

ABSTRACT

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BALTIMORE'S PENN STATION WITH MAGLEV

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Real Estate Development, 2017

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School of Architecture, Planning, and Preservation

This thesis seeks to examine what happens when a purposeful intervention is made at Baltimore's Penn Station, an intervention that accommodates Mag-Lev Rail as part of the Northeast Corridor. With an augmented and fully integrated mass transit system, Penn Station can become an important economic node for the city and the Greater Baltimore Region. The expansion of the station and the design of the surrounding plazas can revitalize the urban fabric and make Penn Station a destination unto itself.

CRITICAL JUNCTURE /
REVITALIZING BALTIMORE'S PENN STATION WITH MAGLEV

By

Sarah R. Alli

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University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Master of Architecture
and Real Estate Development
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Dedication

I would like to dedicate my Thesis Proposal to the life-long learners. Our vision and determination will set the example for all the eternal learners that follow and those that follow them; thus humanity will thrive long into the future. Among these future eternal learners are my five children: Trent, Malik, Mariam, Lateefat and Sodik. I hope that my determination to “make no small plans” will live with them forever and inspire their own big dreams that have the “capacity to stir men’s blood”.

Acknowledgments

I would like to give my wholehearted appreciation for the enthusiasm and insight given by my Thesis Chair, James Tilghman. I would also like to thank Professor Steve Hurtt for your honest criticism, always meant to push me to address the hard and most obvious problems with my project. And finally, I want to express my admiration for the incredible inspiration and organization Brian Kelly brought to my project and to the Architecture Program as a whole.

Table of Contents

Dedication.....	i
Acknowledgements	ii
Table of Contents	iii
List of Figures.....	iv
Background.....	1
Northeast Megaregion	3
Roads.....	4
Air.....	4
Rail.....	5
High Speed Technology.....	5
MagLev Technology.....	7
Site Description.....	10
History: Port City of Baltimore	10
History: Baltimore & Ohio Railroad to Amtrak	11
Site Analysis	13
Penn Station in Baltimore	14
Jones Falls Expressway and River	15
Site Selection	16
Program Objectives	32
Program Special Problems and Issues	37
Program Graphic Depictions	41
Precedents	43
System Precedent: SOM and The Northeast Corridor	45
Station Area Regeneration Precedents	47
Station Precedents: Terminals and Through Stations	47
Design Approach	52
Conclusions	58
Bibliography	67

List of Figures

Figure 1 Comparison diagram of HSR in Eastern Asia, Europe and USA. By author	6
Figure 2 Diagram of Superconducting Maglev technology. By author	8
Figure 3 Time radii comparison of rail technologies. By author.....	9
Figure 4. Map of B&O Railroad, 1891	11
Figure 6. Diagram by author showing the proximity of the station to buildings in existence when Penn Station was built	15
Figure 9. Penn Station and adjacent site options	18
Figure 10. Figure ground at 10,000 feet. Penn Station in center shown in green	19
Figure 11. Bodies of water at 10,000 feet.....	20
Figure 12. Existing intermodal transportation routes, excluding surface streets.....	21
Figure 13. Figure ground at 5,000 feet.	22
Figure 14. 100 year flood plain	23
Figure 15. Vegetation at 5000 feet	24
Figure 16. Street network (center lines)	25
Figure 17. Figure ground showing extents of a 5 minute and 10 minute walk from Penn Station	26
Figure 18. Existing Master Plans approved by Baltimore City Planning. Historict districts (red) overlayed with the Master Plans (gray).....	28
Figure 19. Land use	29
Figure 21. Existing Site Section by Author.....	31
Figure 22. Existing Site Plan by author	31
Figure 37. Outline of new platform over Jones Falls Expressway and tracks. Diagram by author	53
Figure 38. Grid Shift Diagram by Author.	53
Figure 39. New site plan. Proposed buildings and roads indicated in orange.....	54
Figure 40. Plan: Maglev Platforms.....	54
Figure 41. Plan: Regional Rail Platforms	55
Figure 42. Plan: Concourse Level	56
Figure 43. Plan: Galleria Level.....	56
Figure 44. Section A-A.....	57
Figure 45. Program massing diagram.....	57
Figure 46. Final Presentation Boards, actual size 24' x 8'	59
Figure 47. Board 1	60
Figure 48. Board 2	61
Figure 49. Board 3	62
Figure 50. Board 4	63
Figure 51. Board 5	64

Background:

The formation of cities depended upon the surplus of goods and the ability to transport those goods to a central location for trade. Cities were able to grow as transportation became more efficient. A transportation network on land, sea and air now globally connects us. While air and sea transport have geographical limitations, transport over land remains critical to our economy. Baltimore provides a perfect example of the complex intermodal connections necessary for the growth of an economy on the national scale. The deep seaport, protected within the Chesapeake Bay, benefitted from strong connections to a vast rail network that reached into the interior of the continent. The railroads from north to south formed a spine along the east coast that remains the foundation of the economic region called the Northeast Corridor. While rail transport was critical to the development of our nation, its importance has waned. Over the last century, our government has invested heavily in surface roads and airports while only nominally maintaining the rail network. Our existing railroads are shared between freight and passenger services on tracks originally built for speeds barely reaching over 70 miles per hour. These deficiencies cause congestion in major metropolitan areas and poor track conditions inhibit our passenger trains from traveling at higher speeds.

We have now reached a critical juncture in the progress of our nation. Our main mode of transportation, the automobile and its web of highways, streets, bridges and parking lots, is over-utilized and under maintained. The East Coast airports are monopolized by commuter trips under 500 miles that are inefficient and slow the air traffic for the nation. If the rail network of the United States were to be improved and expanded, the nation could benefit from a more efficient system of transport. A nationalized rail network that has intermodal points of connection within the cities will be necessary for efficient movement of people and goods.

This thesis seeks to examine what happens when a purposeful intervention is made at

Baltimore's Penn Station, an intervention that accommodates Mag-Lev Rail as part of the Northeast Corridor. With an augmented and fully integrated mass transit system, Penn Station can become an important economic node for the city and the Greater Baltimore Region. The expansion of the station and the design of the surrounding plazas can revitalize the urban fabric and make Penn Station a destination unto itself.

Northeast Megaregion

Baltimore is one of the five major cities within the Northeast Megaregion. According to America 2050, an infrastructure and research organization, a megaregion is comprised of “interlocking economic systems, shared natural resources and ecosystems, and common transportation systems link these population centers together”.¹ The Northeast Megaregion accounts for approximately 20% of Gross Domestic Product (GDP) while only occupying only 2% of the nations landmass. The productivity in this region is mostly composed of the “knowledge industry”, global financial and business services, biomedical facilities, universities, media centers and cultural institutions.² Critical masses of these productive centers are located within the cities of the Northeast Megaregion, which stretches from Washington, D.C. to Boston, MA. The transportation network between these cities creates a spine along the East Coast called the Northeast Corridor (NEC). This network is a complex intermodal system of highways, airports, seaports and rail that must accommodate both passengers and freight. With a population of over 50 million in the megaregion, the demands on the transportation infrastructure are tremendous and every component of the intermodal system is currently functioning at capacity. This poses a serious problem for a megaregion that is projected to grow by 30% in the next 30 years.³ Investment must be made in infrastructural projects that will have both an immediate and long-term impact to easing this congestion and allowing for economic growth. If we assume that the Federal Government will certainly fund the improvement and

¹ “Megaregions - America 2050,” accessed November 2, 2016, <http://www.america2050.org/megaregions.html>.

² “Amtrak-Vision-for-the-Northeast-Corridor.pdf,” n.d., accessed November 2, 2016, <https://www.amtrak.com/ccurl/453/325/Amtrak-Vision-for-the-Northeast-Corridor.pdf>.

³ Ibid.

augmentation of our transportation infrastructure, we must choose which modes are the “smart investments”: road, air, or rail.

Roads

The congestion on our roads and highways is most apparent to the average user. The highways must accommodate inter-city, intra-city and local commuters, as well as freight and emergency services. While lane expansion might solve some issues initially, there would be serious obstacles in acquiring the necessary land, as many of the roadways are located within urban centers.⁴ In addition, allowing or even encouraging more automobiles on the road will do little to increase efficiency of our cities and will continue to impose a serious strain on the environment.

Air

Air travel is most frequently used to travel between cities of the Northeast Corridor. The Federal Aviation Administration estimates that 4 of the Northeast airports will need additional capacity in less than 10 years.⁵ A significant portion of the air traffic of these NEC airports accommodates trips of less than 500 miles, which is a very inefficient and costly service for the airline. More important, is the additional commuter time spent of traveling to the airport, passing through security and the likelihood of waiting for a delayed flight. In order to accommodate the more frequent international flights required by our globalizing economy, we should have a more reliable mode of transport for inter-city trips of less than 500 miles.

Rail

⁴ Ibid.

⁵ “Amtrak-Vision-for-the-Northeast-Corridor.pdf.”

Once the economic engine of the nation, our railroad networks have fallen into disrepair. Upon advent of the automobile and commercial air travel, the federal government has helped to grow these industries significantly. The federal and state governments pay for the construction and maintenance of the roads and runways while the rail industry is expected to pay for its own repairs and upgrades. This choke point of funding has been detrimental. The advent of Amtrak, a federally subsidized conglomeration of many former private railroad companies, happened on the brink of complete shutdown of the industry in the 1970's. As the rail industry is now dependent upon direct federal funds, politics weigh heavily on the success or failure of America's passenger rail network.

Freight rail is still used to transport many goods nationwide. It is imperative that these freight networks be maintained; however, major improvements are still needed. Recent upgrades to international shipping canals have resulted in massive ocean going cargo ships. Only a few of the ports in the United States are able to accommodate these mega-ships. The Port of Baltimore is one of the precious few. The ramification for land transport of these imports is the need for higher clearances in tunnels and overpasses. The shipping containers offloaded from the mega ships are usually "double-stacked". For example, Baltimore's Howard Tunnel, built in the 1890's falls short by about 2 feet in depth. Both federal and state funding has been pledged to expand the tunnel to accommodate the double-stacked containers.⁶

High Speed Rail technology

High Speed Rail is simply a more efficient system of the traditional rail technology.

