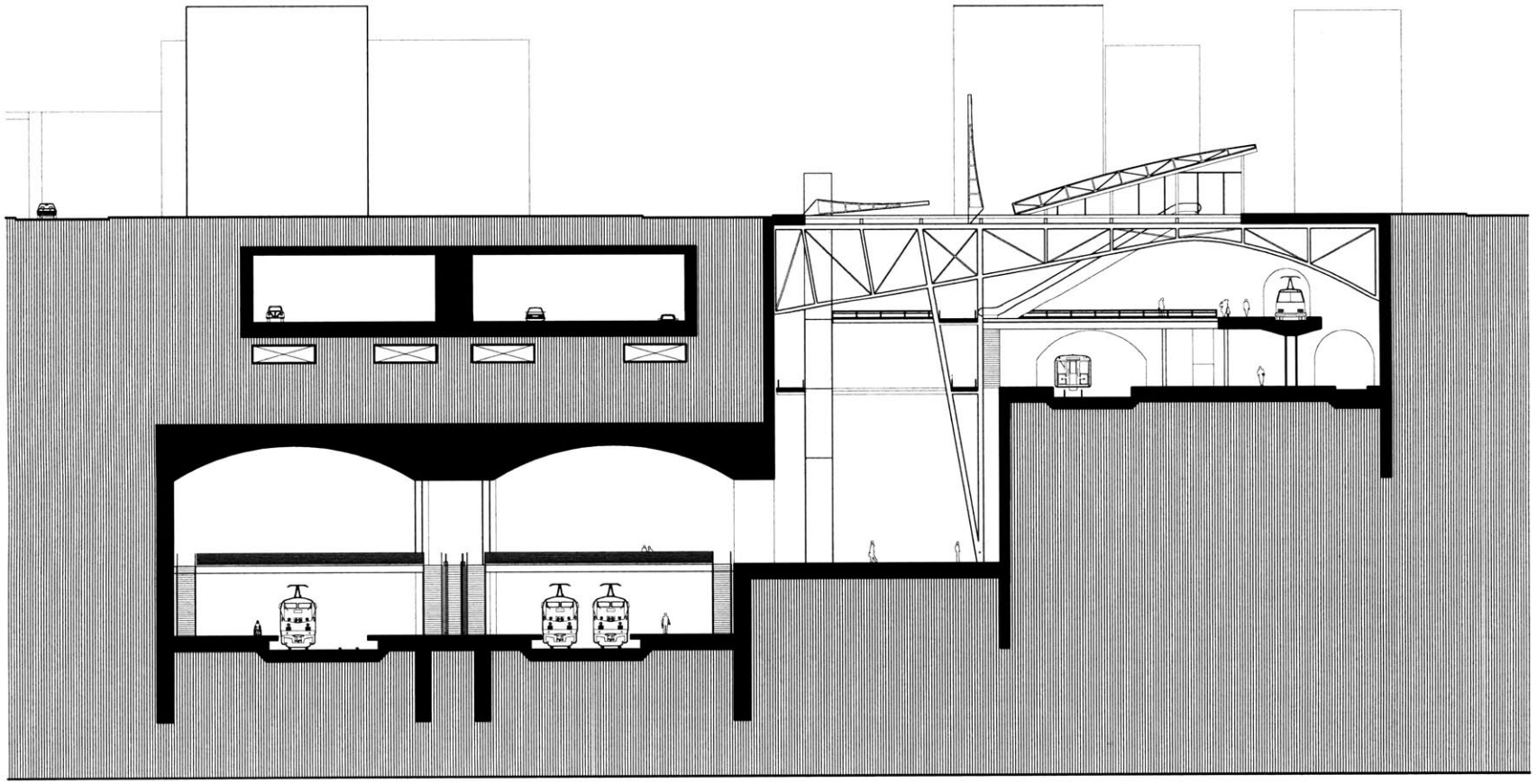


CROSS SECTIONS D AND E scale = 1" = 120'-0" and 1"=80'-0"

Cross Section D is cut through the North South Rail Link and Central Artery Tunnel. This station extends for 1000 feet while the subway portion of the station is only 450 feet.

Cross Section E shows structural form, including differentiation between big and small trusses, and architectural organization, including differentiation between higher and lower level platforms.