⁶ Erin Cox, "Hogan Pledges to Revamp 'Infamous' Howard Street Tunnel," *Baltimoresun.com*, accessed May 19, 2017, <http://www.baltimoresun.com/news/maryland/bs-md-hogan-howard-street-tunnel-20161024-story.html>.

Commonly referred to as “steel-on- steel”. In order for the trains to move at a faster rate of speed, the tracks must be meticulously aligned, resist warping due to extreme weather conditions and be aligned in the straightest line possible. Europe and Asia have built extensive high-speed rail networks. Although many are capable of traveling at speeds over 200 mph, international safety commissions cap the speed at 185mph. The Acela train by Amtrak is an “almost high speed rail” travels at an average speed of 85mph along the Northeast Corridor between Washington D.C. and New York City, and an average speed of 63mph between New York City and Boston, MA. High speeds are unattainable by the Acela train because it shares the tracks with slower trains and freight trains. A comparison of high-speed rail networks among the continents of North America, Europe and Asia show that N. America lags behind significantly.

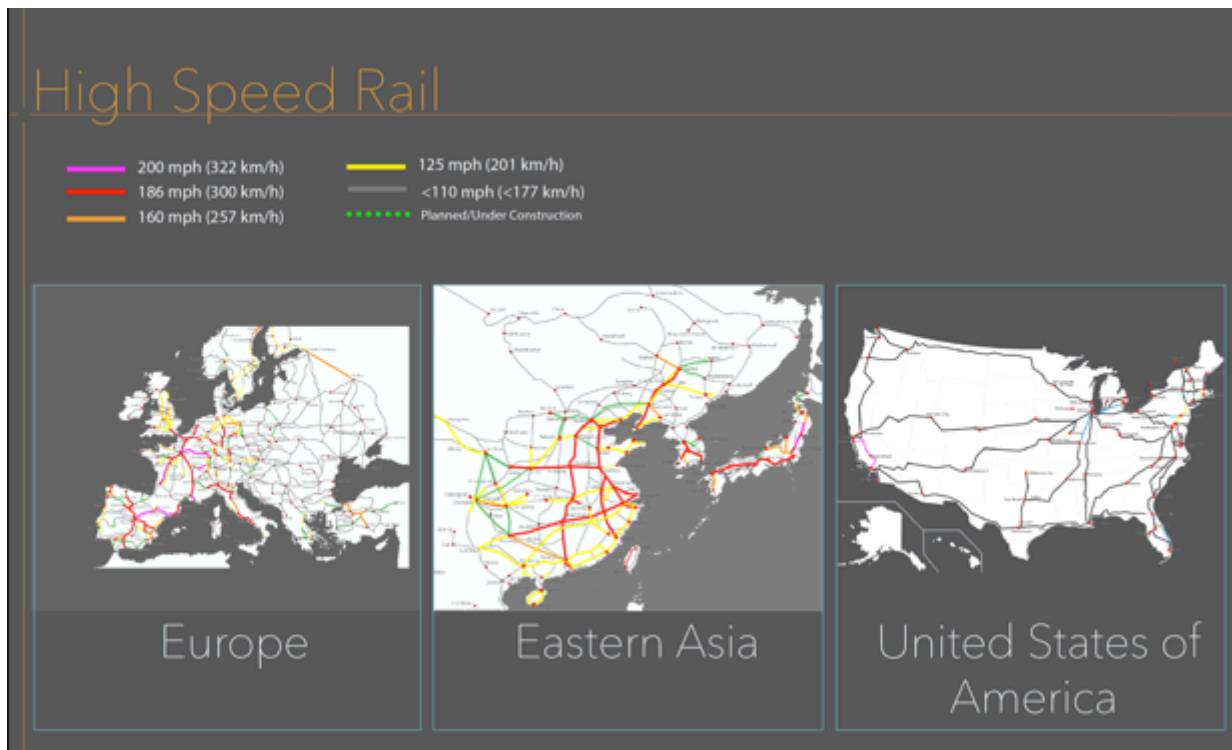


Figure 1 Comparison diagram of HSR in Eastern Asia, Europe and USA. By author

It is possible that the vast land area between cities in the United States coupled with the auto-centric cities make High Speed Rail less imperative to travelers than in Europe or Asia.

However, now that our nation is choking under road congestion and air pollution, perhaps some planning changes need to be made. The advantage of rail transit is that the stations are already located within the cities, impossibility for air travel and the trade-off of traffic jams by car. Connecting these nodes to augment the existing rail network would vastly improve the transit time between the cities.

Magnetic Levitated Train technology

A relatively new train technology is being utilized in China and Japan, magnetic levitated trains or maglev for short. China has used maglev in its monorail system from the Shanghai airport to the city for about 20 years. Japan has developed a new configuration of the maglev system. China's Shanghai airport maglev is a monorail while the Japanese technology is more like a "chute". Both use the same underlying technology: strong magnetic forces created through strong electrical currents are positioned so that the polarity of the magnets repels each other. This magnetic force is strong enough to levitate the train above the track so that the track merely acts as a guide-way for the train.

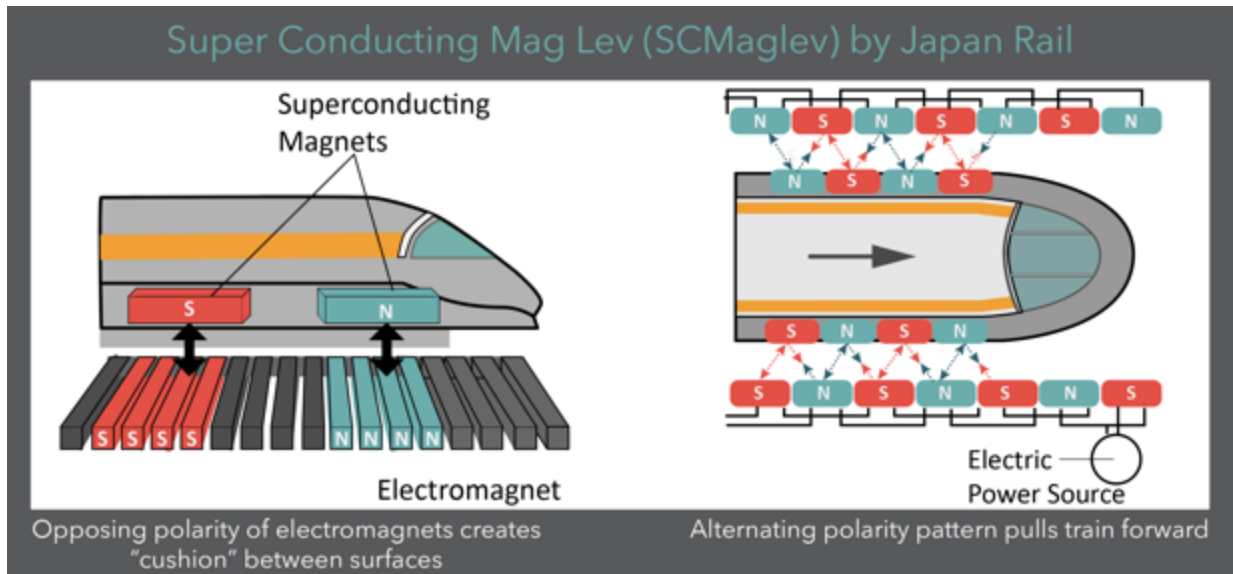


Figure 2 Diagram of Superconducting Maglev technology. By author

While at traveling speeds the maglev has no moving mechanical parts therefore the only resistance is from air. Japan's Superconducting Maglev holds world speed record at 375 miles per hour on their test track outside of Nagoya, Japan. Japan Rail is currently building a maglev that connects Tokyo to Nagoya and will eventually stretch to Osaka. Maglev is the cornerstone of the a proposed "world land bridge" in which six of the continents will be connected over land and tunnels.⁷ At these rates of speed, the cities along the Northeast Corridor become next-door neighbors.

⁷ "World Landbridge," accessed May 20, 2017, <https://larouchepac.com/world-landbridge>.

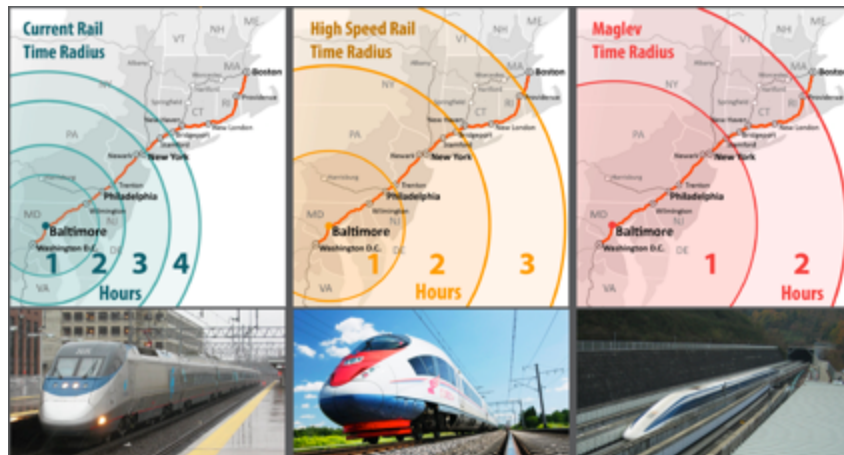


Figure 3 Time radii comparison of rail technologies. By author.

Site Description: History

Port City of Baltimore

Baltimore began as a port town sheltered in the Chesapeake Bay. Even before the American Revolution, Baltimore was among the most active merchant ports in the American Colonies. After the American Revolution, Baltimore became known as a “free town” where free and formerly enslaved peoples were able to find employment on the docks or in manufacturing companies within the city. It was clear that the key to economic growth of a nation in its infancy depended on extracting raw and agricultural products from the interior of the continent and transporting it to the seaports for trade across the Atlantic. When the Erie and the C&O canals, of New York and Washington DC respectively, began to redirect a significant amount of port goods away from Baltimore’s, Baltimore businessmen made the bold move of establishing the first chartered rail line, the Baltimore & Ohio Railroad. Beginning in the 1830’s the B&O established the fastest and most reliable over-land transport system in the nation. The B&O quickly reestablished Baltimore as Maryland’s greatest port as “it was the farthest west of any Atlantic Coast seaport and nearly equidistant from points in both the North and South. It was also the first to enjoy the advantages of transportation facilities connecting it to the new western lands.”⁸

⁸ Maryland. State Planning Dept, *The Counties of Maryland and Baltimore City : Their Origin, Growth, and Development, 1634-1967* ([Baltimore] : State Planning Dept., 1968), accessed November 3, 2016, <http://archive.org/details/countiesofmaryla146mary>.



Figure 4. Map of B&O Railroad, 1891

Baltimore & Ohio Railroad to Amtrak

The B&O inspired many independent railroads to establish lines within their own states. The railroad enjoyed a particular prominence in the United States for the next 90 years. By 1920 there were about 20,000 passenger trains in service however by 1970 there were only 450 and many were in the process of being discontinued.⁹ This 80% decline in rail travel may be attributable to a few factors: the advent of the automobile and airplane and the subsequent government subsidies given to these industries. The technological advances made in the automobile and airplane did not immediately lend themselves to the railroads, especially when the underlying infrastructure of tracks and engines was in dire need of upgrade. In order to preserve a national rail network and to save the failing business of the individual railroad

⁹ David C. Nice, *Amtrak: The History and Politics of a National Railroad*, Explorations in public policy; Explorations in public policy. (Boulder, Colo: Lynne Rienner, 1998).

companies, the US Government established Amtrak in 1970. This was a “semipublic organization, Railpax [Amtrak], which would operate needed passenger trains with a modest infusion of public funding.”¹⁰ Not surprisingly, this solution did not provide the expected results and more funding was infused within 8 months. Currently Amtrak is the national passenger rail of the United States. Many of the lines still share tracks with regional freight rail lines.

¹⁰ David C. Nice, *Amtrak: The History and Politics of a National Railroad*, Explorations in public policy; Explorations in public policy. (Boulder, Colo: Lynne Rienner, 1998).

Site Analysis

Baltimore's Pennsylvania Station

Union Station, later renamed Pennsylvania Station, was built in 1911. It replaced a brick, Victorian era station that was part of the Pennsylvania Railroad (PRR) system serving trains to Western Maryland and Harrisburg, PA. The architect, Kenneth McKenzie Murchison (1872-1938), was a student from a classic architectural education culminating

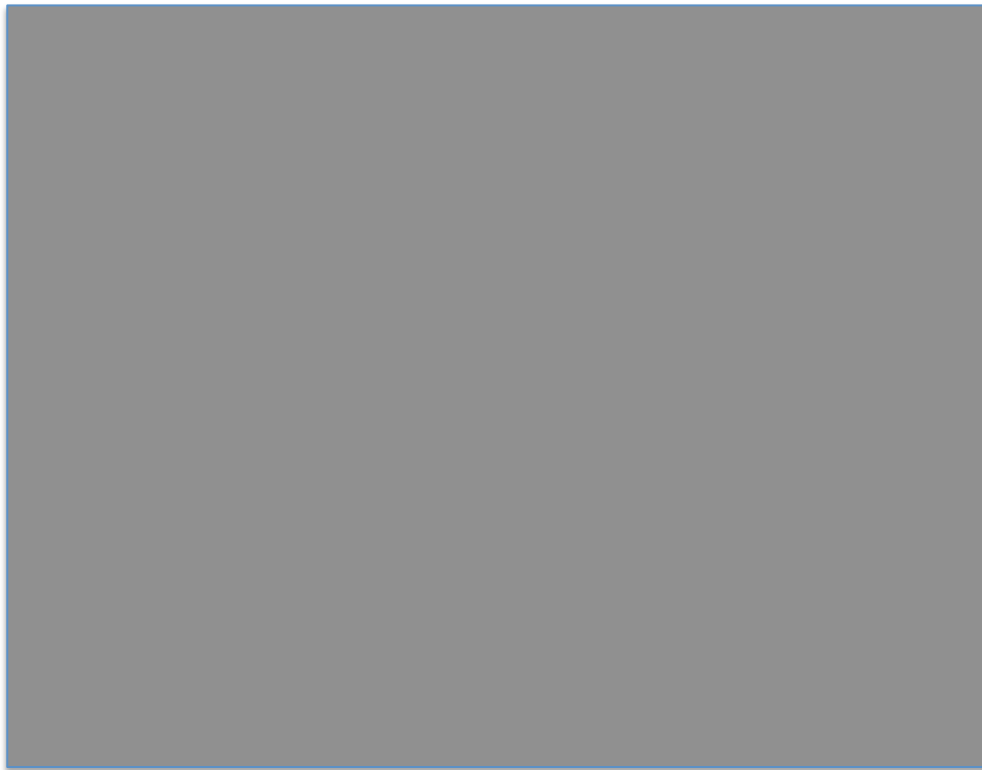


Figure 5. Aerial view of Pennsylvania Station, 1915

in the graduation from the École de Beaux- Arts in 1900. Murchison designed many railroad stations in Pennsylvania, New Jersey and New York. This period of architecture is notable for the City Beautiful Movement in which monumental buildings and urban design were transforming cities throughout the United States. Inspired by European cities and

Site Analysis

catalyzed by Daniel Burnham's White City in Chicago, the City Beautiful Movement sought to replace congested areas of the city with beautiful architecture and landscaped open space. The monumentality within the urban context had the double effect of creating the perception of legitimacy to the United States during a time of mass immigration as well as claiming a notable style of architecture for the civic realm of the city.¹¹

Penn Station in Baltimore

Penn Station is located near the State Center of Baltimore City. Many government and cultural institutions, City Hall, the National Basilica, Enoch Pratt Free Library, Peabody Institute, are located within eight blocks of the station. As in numerous other cities, the railroad station was the grand gateway to the city. The railroad provided a direct connection to cities along the Northeast Corridor and cities to the West.

¹¹ Daniel M. Bluestone, "Detroit's City Beautiful and the Problem of Commerce," *Journal of the Society of Architectural Historians* 47, no. 3 (1988): 245–262, accessed November 3, 2016, <http://www.jstor.org/stable/990300>.

Site Analysis

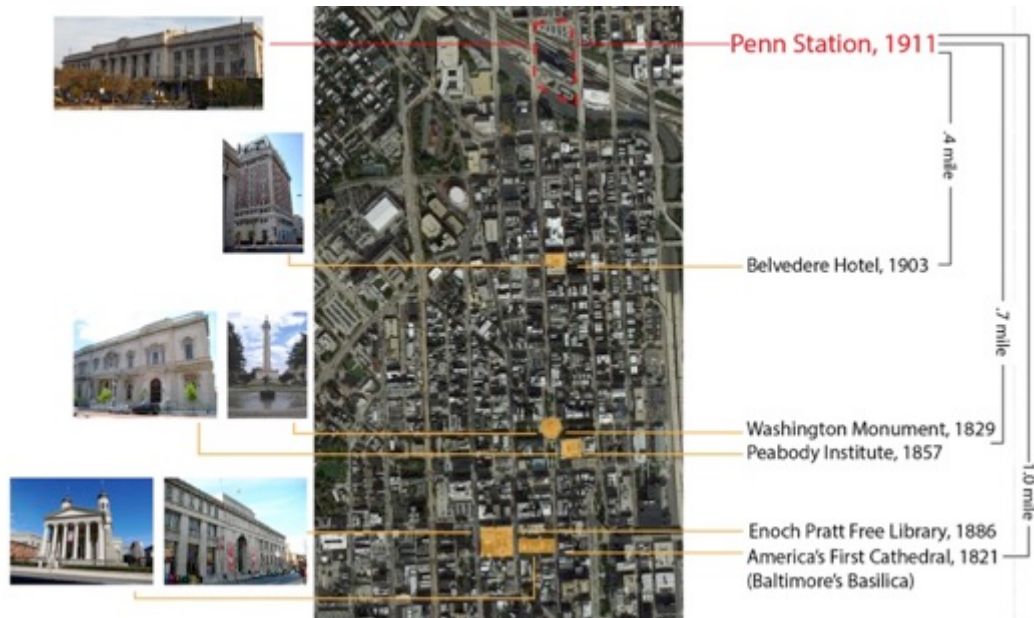


Figure 6. Diagram by author showing the proximity of the station to buildings in existence when Penn Station was built

As industry and manufacturing started to decline in the mid-20th century Baltimore's Inner Harbor became a collection of abandoned warehouses and rotting piers. As the economy of Baltimore shifted from industrial manufacturing to financial and medical based industries, the perceived city center shifted to the newly developed tourist attraction of the Baltimore's Inner Harbor, redeveloped in the 1960's. This shift left Penn Station isolated on the northern edge of the State Center.

Jones Falls Expressway and River

In 1959 the Jones Falls Expressway (I-83) was constructed through the city in order to reduce the travel time for business executives living in the Baltimore suburbs. Interstate 83 extends north from Fayette Street (near the Inner Harbor) for 85 miles to Harrisburg, PA.¹²

¹² "JFX Is a Long Stretch of History," *Tribunedigital-Baltimoresun*, accessed November 4, 2016, http://articles.baltimoresun.com/2009-02-07/news/0902060189_1_jones-falls-falls-expressway-highway-bridge.

Site Analysis

The age of the automobile had firmly taken root throughout the United States during this period. We now know this type of urban “planning” was extremely shortsighted. In many cities, highways were built with very little consideration of the disruption of the urban fabric of the city or the disruption to existing neighborhoods. The people of the affected neighborhoods were often working class and poor so had very little ability to prevent the construction. The Jones Falls Expressway was another blow to Penn Station. The construction of I-83 into downtown Baltimore eliminated two rail tracks dedicated to the western Pennsy line and created a concrete barrier between Penn Station and Downtown.



Figure 7. Photo by author from John Angelos Law Center, University of Baltimore

Although the Jones Falls River had already been redirected when the station was built, the Expressway project tunneled the water completely. The river now runs directly beside the

Site Analysis

highway until just north of Penn Station where it is directed underground until it empties into the Inner Harbor between Pier Six and Fleet Street.