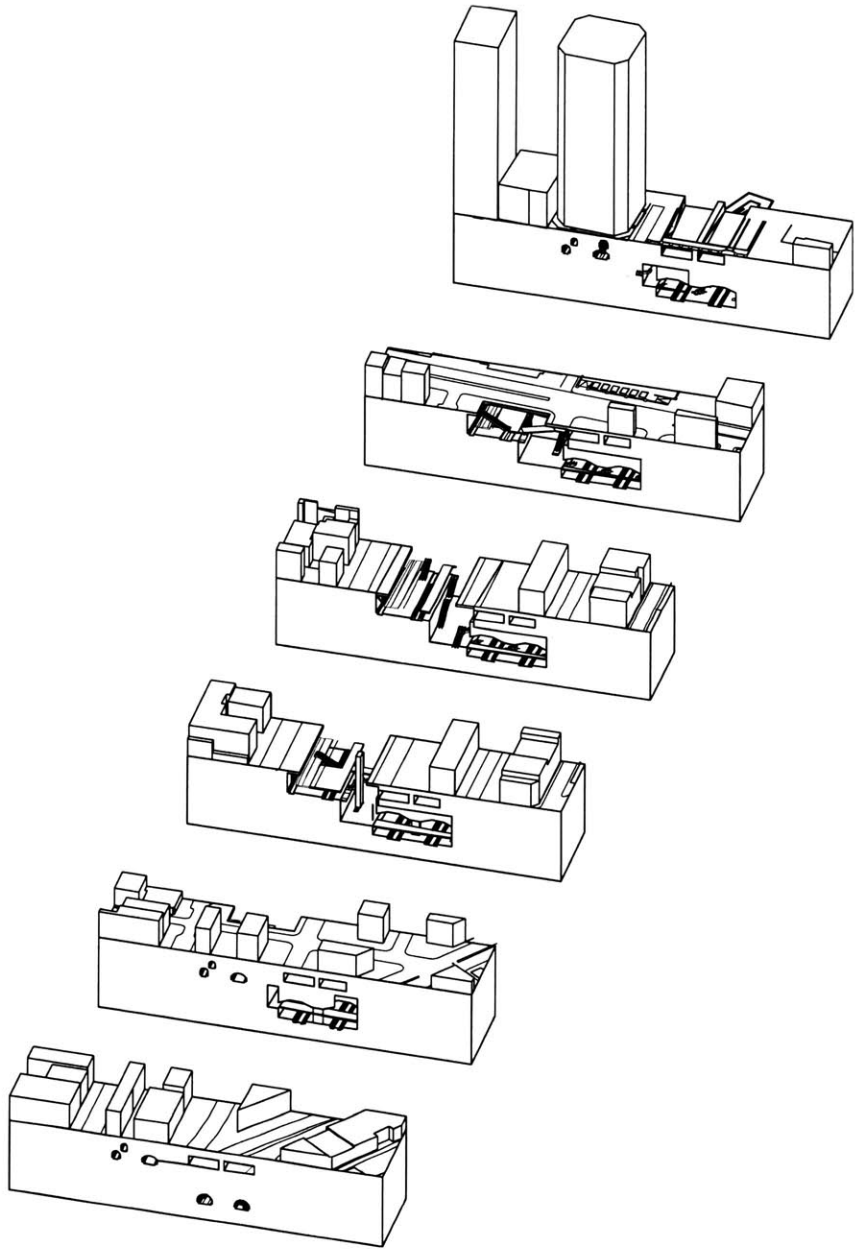


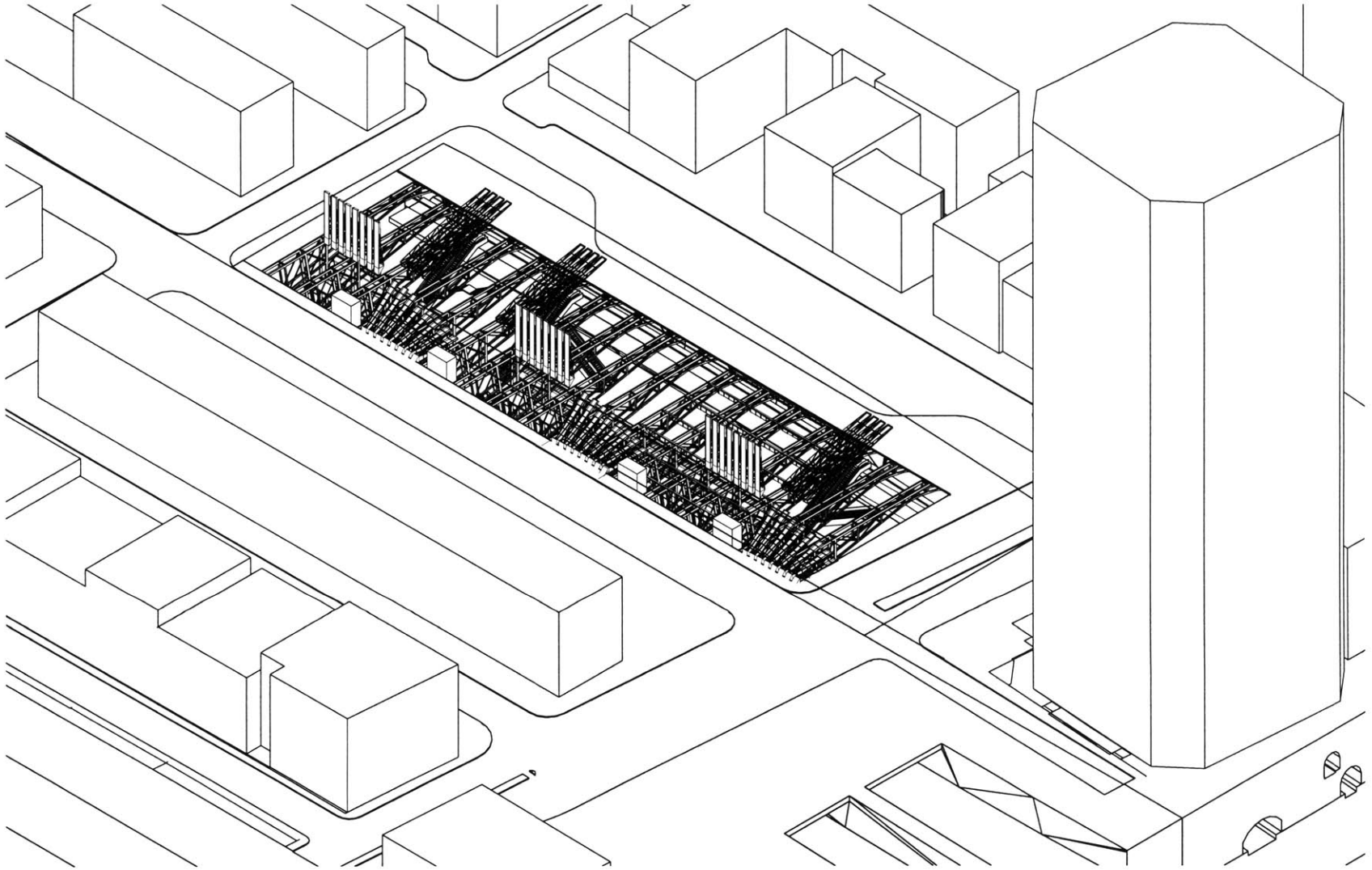


AXONOMETRICS

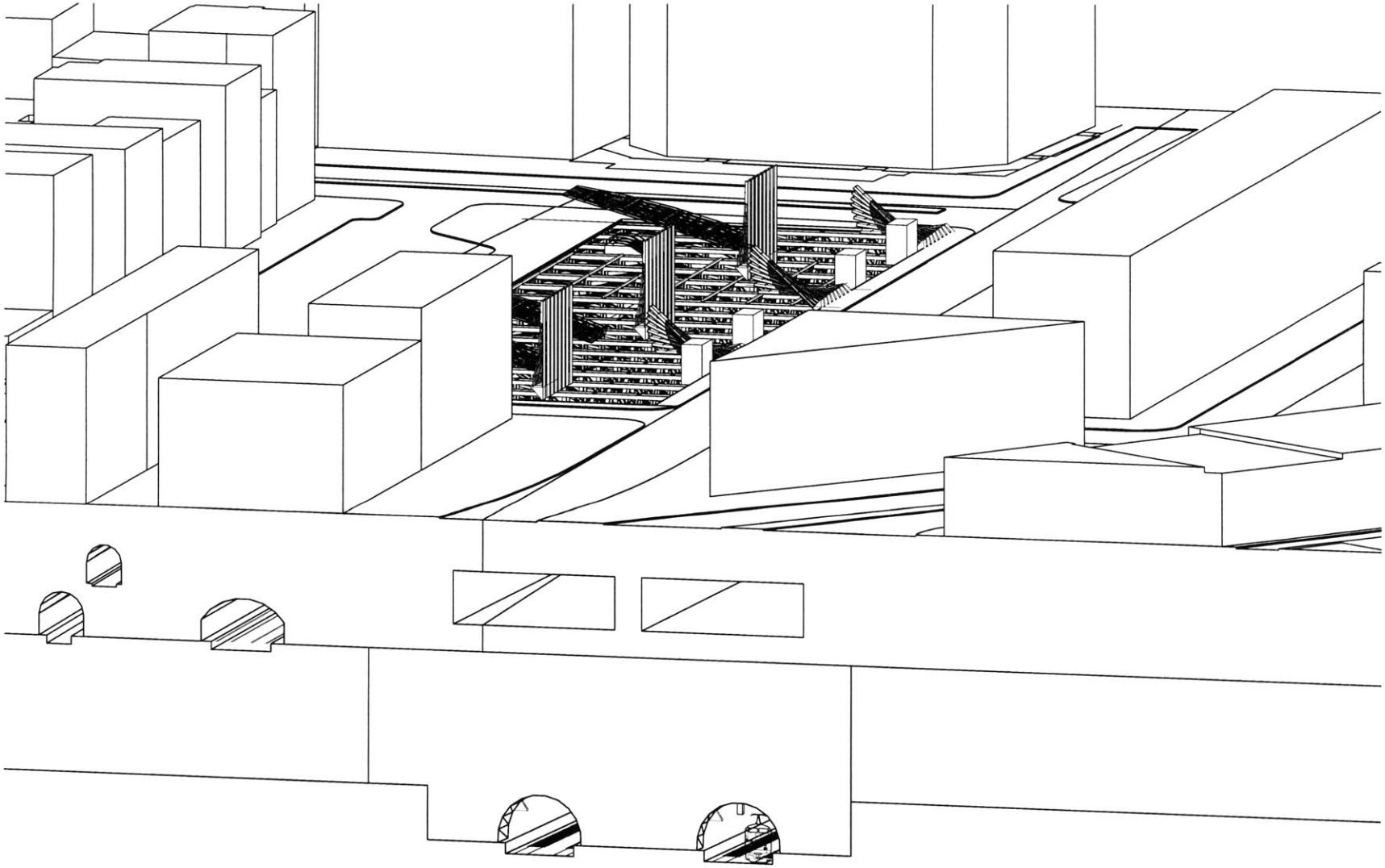
Axonometric drawings were an indispensible tool during the design process, to visualize an ongoing 3D model.

right - exploded axonometric showing cross-sections of the site.

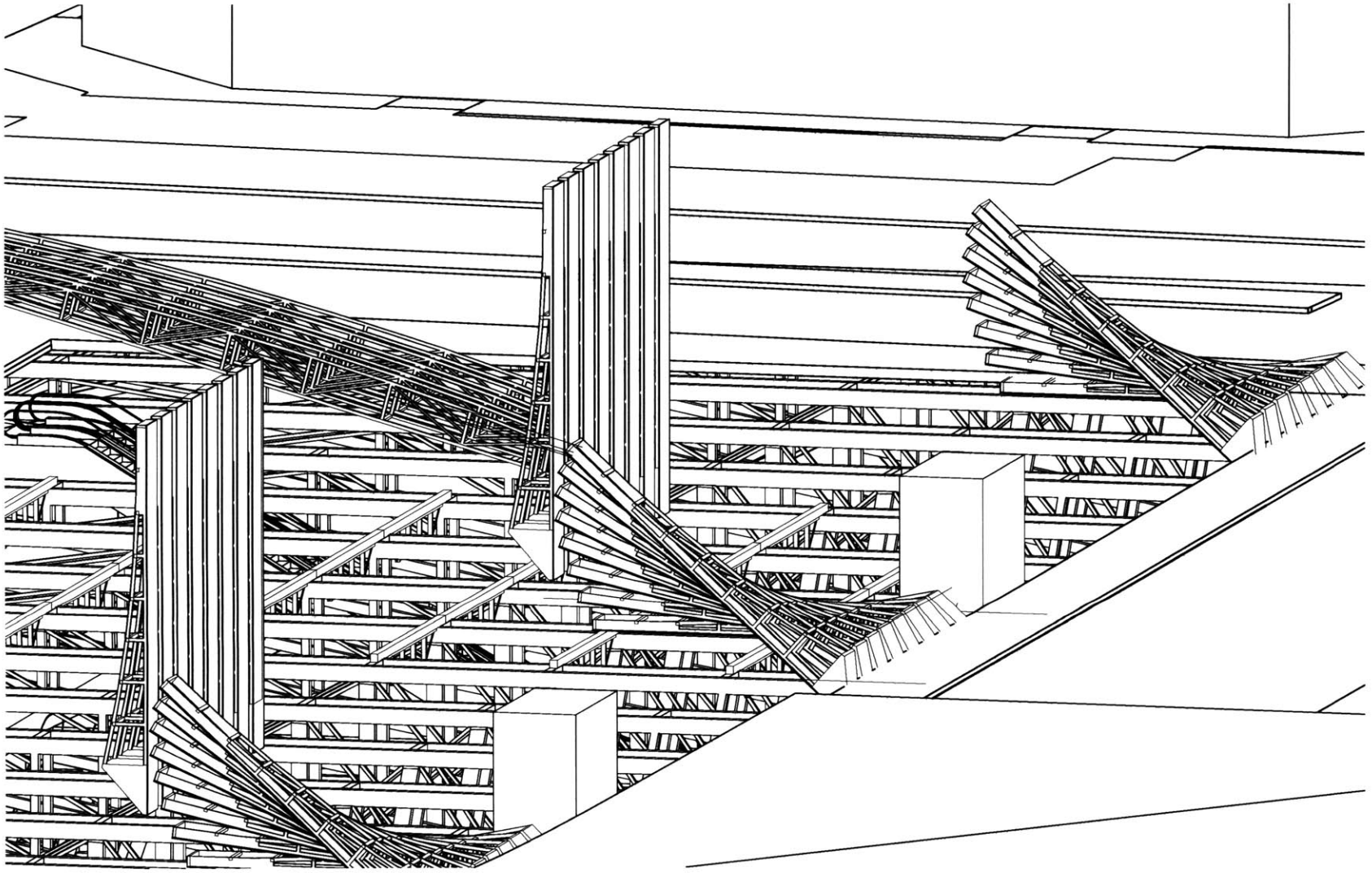




view looking south over proposed North Station. One can surmise that it is the morning because reflectors are facing east. The design proposes a unique urban plaza space.

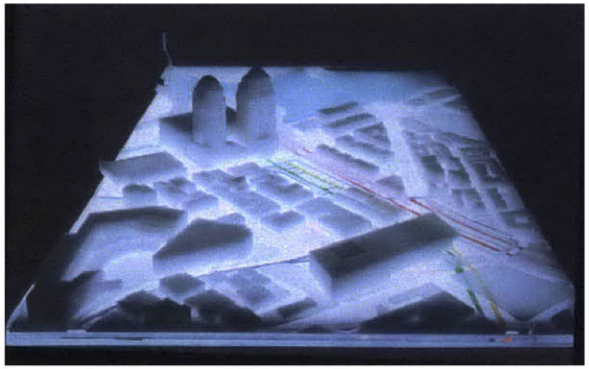


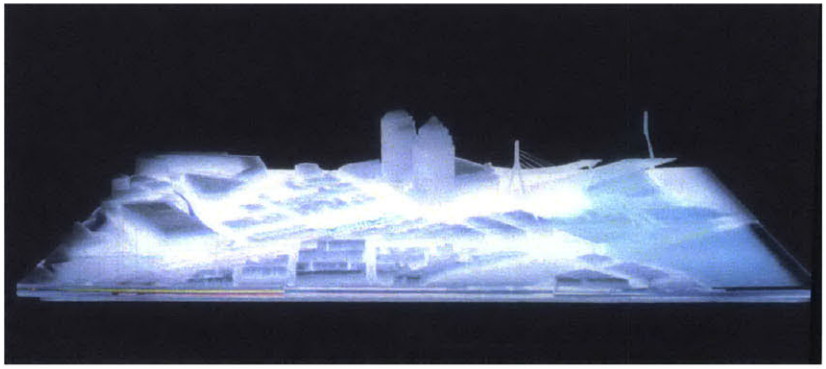
view looking northwest - revealing sections underground and above

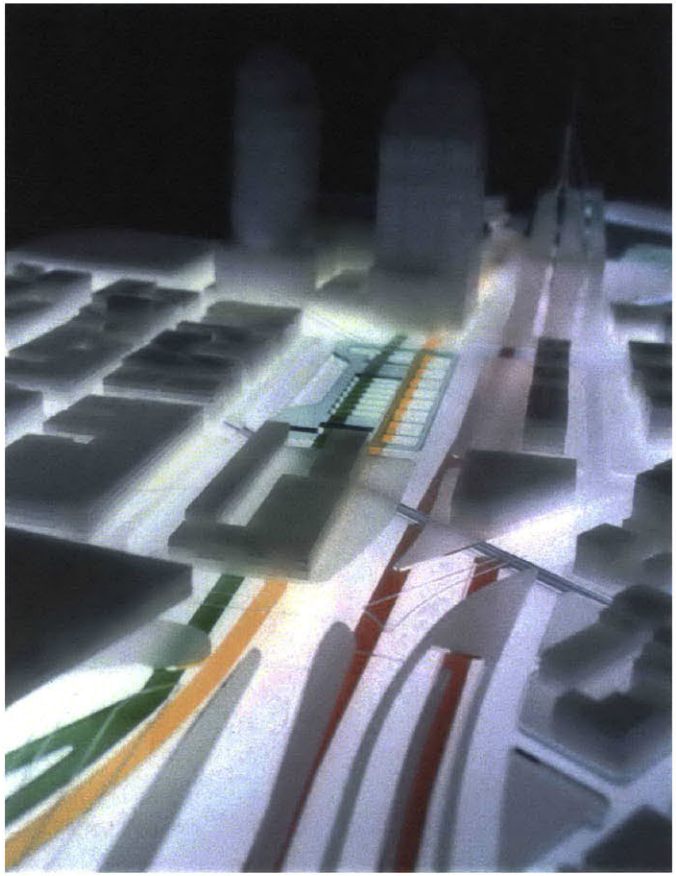


close-up view of previous axonometric - expressing the sketeton of the structural system

64 MODEL





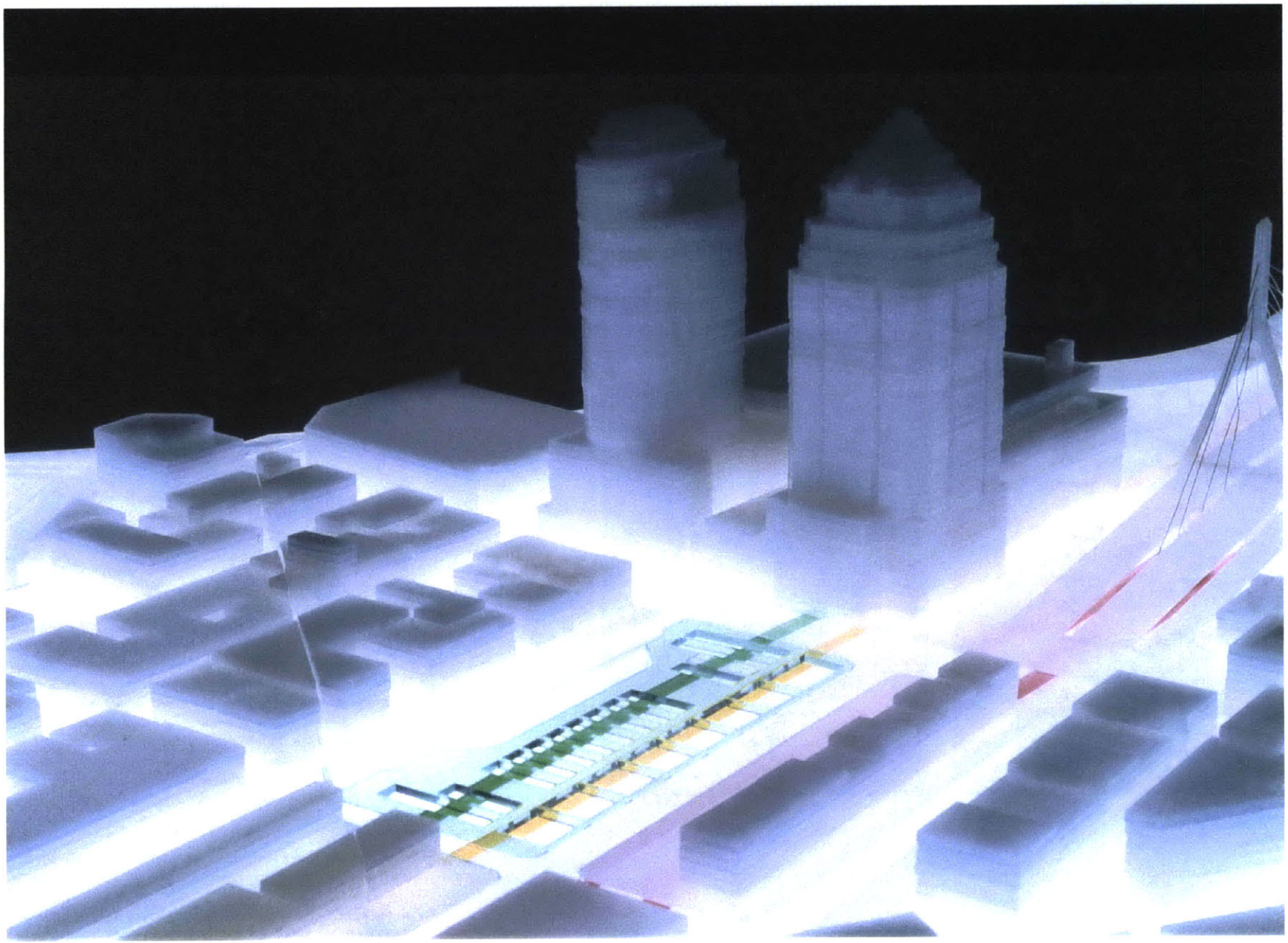


Preliminary 64 Model

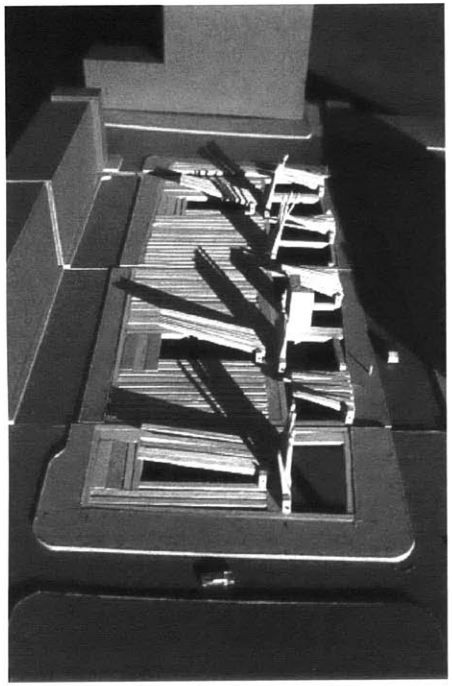
plexiglass 1"=64'-0"

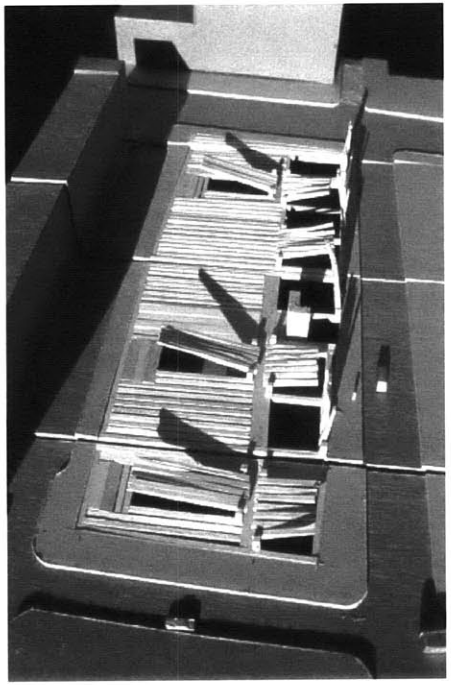
The intention of the model is to show the layers of infrastructure that cross the site at North Station. Buildings are made to be translucent and roads transparent. When illuminated, light from the Green Line, Orange Line, Blue Line, and North South Rail Link are clearly visible.