Figure 8. Jones Falls underground conduit, photo by Logan Hicks May 2012

Site Analysis

Site Selection



Figure 9. Penn Station and adjacent site options

This thesis proposes an updated train shed and platform area at a minimum for Penn Station and is indicated as part of the Core Area above. As connectivity to the areas along the Northeast Corridor is of supreme importance, the intermodal connections at Penn Station are vital and will occur within the Core Area. Depending upon the extent of the Program needed to achieve a catalytic intervention within Baltimore, the site may cover the width of the adjacent city blocks as well by covering the tracks on the rail surface. The surface parking lot north of the station may be considered as part of an Extended Site as well.



Figure 10. Figure ground at 10,000 feet. Penn Station in center shown in green

Site Analysis



Figure 11. Bodies of water at 10,000 feet.

Penn Station marks the location in which the Jones Falls is directed underground about 1.85 miles to the outlet in the Inner Harbor to the south. The large body of water to the northwest of Pen Station is Druid Hill Reservoir originally formed by an earthen dam capturing a feeder stream of the Jones Falls.¹³

¹³ "Baltimore Heritage - Druid Lake," *Baltimore Heritage*, n.d., accessed November 5, 2016,

Site Analysis

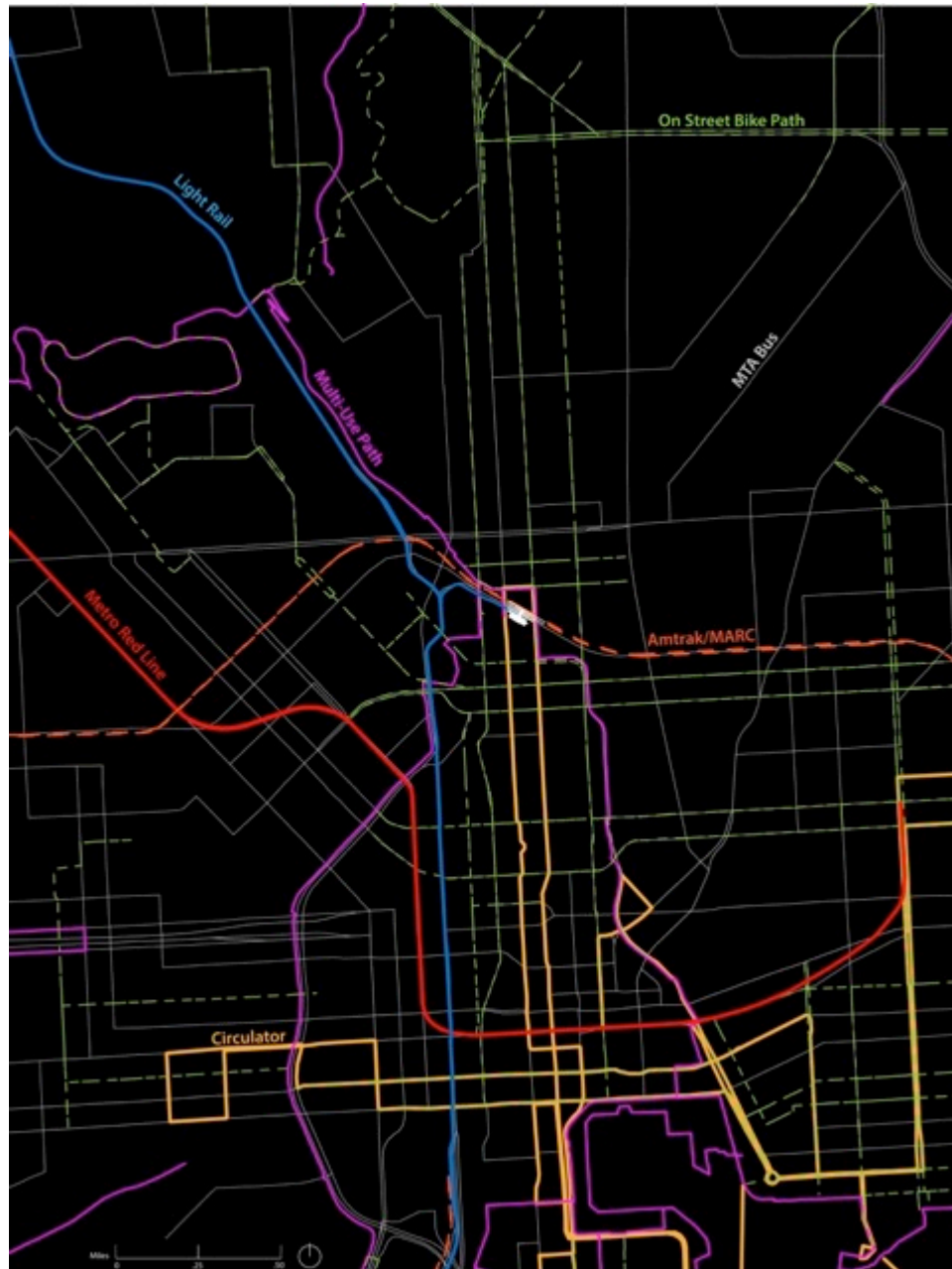


Figure 12. Existing intermodal transportation routes, excluding surface streets

Penn Station is far north of the most connected area of Baltimore. Rail passengers must use

<http://baltimoreheritage.org/issue/druid-lake/>.

Site Analysis

MTA bus, the Baltimore Circulator, or the single Light Rail line to connect to other areas of the city. Multi-use and bike paths are a relatively new addition to the city.



Figure 13. Figure ground at 5,000 feet.

Site Analysis



Figure 14. 100 year flood plain

The channelized Jones Falls pours into the Inner Harbor. During a flood event, the swift moving water will quickly fill the outlet in the Inner Harbor. Penn station is situated within the natural river valley and will be subject to flooding.

Site Analysis

Vegetation

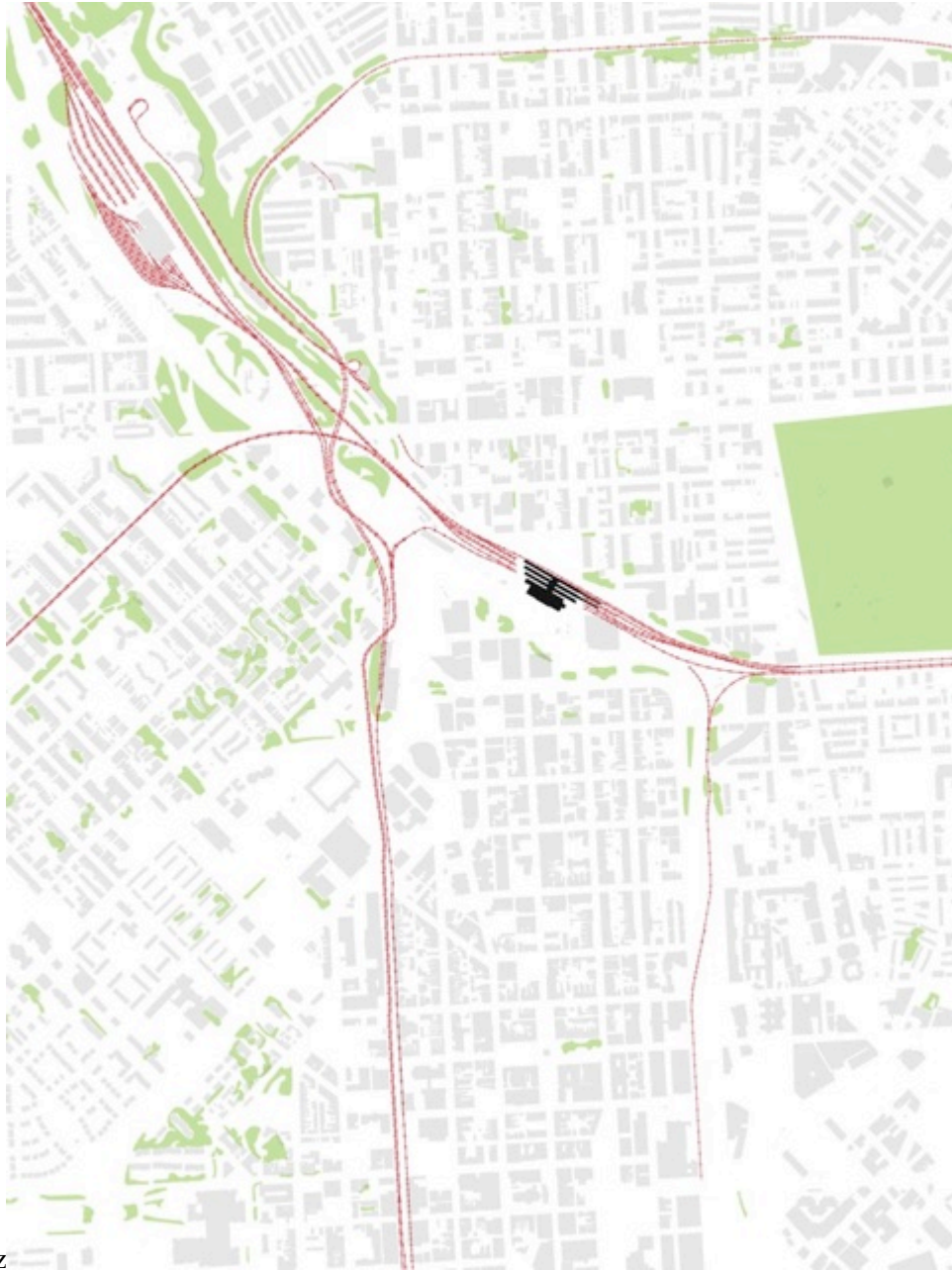


Figure 15. Vegetation at 5000 feet

The Jones Falls river valley is easily recognizable with the abundance of vegetation. The large vegetated area to the east is Historic Greenmount Cemetery elevated from street level by a 6 foot wall.