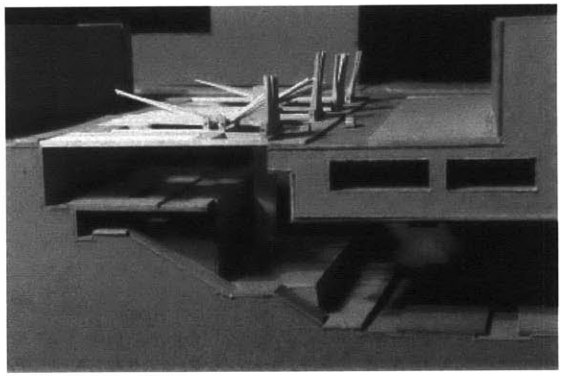
Model also shows surrounding context such as planned - office tower buildings, new suspension bridge, and the depressed Central Artery Tunnel.



32 MODEL







photographs to the left illustrate the movement of the reflectors. to the far left, morning reflectors deflect light.

to the immediate left, afternoon reflectors are operational. morning reflectors close so as not to cast shadows.

at night, when the station is not in operation, and during times of windy or story conditions, the light-deflectors close.. the zone of space that contains these reflectors corresponds to the zone of circulation which provides access to all levels of the station.

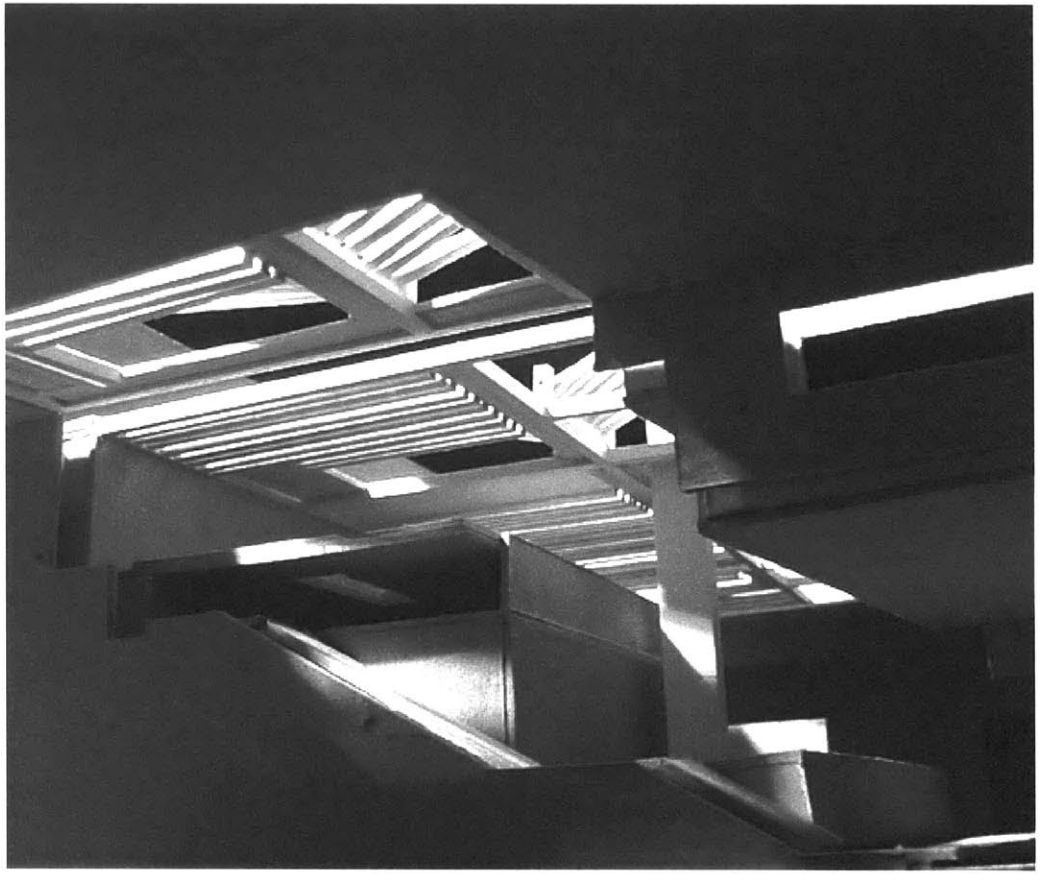
above, model shows both upper and lower halves - the street zone and the underground zone.

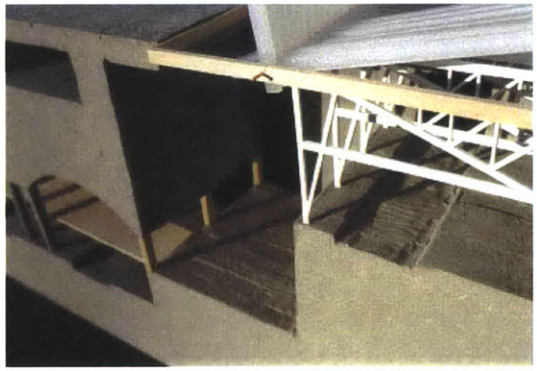
to the right, one can see varying qualities of light in different sections of the building.

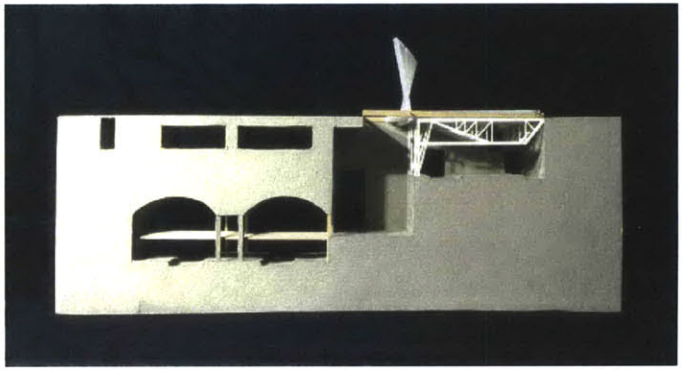
Preliminary 32 Model

chipboard and basswood1"=32'-0"

This model was constructed to visualize the entirety of the interior space as well as to test various designs for the roofscape. Moving parts and surrounding context facilitated testing of lighting conditions. Several roof schemes were initially studied on this model; the one shown is a version of the final roof design.







Preliminary 16 Model

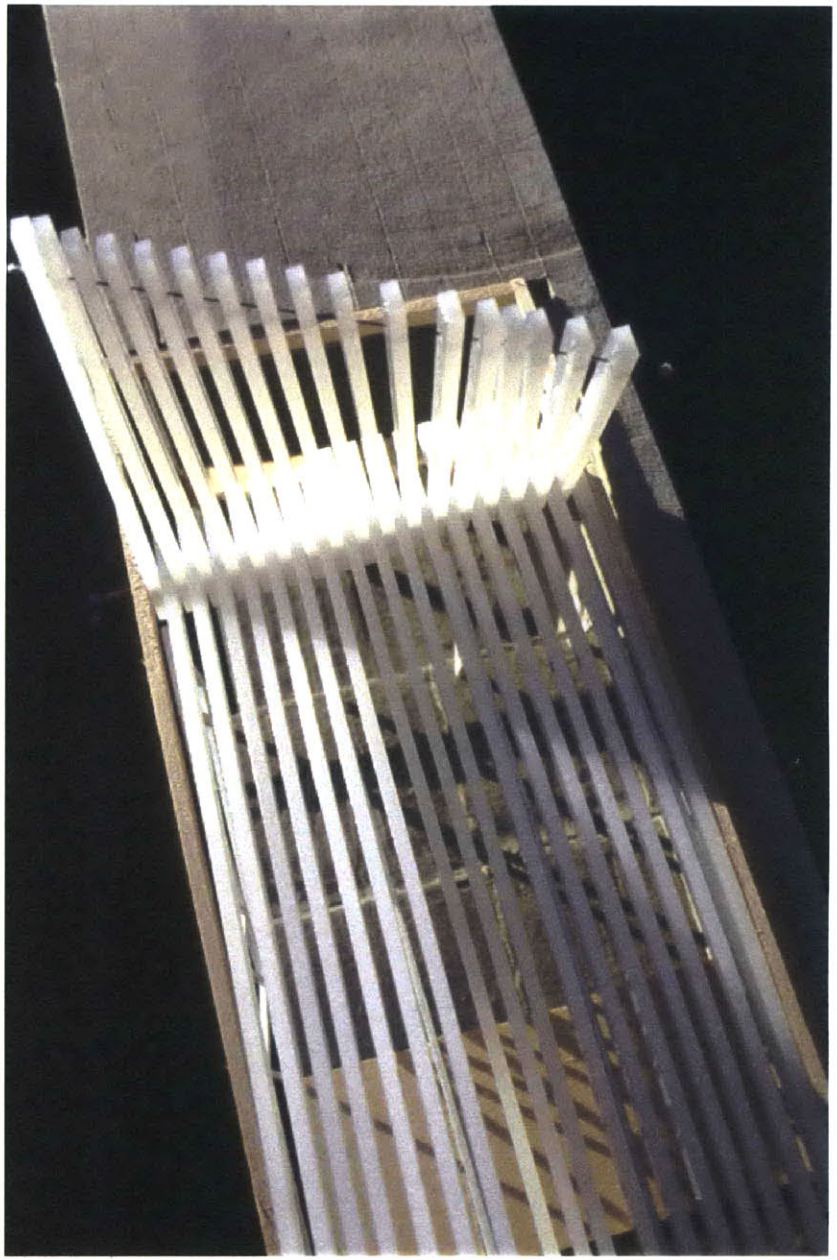
homosote, basswood, and plexiglass 1"=16'-0"

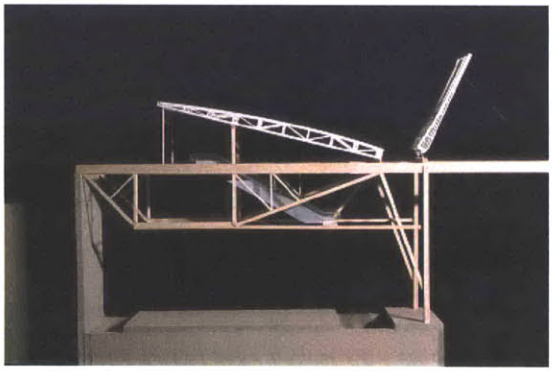
This model shows a complete cross-section of the building. Here one can perceive the differences in qualities between the space that is the Green Line/ Orange Line Station, the vaulted North South Rail Link, and the circulation/light zone that connects the two.

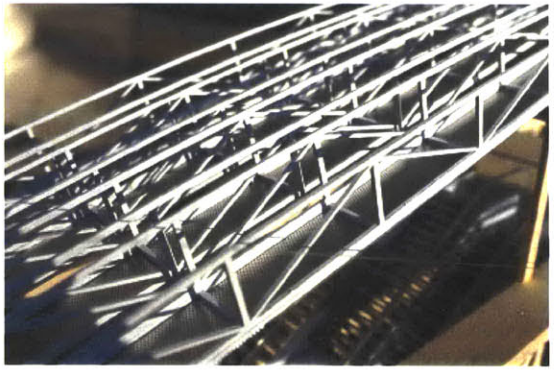
Kinetic aspects and details of the canopy, in addition to initial studies of the form of the structural system, are studied in this model. The roof over the North South Rail Link would be left as proposals indicate, a vaulted system strong enough to carry the weight of traffic, tunnels, and buildings. In this scheme the truss was designed to hang the Green Line inbound train providing for a column-free space below. However this was modified in subsequent schemes.

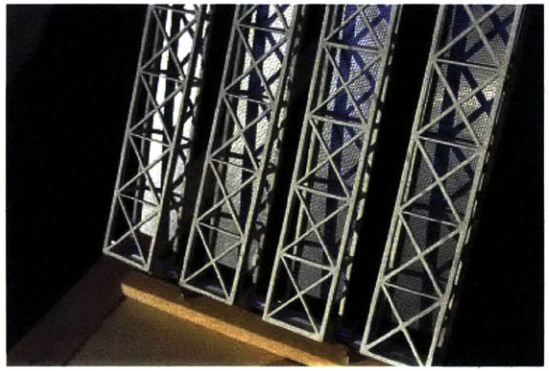
above left
image shows the spatial and lighting differences between two zones of stations, the green line and orange line station to the upper right, and the amtrak and mbta commuter rail on the lower right.

right
model shows initial studies into the form of the roof- deriving from the notion of peeling back the ground.