Site Analysis

Street Grid

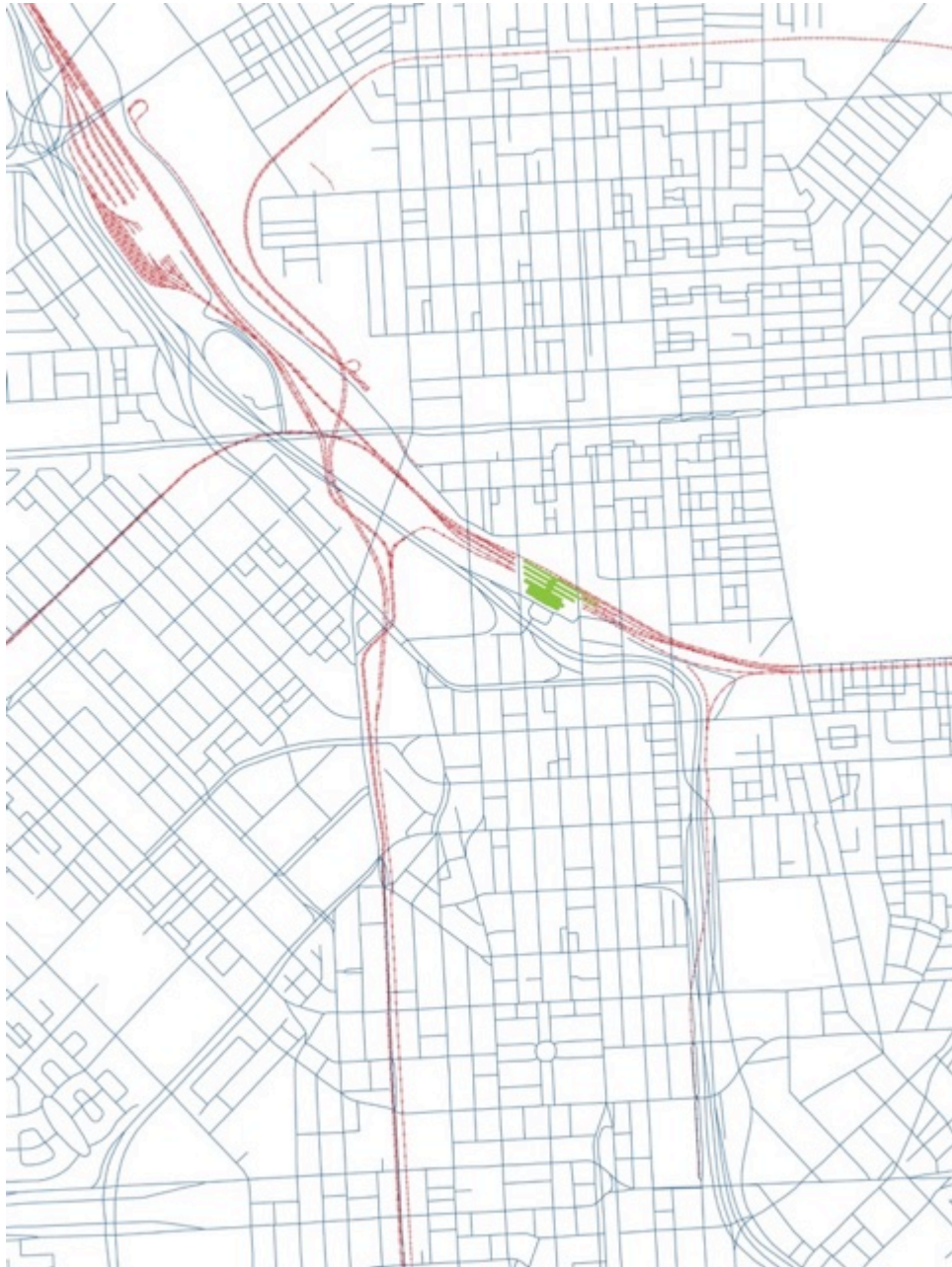


Figure 16. Street network (center lines)

Site Analysis

Walkability



Figure 17. Figure ground showing extents of a 5 minute and 10 minute walk from Penn Station

Baltimore's Cultural Center including the Meyerhoff Symphony Hall and Lyric

Site Analysis

Opera House lie within $\frac{1}{4}$ mile walk. A $\frac{1}{2}$ mile walk encompasses all of the University of Baltimore campus to the south of the station.

Neighborhoods



Site Analysis

Master Plans and Historic Districts



Figure 18. Existing Master Plans approved by Baltimore City Planning. Historic districts (red) overlayed with the Master Plans (gray)

Site Analysis

Land Use and Railroad Rights of Way



Figure 19. Land use

Site Analysis



Contour and Slope

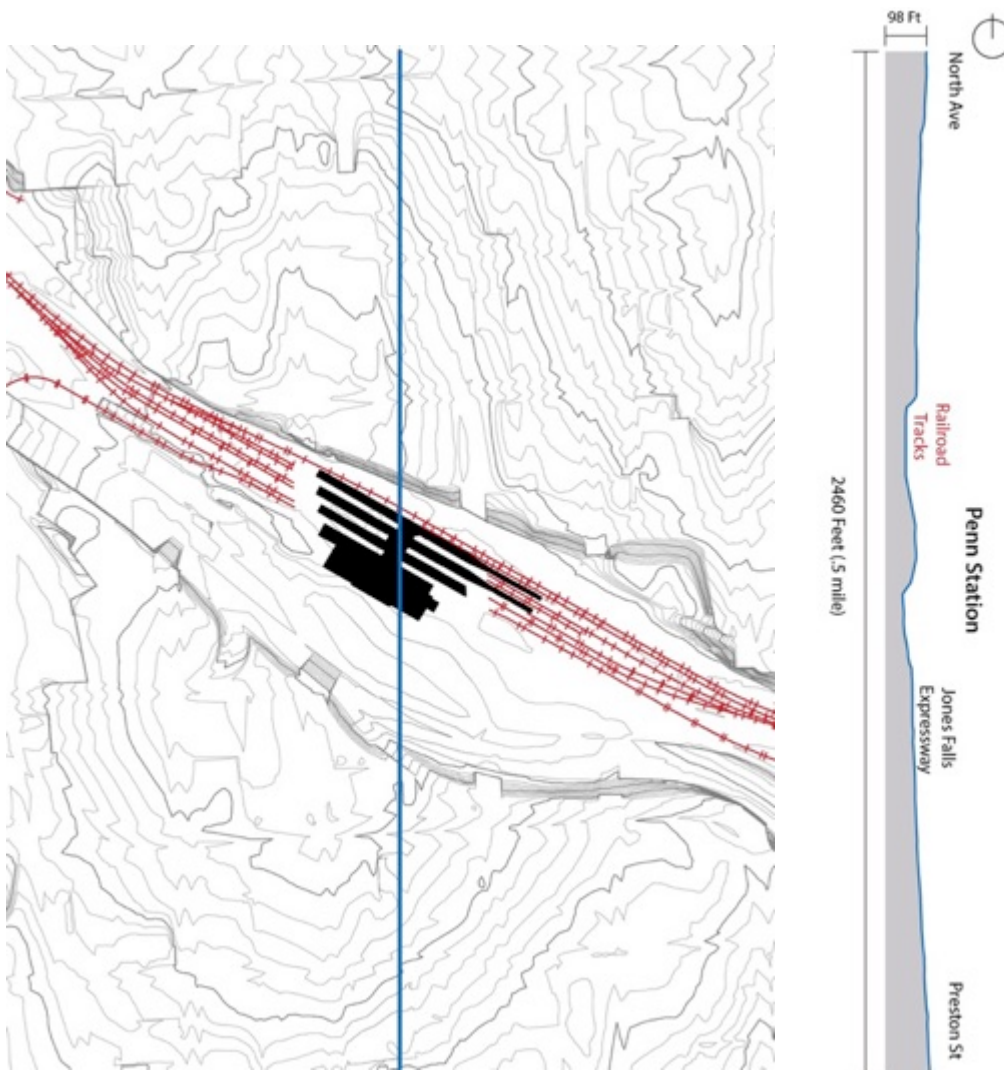


Figure 20. 2 and 5 foot contour lines. Section cut shows Penn Station, tracks and highway within the Jones Falls river valley