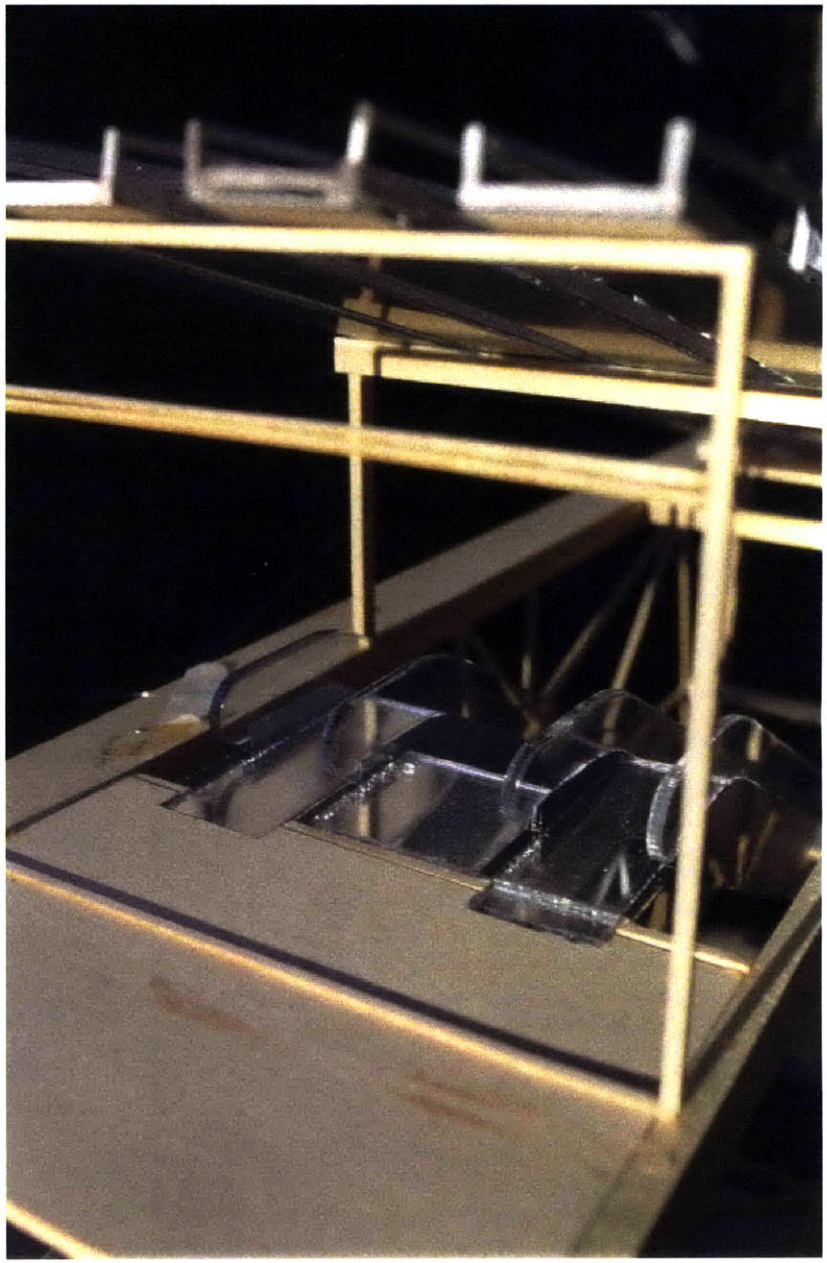


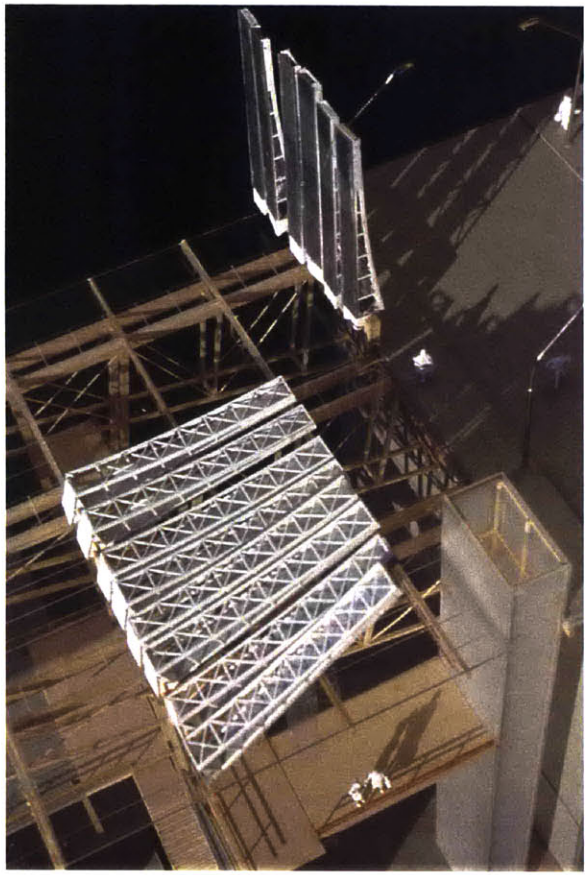
Preliminary 4 Model

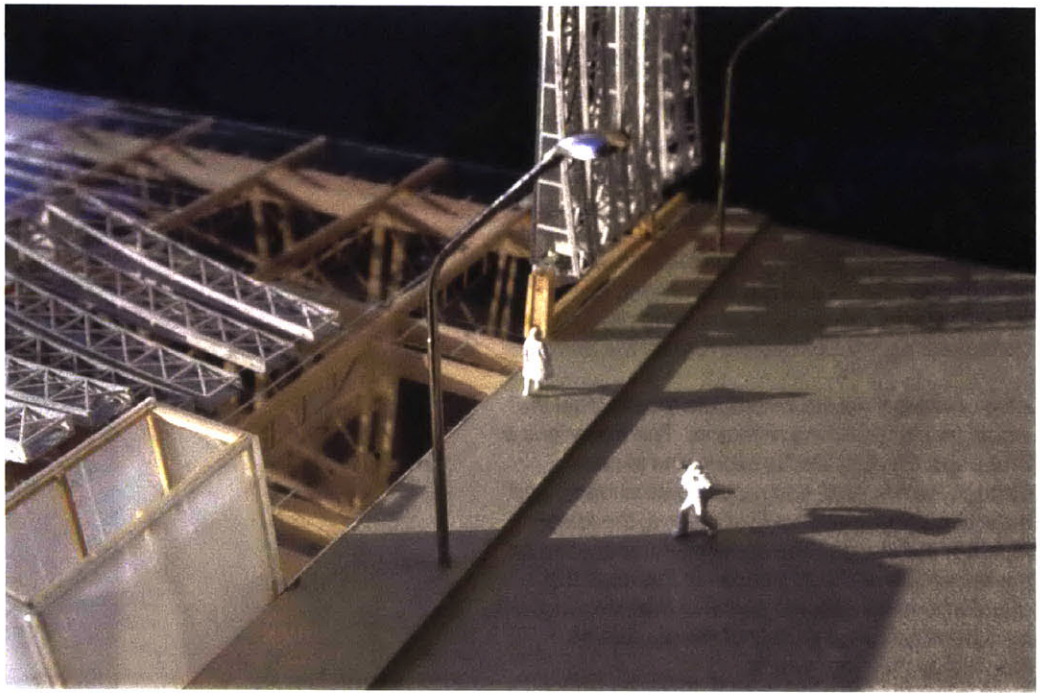
homosote, basswood, mirrored plexiglass, and metal mesh 1"=4'-0"

A large-scale model was built in order to understand structural elements and the play of light, to investigate the mechanism of moving daylight-deflectors, and to express the form of the entrance.

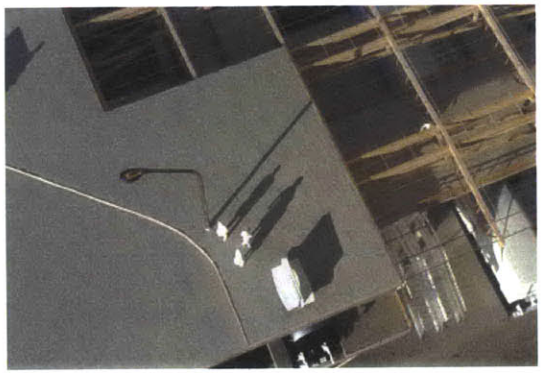
Also of interest was to investigate the material that would be placed on the reflectors. The material is a metal mesh, perforated to allow wind to pass through the material, and reducing wind loads, and reflective so as to deflect light down to the lower levels of the station. The same material is used on the underside of the entrance - in this case it is doubled to allow users to perceive their own motions by experiencing the variety of moire patterns induced by their movement.



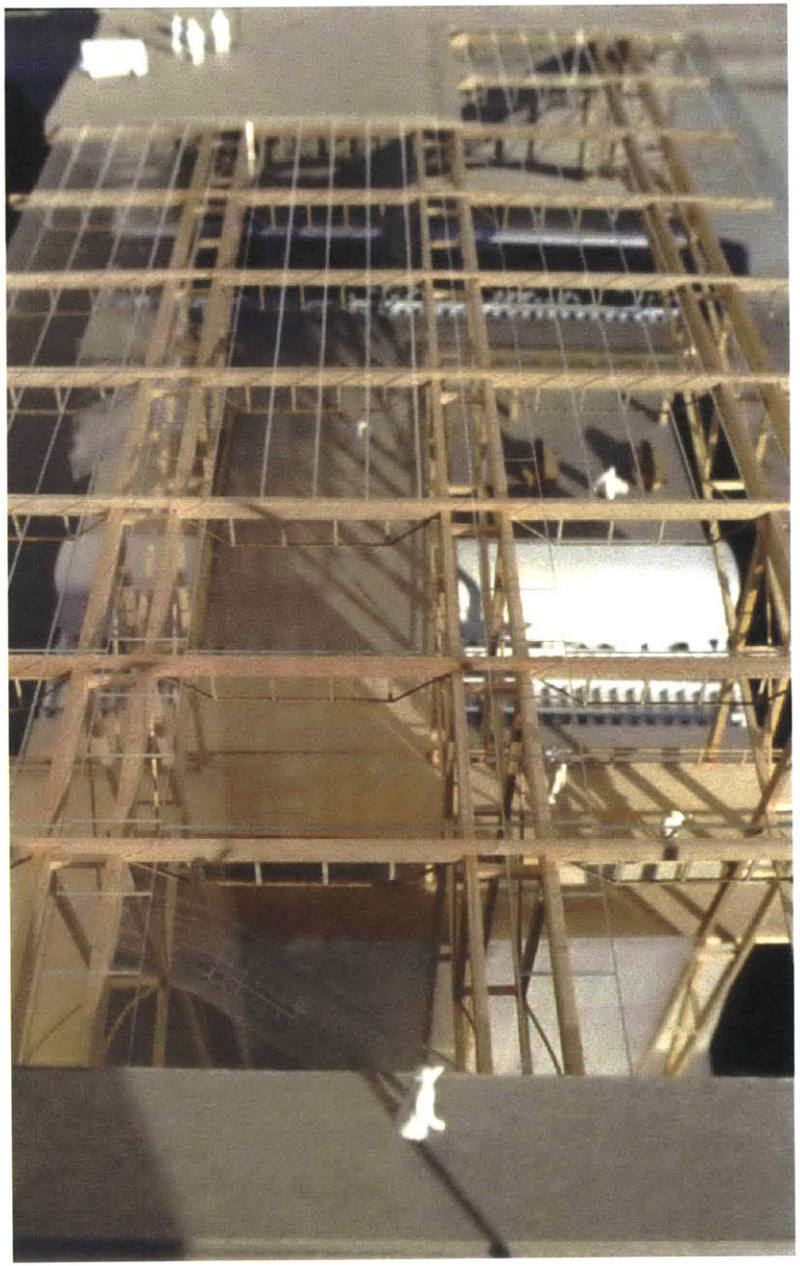




view of reflectors at the street level



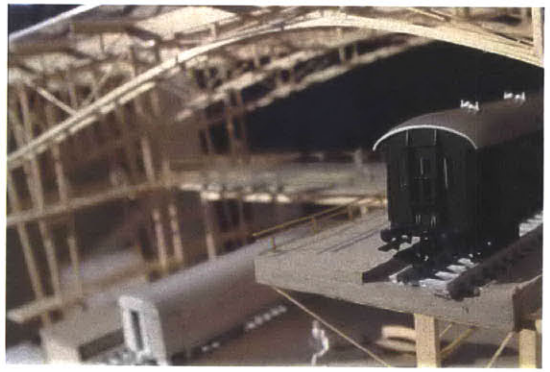
bus stop, along Canal Street



Final HO Model

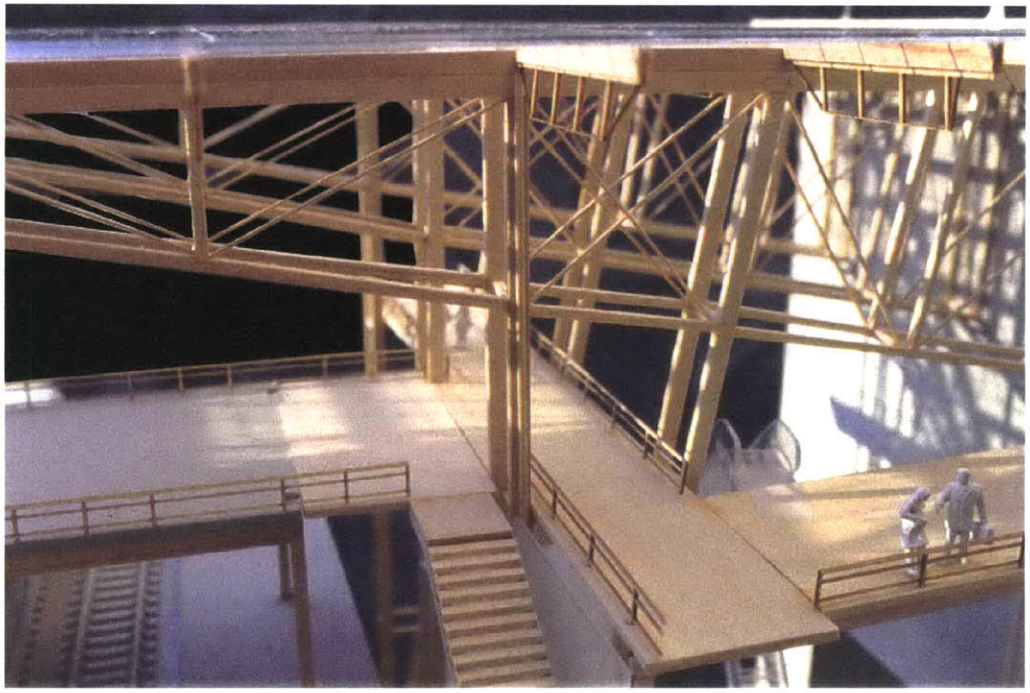
newsboard, basswood, plexiglass, metal mesh
1:87 or 1"=7.25'-0"

The primary intention was to show scale trains and people occupying the space within and above the train station. Material connections and structure, which form the framework required to create movement paths, are articulated in detail. A system of structural members works together with an enclosure system to define a large flat glass canopy. This is to function as the building's facade and elevation.