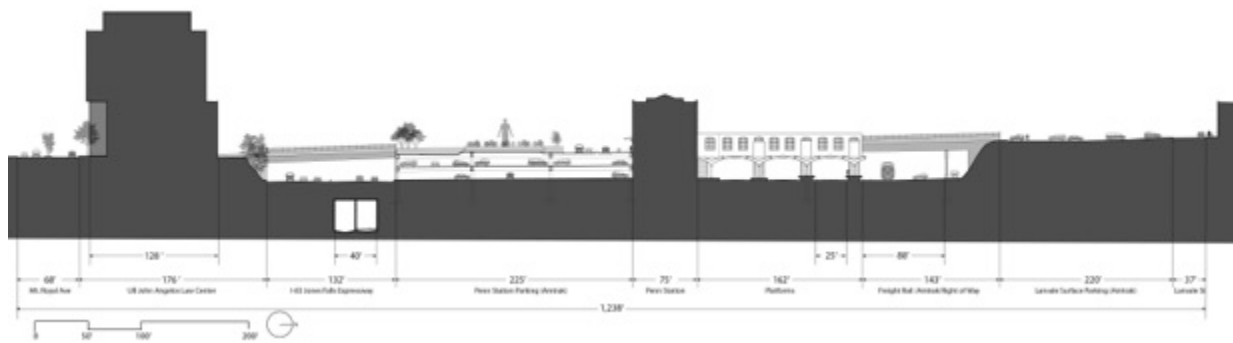


Figure 21. Existing Site Section by Author

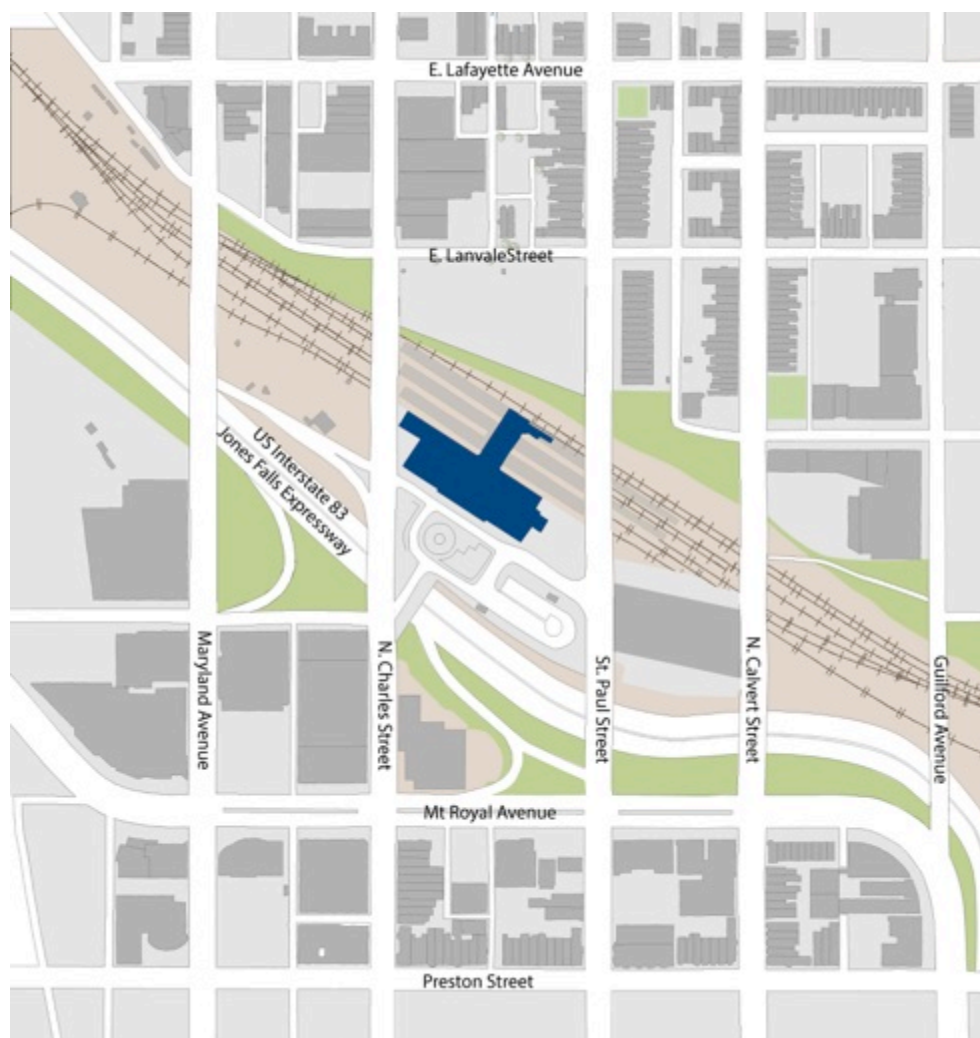


Figure 22. Existing Site Plan by author

Program Objectives

There are inherent components to the program of any railway station. Baltimore's Penn Station is currently a functioning station therefore the basic programmatic elements are in place. The objective of this thesis is to implement a program that will activate development in the neighborhoods adjacent to the station and throughout the Baltimore region as a whole. The intervention at Penn Station must operate at two scales, neighborhood and regional.

A modernized High Speed Rail and/or Magnetic Levitated rail network through Baltimore will bring an increased number of passengers through the station. However, for the station to reach its full potential as a generator of city and regional development, there need to be seamless connections from the HSR/ML to various modes of transit at the city scale. If the intermodal connections were to remain as they are now, passengers would arrive in Baltimore City in record time then spend a significant amount of time for the "last mile" of transit. One Light Rail spur, taxis, city busses, a Johns Hopkins University shuttle, and the Circulator service Penn Station. An expansive bike parking station has been located on the top level of the 2-story parking garage.

In order for Baltimore to increase its economic vitality on the Northeast Corridor, significant investment must be made to the citywide transportation infrastructure. Additional service lines of the subway need to be built that link the outer edges of the city to the central business district and to regional transit centers. The light rail, currently operating with a single route, need to be expanded to enhance the subway. Baltimore's primary mode of mass transit is the extensive city bus network. Implementing Rapid Bus

Program Objectives

routes strategically in the city could augment the current network. Personal automobiles need to be assigned safe and convenient pick-up and drop-off locations as well as parking; although, the new station design should reflect an intention to reduce the use of the personal automobile in favor of urban scaled mass transit. Dedicated bicycle lanes incorporated and storage must be provided on site.

Programmatically, the new design for Penn Station must provide efficient and easily found locations for every intermodal connection above.

The specific placement will ultimately depend upon the proposed track alignment and accompanying concourses and platforms for each type of rail: Magnetic Levitated Train, High Speed Rail, Regional Rail (“slow rail”), subway, and light rail/street cars. The arrangement of this area of the program will happen largely in the vertical axis of the station, or the sectional plane. Interlocking with this complex transit network will be the traditional services found inside a railway station:

- Entry hall
- Ticketing & customer service
- Rail employee back offices
- Station employee back offices
- Service core (restrooms, stairs, elevators)
- Newsstands
- Coffee shop/convenience store
- Waiting areas

Program Objectives

The increased number of passengers brought by the expanded rail requires an expanded number of services to be housed in the station. These expanded services, regularly found in larger rail stations, will include

- Lounge or waiting areas equipped with digital capabilities
- Restaurants/ eateries
- Mail or information technology services
- Retail
- Hotel
- Short term luggage storage
- Security

Moving outward from the core of the station, the program will include neighborhood related services such as

- Dry cleaning
- Small grocery store
- Pharmacy
- Bank
- Personal care services (barber shop, hair and nail salon, etc.)

Outside of the train station passengers must make a seamless transition to the fundamental areas of the station. Penn Station must mark its existence as a meaningful component of

Program Objectives

Baltimore City. The approach to Penn Station, currently underwhelming, must increase its monumentality within Baltimore. It is to be the gateway that welcomes passengers into the city and invites them back as they depart. This memorable experience will depend largely upon the ease of transition at the perimeter of the station site. The exterior program elements will include:

- Light Rail stops and shelters
- Bus stops and shelters
- Taxi or ride share pick up and drop off
- Bicycle parking and storage
- Sheltered waiting areas
- Automobile parking
- Green space, seating and beautification

As the site of Penn Station reaches into the adjacent neighborhoods the radii of engagement will accommodate the nature of those neighborhoods. The character of the neighborhood to the south of Penn Station is that of a University campus. The latest Master Plan from the University of Baltimore expresses the need for services that will enhance the university experience. Program elements on the southern edge of the site may include:

- Conference Center
- Innovation/maker space

Program Objectives

- Alumni Center
- Co-working Office Space
- Traditional Office Space

The north edge of the site extends into the Station North Arts and Entertainment District.

There are many small theaters, small restaurants, residential units, row houses, and artists' lofts. This neighborhood is resurging in popularity and is attracting many students that attend MICA and University of Baltimore. Further north is the main campus of Johns Hopkins University, which is experiencing a resurgence of its own. Neighborhoods to the northeast of Penn Station are still more reflective of the economic struggles of the city. There are many vacant properties and a struggling socio-economic population. Penn Station can serve as a bridge of development that begins to extend the prosperity northward "across the tracks".

Program components on the northern edge of the Penn Station site may include:

- Library
- Child Care facilities
- Medical offices that serve both the neighborhood and specialized medicine for out-of-town patients
- Gym or recreation facilities
- Independent theater
- Outdoor amphitheater and open space
- Farmer's market space
- Gallery space

Program Special Problems and Issues

The re-imagination of Penn Station as part of a fully integrated urban transit node along the Northeast Corridor requires special consideration of the technological requirements of High Speed and Magnetic Levitated Rail, site conditions on the Jones Falls river valley, and the economic realities of Baltimore City. Each of these components is complex individually but the overlap of the three is required to create a catalytic station in Baltimore.

A system-wide challenge is the overall construction of the High Speed and Mag Lev Rail. Fortunately, United States has many precedents and resources from which to gain knowledge. Some basic requirements must be met for both rail technologies. High Speed, steel-wheel trains require long stretches of straight and precisely laid tracks. These tracks may not be shared with the heavier freight trains in order to maintain the quality of the connections. This will mean that an entirely new rail network must be built. The magnetic levitated train has no rails at all. The trains travel within a superconducting electromagnetic trough. Travelling at speeds over 300 miles per hour, the trains must be elevated or tunneled for aerodynamics and for safety. These technological issues must be addressed at each station within the network. One advantage of Penn Station's location within the Jones Falls valley and outside of the congested city center is the availability of space; a factor which other cities like New York will not have.

Baltimore's Penn Station was located at a place within the city that was near to historical city center however circumstances likely played a larger role. As the first fully integrated rail network within the American Colonies, the B& O railroad was in operation long before the construction of Penn Station. The purpose of the rail network was to transport goods to and from the Port of Baltimore into the interior boundaries of the continent. The river valley

Program Special Problems and Issues

of the Jones Falls offered the opportunity to traverse a gentle slope between the water level of the Atlantic Coastal Region and the higher elevation of the Mid-Atlantic piedmont. As rail transportation grew in popularity, the railways were shared with the passenger and freight rail lines. Penn Station was erected along this historic railway rather than purposefully placed within the center of Baltimore City. Concurrently, the grid of city streets was placed on an orthogonal North-South axis. This configuration creates a unique cross-axis between Penn Station and the main street axis.