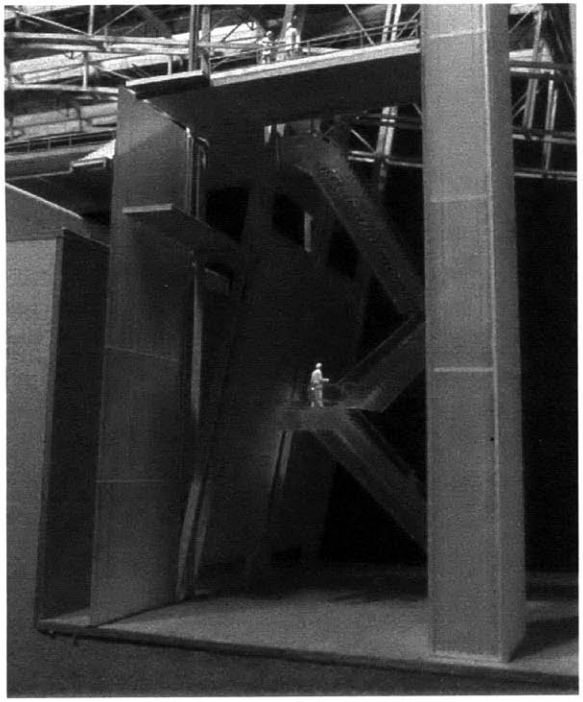
FINAL "HO" MODEL - VIEWS FROM THE GREEN LINE / ORANGE LINE

The Green Line Orange Line Station is physically and visibly most connected to the exterior. Passengers waiting for trains can see people above, hurrying to the train, or crossing the plaza space to go home. On the other hand, people at the street level can see the workings of the train station, the arrival and departure of a train, and ensuing movements of the passengers.

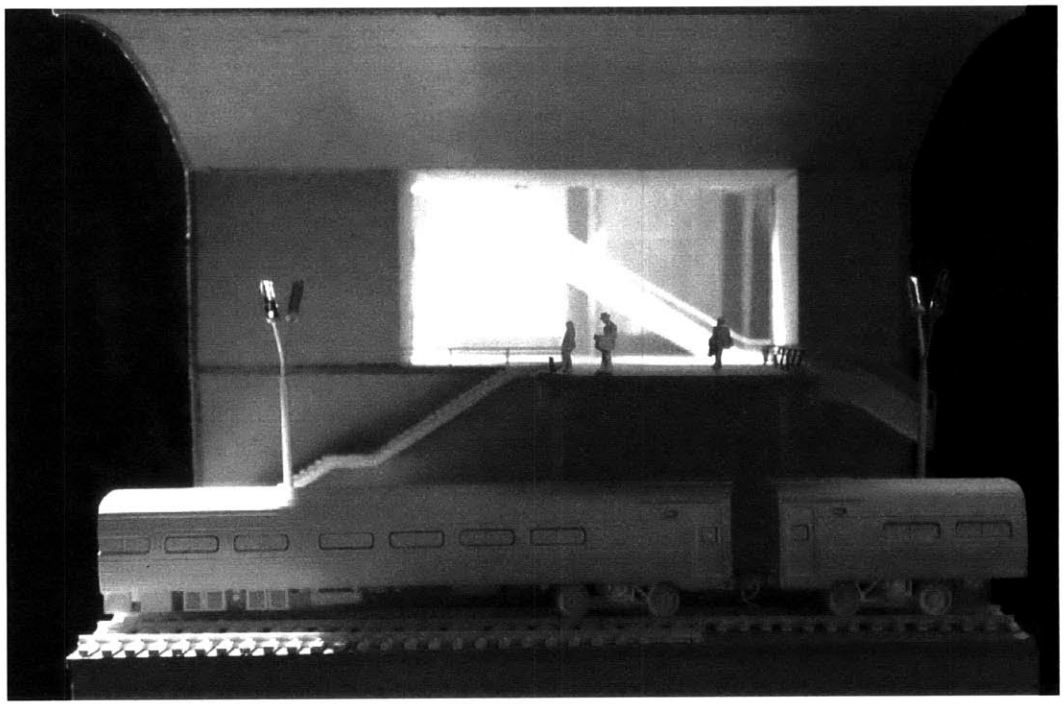


FINAL "HO" SCALE MODEL - VISUAL CONNECTIONS FROM BELOW

From the lower levels, the experience of the station is more dramatic. The connection to the exterior still exists at the lower concourse level in the circulation zone. Here one can see the blue of the sky, and surrounding buildings. Light-deflectors reflect light to the lowest levels of the station.

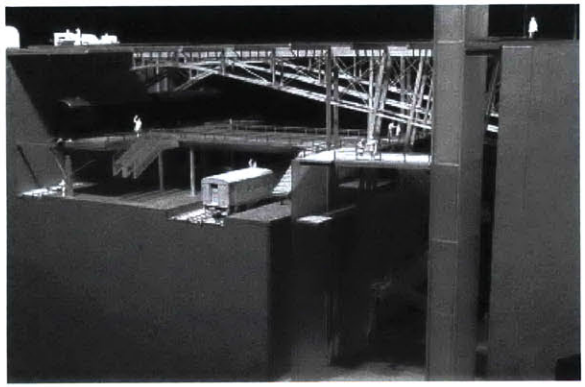


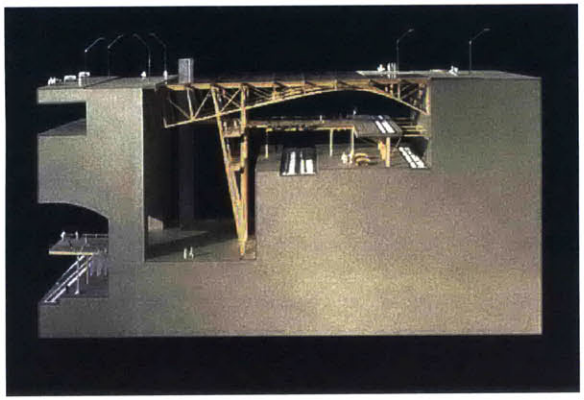
passengers move through escalators, stairs, and elevators to reach the lower concourse level of the circulating zone.

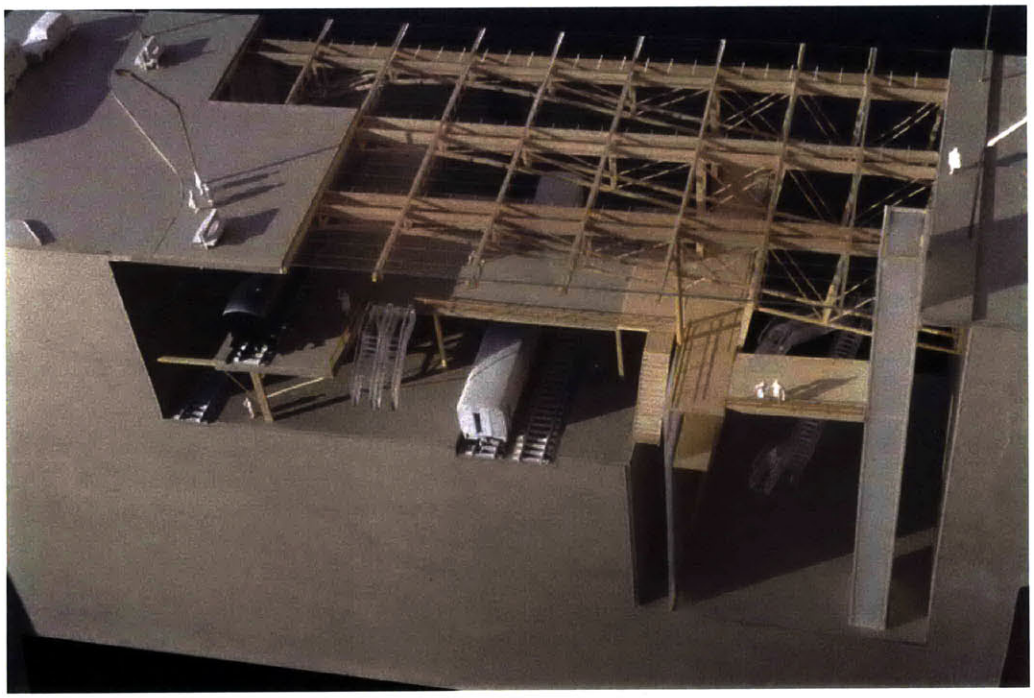


view of lower concourse level and circulation/light zone from the tracks of the North South Rail Link. After much time spent underground, arriving passengers have a sense of where to go by seeing the movement of people and changing qualities of daylight.

FINAL "HO" SCALE MODEL - VIEWS OF THE BUILDING SECTION







Keeping in mind that the train station is actually a slice, or a small part of large network of tunnels, the building type is perceived as a section - through which movement takes place. At North Station, this movement comes in the form of 4 different types of trains, cars in the Central Artery Tunnel, and of course, people. The last inhabitant - people - roam freely while the others mentioned travel along fixed paths.

Though I have made an effort to create clear paths which move one from one section of the building to the next, there exists a freedom of movement for those who desire it - in the form of connected catwalks, and the concourse level at the bottom of the station.

CONCLUDING REMARKS


film stills from Bilbao Abando station - four women race to catch a train.





The topic of the thesis has been to investigate a new major rail stop at the site of Boston's North Station, developed as a terminal station on a future high-speed rail line connecting Portland, Maine to Washington DC and to points beyond. At the urban level, the building attempts to make comprehensible a reading of the complex network of tunnels beneath the city street. A building that acts much as urban intervention serves to unify a neighborhood and provide a grand public space. On the local level, the station serves as an urban gateway organizing the complex convergence of lines including subway, commuter, and long-distance railways. For the reason that the project is located underground, importance has been placed on creating a strong correlation between interior and exterior spaces. Much of the design is concentrated on the quality of the interior space, and the introduction of light to concourses and waiting platforms at all times of day - with the intent to create a temporal diversity of vibrant spaces for dynamic users. In addition, the motivation lies in making clear to the visitor a conscious recognition of the underlying historical and programmatic components.