The first alignment of the B&O rail tracks was likely directly adjacent to the Jones Falls. As the rail network expanded it was necessary to deck over the river, rerouting it slightly to the south of the tracks. While Penn Station's entry is at the level of the city streets, the platforms

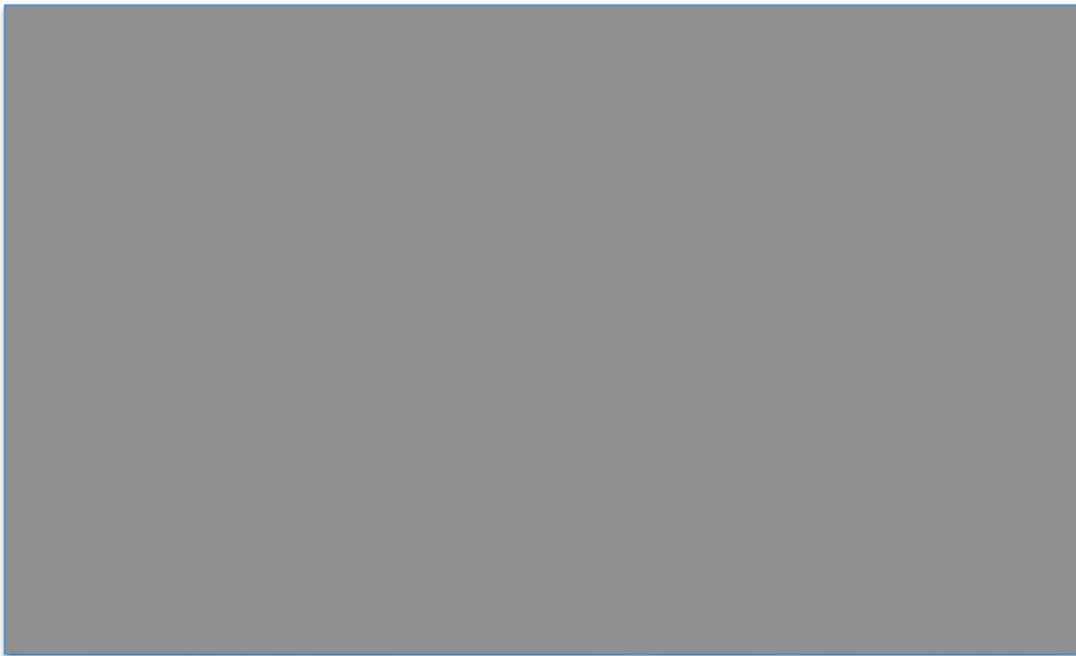


Figure 23. Aerial photograph of Penn Station, 1915

Program Special Problems and Issues

are located at the track level, clearly within the river valley. In fact, the entire station remains at a slightly lower elevation than the surrounding neighborhoods. In the beginning years of the Automobile Age, highways were constructed directly into the center of the cities. The Jones Falls Expressway (Interstate 83) was constructed in the area of least resistance, the Jones Falls River Valley. The 4-lane highway lies adjacent to the Jones Falls River and its tributaries for most of the journey into Baltimore. Approximately 1000 feet northwest of Penn Station, the Jones Falls river is directed into an underground conduit until it spills into the Inner Harbor, just as Interstate 83 come to an end.

Baltimore's Penn Station is complicated by the sectional limitations of the Jones Falls River and Expressway, both coincident within the Jones Falls river valley. It would be ideal to allow the Jones Falls River to be brought back to the daylight and for the highway to be removed altogether. Concerning the Penn Station site specifically, this would create a significant challenge, one that is not insurmountable but is too large to address in this thesis proposal. The sectional limitations of introducing tracks requiring precision alignment for high spend rail and magnetic levitated pathways are complicated by the River and highway configuration. The existing tracks are on the north side of the station. There are opportunities to add additional tracks on the north side and immediately to the south (the "front") of the station where old coal rails had been located. In addition, new rail lines could be tunneled beneath the station; river and highway or new alignments could be elevated above street level.

As discussed in the Chapter concerning the site, Baltimore's new city center has shifted closer to the Inner Harbor. Until the 1960's, the Inner Harbor was populated with warehouses and markets. As the Eisenhower Interstate system was expanded, Interstates 395 and 83 nearly

Program Special Problems and Issues

converged at the Inner Harbor. This traffic has been funneling business executives, employees and tourists directly into the Harbor and bypassing the rest of the city, and the rest of the city has suffered economically and socially. Charles Street has remained Baltimore's "decumanus", or main Commercial Avenue. It is ironic that the Interstates allow a certain economic vitality to occur in the city center but ultimately have a detrimental effect on the welfare of the citywide economy. In fact, the strongest economic centers lie within the geographic confines of these Interstates. Penn Station lies at a critical juncture within this double-edged economic condition. The re-imagined site of Penn Station will become a bridge that allows the economic vitality along the Charles Street corridor to extend northward over the confines of Interstate 83. The cross axis of the Charles Street Corridor and the Northeast Corridor will be a catalytic development within the city encourage economic growth outside of the privileged Inner Harbor area.

Program Graphic Depictions



Figure 24. Diagram showing adjacent neighborhood influences of the Program of the Penn Station site

Program Graphic Depictions



Figure 25. Site option that occupies street level between N. Charles Street and St. Paul Street.

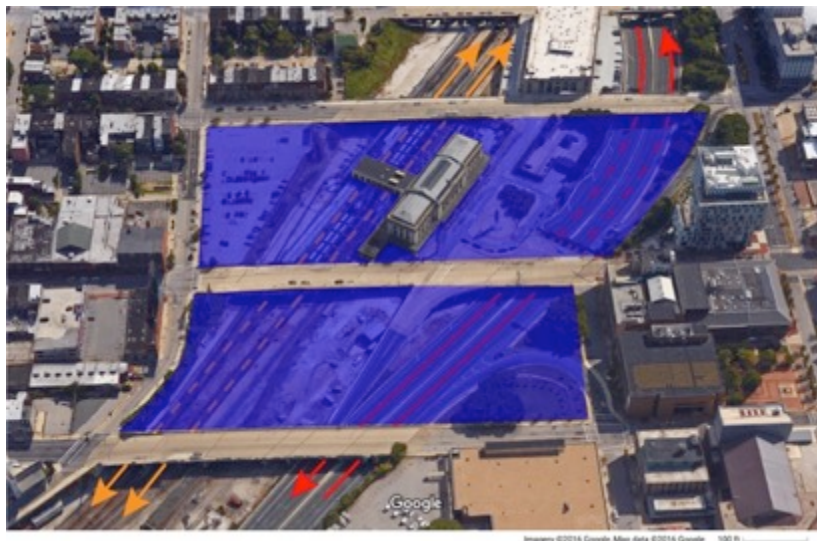


Figure 26. Site option 2 occupies the street level between Hoard Street and St. Paul Street

The catalytic intervention proposed at Baltimore's Penn Station requires examination of precedents on three scales. As part of the Northeast Corridor, the station will be integral in a system-wide update. Penn Station should be understood as the regenerative catalyst within the Baltimore metropolitan area – or the Station Area Regeneration. And finally, an upgraded Penn Station will need to incorporate elements from other great stations throughout the world.

System Precedent: SOM and The Northeast Corridor

Although reluctant, the Federal Government took over management of the railways in 1971. The rail network was in extreme disrepair and had become severely disjointed during the Golden Age of the automobile. SOM was hired in 1976 to overhaul the entire Northeast Corridor. The NEC consisted of 15 stations and 456 miles of rail.¹⁴ The stations required many types of renovations and upgrades that ranged from minimal sprucing up to complete teardown and reconstruction. Much of the tracks had to be repaired and rejoined. A few notable examples of upgrades are Washington, DC's Union Station in which a new concourse and gates were added at the rear of the station. A food court and movie theater was added later in the lower levels of the retail

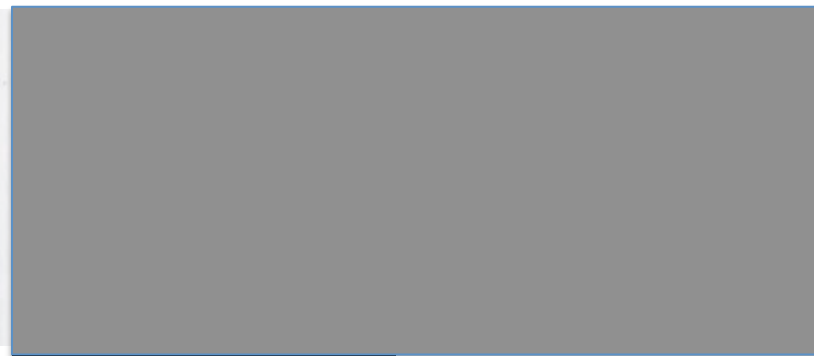


Figure 27. SOM map of Northeast Corridor stations

complex. While Union Station has remained one of the most complete stations, in terms of available services and city

36 (Milan: Electa Architecture ;,

2007).

retail centers, there are plans underway to make it a part of a larger urban center. The new development, Burnham Place, decks over the tracks to create connections with the existing street grid, enhance open space and build a mixed-use development in the heart of the Capital. The Providence, Rhode Island station was completely rebuilt. It was relocated to a site directly in front of the State Capital building designed by McKim, Mead and White. It lies low to the ground with a shallow dome protruding from the ground plain above. A Brutalist clock tower marks the entrance to the station. South Street station in Boston was partially rebuilt, according to the original plans for the building, a new central retail area was constructed using the historic façade as one of the anchor interior walls, and a large parking structure was added over the tracks to accommodate 2,200 cars and a bus terminal.¹⁵

Many, if not all of the stations SOM refurbished or designed in the 1970's and 80's are now in need of another upgrade, including Baltimore's Penn Station. It was a massive project to make the entire Northeast Corridor functional. The project was approached from a systemic view, as must be the overall agenda of the HSR/ML upgrade.

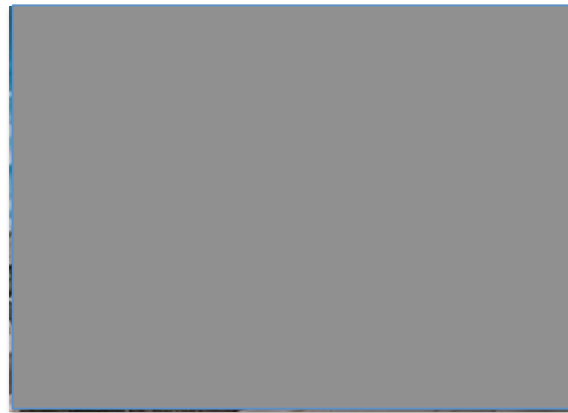


Figure 28. Providence, Rhode Island station clock tower

¹⁵ Nicholas Adams, *Skidmore, Owings & Merrill: SOM since 1936* (Milan: Electa Architecture ;, 2007)..