The principal design impetus embraces modern concepts of space-time in the practice of architectural design with through perceptive contemplation of space relative to position and speed, light and movement. The thesis aims at enhancing the public realm through creating a legible organization with a dynamic aesthetic based on an explicit recognition of the movement of time through physical space. This expression took the form of a great canopy and supporting structural system. As a metaphorical mapping of the station as a whole, the canopy and its structure together to reflect to the city a powerful simplicity resting amidst the layers of history and infrastructure – a landmark gateway befitting both the site and the city as a whole.

Throughout the semester, images, film, text, and personal interviews provided a background for a design process. In addition, the role of experience, visiting numerous stations, at all times of day, helped to acquaint myself with the workings and life of a station. It is these memories of people, sounds, place that were inspiration for the design of a building that seeks to intensify these experiences through a design that simply resolves the programmatic complexity in an architectural expression of space and time, light, structure and movement.

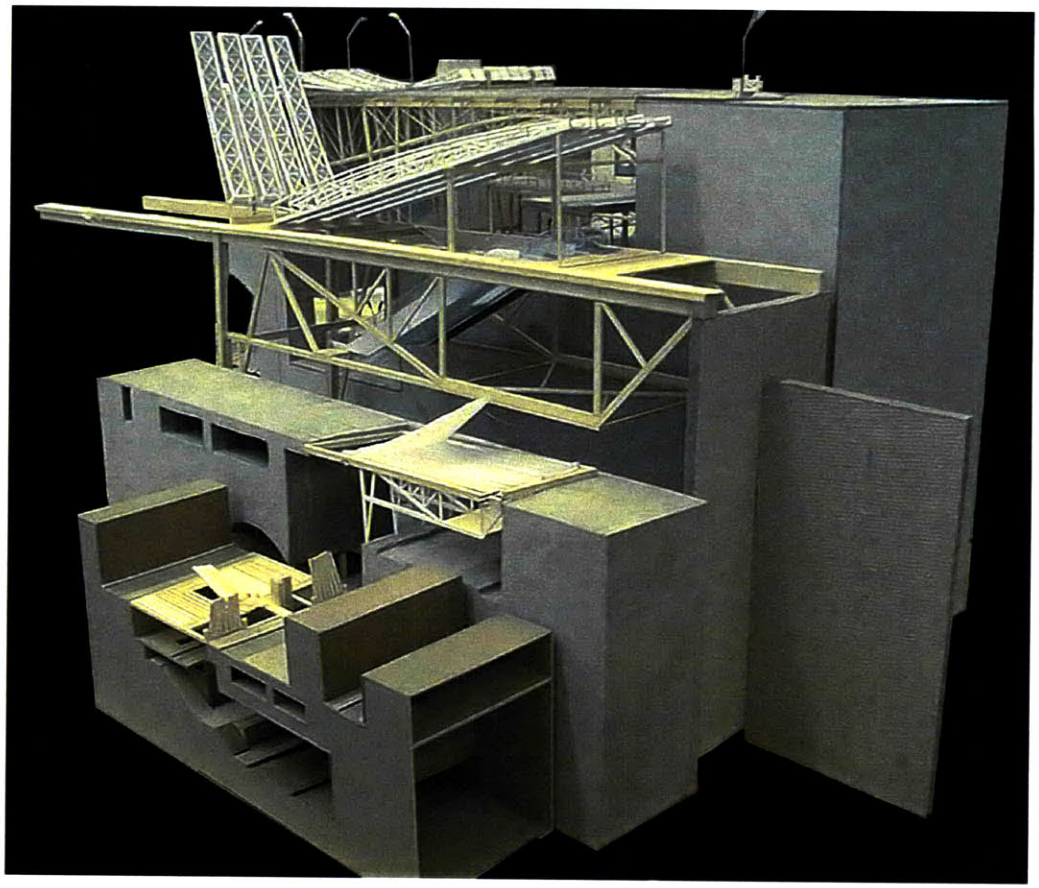


FIGURE CREDITS

All images and figures by the author unless otherwise noted.

SECTION 01 – SHAPING TIME LIGHT AND MOVEMENT

1. Tesseract image from Madeleine L'Engle. *A Wrinkle in Time*. New York: Ariel Books, 1962. p. 76.
2. Grand Central Station image from Kenneth Powell. *Grand Central Terminal : Warren and Wetmore.* London: Phaidon Press Limited. 1996. p. 19.

SECTION 02 – TRAIN TRAVEL, PAST AND PRESENT

3. *Acela* advertising postcards, available on billboards and in trendy restaurants
   a. Brainchild
   b. Arrive
   c. Read
4. [online] available http://chicago.sidewalk.com
   a. Chicago's NorthWestern Station
   b. Chicago's NorthWestern Station
   c. Amtrak Lines
5. An image from *Charles Sheeler: Paintings.*
6. Pennsylvania Station image from Steven Parissien, *Pennsylvania Station : McKim, Mead and White.* London: Phaidon Press Limited. 1996.
7. Sections of train sheds. From G. Wasmugh, *Lexikon der Baukunst* (4 vols. Berlin, 1929-32), 2, 342.
8. Silhouettes of a sequence of large railroad stations. Drawings by Jack Rose. From Carroll L.V Meeks. *The Railroad Station, An Architectural History*. New Haven: Yale University Press, 1956. illustration 40.

9. Image of Acela from Amtrak home page. [online] available http://acela.com
10. Film Stills from *Union Station.*
    a. Information
    b. Waiting on platform
    c. Meeting.
11. Pennsylvania Station image from *Pennsylvania Station : McKim, Mead and White.*
12. Image of escalators in Chicago Union Station, [online] available http://chicago.sidewalk.com

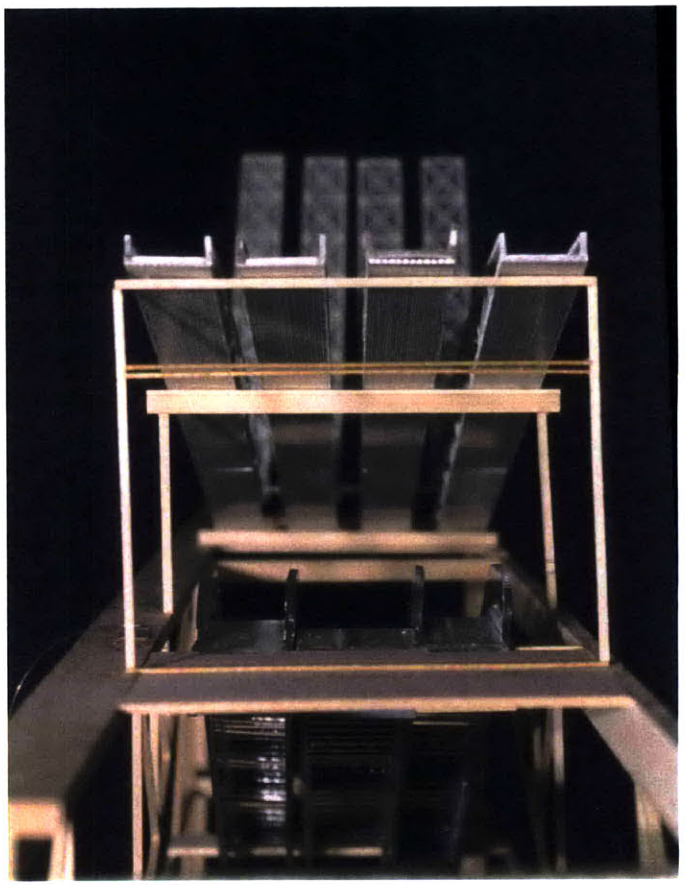
SECTION 03 – NORTH STATION, SITE AND PROGRAM SPECIFICS

13. Aerial photo [online] available http://gis.mit.edu
14. Axonometric of network of open space from *Joint Development Parcel-By-Parcel Analysis: Central Artery Corridor.* July 1991.
15. Three versions of North Station
    a. from the web – postcard of old North Station
    b. Courtesy of Empire Frame; 59 Causeway Street
16. Courtesy of Empire Frame; 59 Causeway Street
17. Courtesy of Abbot Labs.
18. View of Tobin Bridge, soon to be torn down. [online] available http://bigdig.com
19. View of new suspension bridge. [online] available http://bigdig.com
20. Insert in *Sunday Boston Globe*, November 7, 1999.
21. [online] available http://bigdig.com
22. From Herbert Murray. "Il Grande Scavo Continua" *Spazio e Società.* Volume 73

23. From *The Architectural Review.* August 1999.
24. Received in interview with Clay Scofield
25. From a report for MBTA/EOTC/MHD/Amtrak, "North South Rail Link Project" by Project Consultant VHB/FRH – A Joint Venture.
26. From a report for MBTA/EOTC/MHD/Amtrak, "North South Rail Link Project" by Project Consultant VHB/FRH – A Joint Venture.

SECTION 04 – DESIGN INTENTIONS

27. Stratford Station Drawings from *The Architectural Review.* May 1999. p. 59
28. Image of preliminary sketch model taken by Luke Yeung.



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INTERVIEWS

Clay Scofield - MBTA North/South Rail Link, personal interview, September 1999.

Dino Diferente - MBTA North Station SuperStation, personal interview, July 1999.

George Murphy - MBTA North Project Area Engineer, personal interview, July 1999.

Jim Malcom - Wallace Floyd - Construction Manager – North Station Superstation, personal interview, September 1999.

Jim McCarthy - CA/T, personal interview, personal interview, June 1999.

Paul Christie - Amtrak High-Speed Rail, phone interview, June 1999.