Station Area Regeneration Precedents

St. Pancras and Kings Cross Stations, London, UK

St. Pancras Terminal Station has been a landmark in London since 1868. The Midland Grand Hotel, a Victorian Gothic architecture style, marked the front of the station. Currently, the station has become the terminus for the Eurostar High Speed Train connection the island with continental Europe through the Channel Tunnel. The hotel, saved from demolition in the 1960's,



Figure 29. St. Pancras International Station, London, UK
(photo by author)

has been completely renovated and expanded now under the management of the Renaissance Hotel brand. The London Underground Station, Kings Cross lies adjacent and slightly askew of St. Pancras. The two stations have been “joined”

so that the services offered connect seamlessly to one another. Modern trussed steel and glass

roof structures physically bridge the spaces between the larger station buildings. The neighborhoods surrounding the conjoined stations have been invigorated and have left their more rough reputations behind. It must be noted however, that the incorporation of the Eurostar together with the renovations (which spanned over a decade) had to happen simultaneously. In other words, the Eurostar may not have chosen to terminate so far within the limits of London if station improvements and development incentives in the surrounding neighborhoods were not planned. Likewise, the development incentives would not exist without the promise of the High

Speed Rail.

Euralille, France

A short trip on the Eurostar will take one from St. Pancras in London to Lille, France. Also a development spawned from the burgeoning High Speed Rail, Euralille has been developing since the 1980's under the Master Plan of OMA. The planned expansion of the High Speed Rail connecting Brussels London and Paris transformed Lille, France from a forgotten town into a thriving metropolis. A Master Plan was implemented that incorporated the historic city center with a modernized central business district. The development continues today and is spurred on by the improvements made in the neighboring city centers, including London and Brussels.

Zuidas, Amsterdam

This area in the south of Amsterdam lies only 8 minutes travel time from Amsterdam's Schipol Airport. It is the newest business district of the city. The Zuidas Station will link the underground Circle Line to the High Speed Rail lines connecting to Brussels, London and Antwerp. The area was largely unpopulated as it was part within the planned expansion area of the city of Amsterdam. It will be under development through the 2030 decade and includes live, work and play programs throughout. Again, the development has been spawned as part of an overall



Figure 30. Zuidas Station, Amsterdam

objective of connection through High Speed Rail lines in the European continent.

Station Precedents: Terminals and Through Stations

There are two categories of train stations, terminal stations and through stations. Terminal stations are simply the ends of the rail line. The trains enter the station in one direction and must reverse along the route to leave. The track configuration of a terminal station allows the head building to have its entry directly on a main thoroughfare of a city. The train sheds covering the platforms extend behind the head building and the tracks fan out from the tail-like rails leading to the station. Examples of terminal train stations already discussed are Union Station in Washington DC, South Street Station in Boston, and St. Pancras International Station in London.

Union Station, Washington DC

Union Station in Washington DC is a terminal station, aptly named Union Station from the time when there were multiple privately owned railway companies that converged at the station. The head building is appropriately grand in scale and the variety of uses housed within the station make it a destination within the city. There is also a Metro stop incorporated within the building.

A large scale mixed use development is planned for the area behind the head building, Burnham Place, named for the architect of the Station. The development will be anchored to a deck

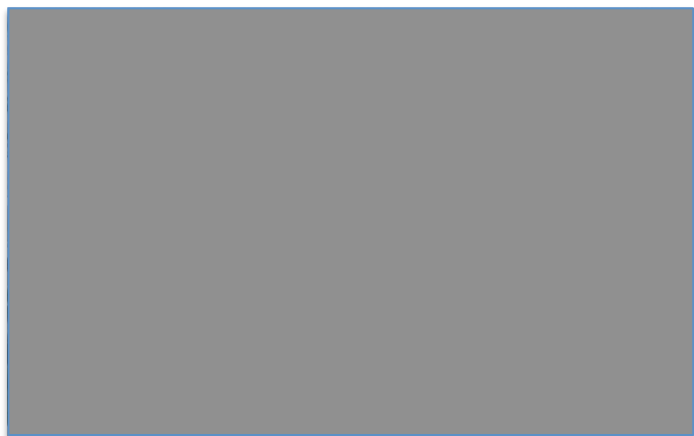


Figure 31. Rendered aerial view of Union Station redevelopment

covering the fan of tracks approaching the station. This offers a second grand entrance at the rear of the Station, creates open space and many opportunities for real estate development.

Grand Central Station, New York

New York's Grand Central Station is also a well known terminal station. It too, utilized the air space over the tracks for the construction of the Prudential Building (now the Met Life building).

The multiple level entries within the cityscape is the important component of this building for this

Thesis proposal. The lower street level is utilized mainly for automobile pick up and drop off, bus

passengers and of course pedestrians. The streets surrounding the building on this level are 42nd St., Vanderbilt Avenue and 45th St. The cross axis occurs on a second level of the street grid.

Park Avenue begins to incline at 39th St and then circumvents the station building at that level.

This dual entry system capitalizes on the verticality of the city, even though the station building is quite short in comparison to the surrounding buildings. The section plane through the station reveals the complex system of rail at the various scales required for urban development.

Multiple levels of railway tracks sit upon multiple levels of subway tracks, through which the user has to circulate vertically to access.



Figure 32. Section-perspective of Grand Central Station (above) and plan of terminus tracks (below)

Waterloo Station, London

The last terminal precedent is London's Waterloo Station. Also a grand terminal station, it has



been updated and expanded to offer a complete urban retail street sheltered inside of the building.

It is the terminal for trains serving the Southwestern areas of Britain. It was the original terminus station for the Eurostar until 2007 when

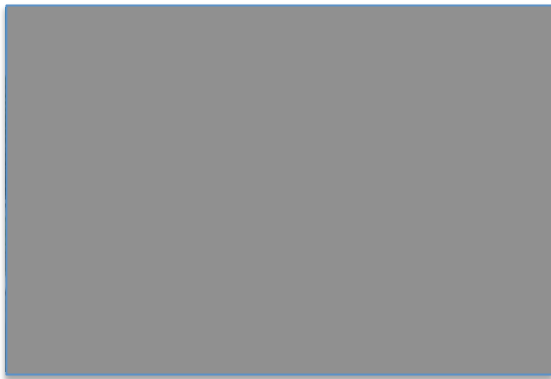
the Eurostar was routed to St. Pancras. In addition, Waterloo has the necessary Underground station incorporated within. The grand entry is along Waterloo Road on the south bank of the Thames River. Capitalizing on the real estate made available by decking over the tracks, Waterloo is a sprawling development within London.

Figure 33. Waterloo Station, London, UK

Through stations are generally smaller in scale than terminals. They include stations called whistle-stops or halts that consist of barely more than a small structure placed adjacent to the tracks. Through stations, however can be quite large. The train sheds still cover the tracks but are usually in a position parallel to head building- or the head building and the shed are incorporated into one large structure. The Providence, Euralille and Zuidas stations are all

examples of through stations already discussed.

Wilmington, Delaware

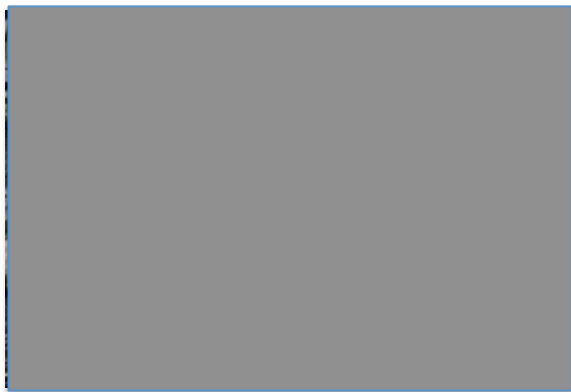


The Wilmington, Delaware station is on the Northeast Corridor and is one of the smallest examples of a through station. It consists of a single platform serviced on two sides by the Amtrak trains. Entry to the station is on street level

Figure 34. Wilmington, DE station

while the platforms and rails are one level above. This arrangement can be useful in studying the effects of elevating the new tracks of the HS/ML rail.

Hauptbahnhof, Berlin



A much larger example of a through station is Berlin's Hauptbahnhof. The Hauptbahnhof was completed in 2006 and resides on the site once divided by the Berlin wall. The station that was placed in West Berlin was a terminus for the City

Figure 35. Berlin Hauptbahnhof

subway as well as the National rail. Once Berlin

was reunited, the divided system had to be reestablished as well. The new station marks the existence of the double wall configuration by placing two extended towers the bridge the curving tracks below. A central core marking the grand entrance to the building connects the towers. The designers of the station, Gerkan, Marg and Partners, made excellent use of the opportunity to bridge the tracks and place large plaza on either side of the station.

South Beijing Station, China

South Beijing Station is one of the largest stations in Asia. From above it appears to be configured as if it were a through station, however it is actually a terminus for high-speed trains

approaching from opposite directions.



Figure 36. Beijing South Station

Trains approach from Shanghai from the west while trains approach from the neighboring city of Tianjin from the east. The structure of the station is therefore a hybrid of a terminal station and a through station. The fan of tracks on both the east and west sides are covered by the symmetrically curved form of the station. The Beijing subway and high speed airport trains are incorporated into the station.

Design Approach

The complexity of the components of the site required certain assumptions to be made in order to design a building. Without the benefit of civil engineers the alignment of the Maglev had to be assumed. I choose to place the maglev underground, north of the existing Penn Station and normal to the street grid. The maglev tunnel would be located at a safe level underneath the surface level of the regional rail.

Insertion

The circumstantial orientation of Penn Station along the rail lines divorced it from the street grid. By decking over the entire Jones Falls Expressway on the south elevation and the rail road tracks on the north elevation, Penn Station creates a literal bridge between the city-scale and the neighborhood scale. The new “land” created on the south side of the platform can be built out in high density office or university buildings; a scale that matches the existing buildings such as the John and Frances Angelos Law Center. The new building on the north end of the site will not match the existing fabric as it is new hub of transportation along the Northeast Corridor. However, stepping back the mass of the building at the fourth story will help to define the neighborhood scale.



Figure 37. Outline of new platform over Jones Falls Expressway and tracks. Diagram by author

The alignment of 2 grid systems created by the position of Penn Station and the orthogonal street grid created the Parti for the design. Where the diagonal grid lines intersect the orthogonal grid is the hierarchical moment in the parti.



Figure 38. Grid Shift Diagram by Author.

At this shift in the grid, a right triangle is formed. This right triangle becomes the icon for the maglev at Penn Station. Used as a locating and orienting device, it can be seen from every area of the station. It can be seen from the outside the station and becomes a beacon for maglev and the new infrastructure of Baltimore.

Station Design

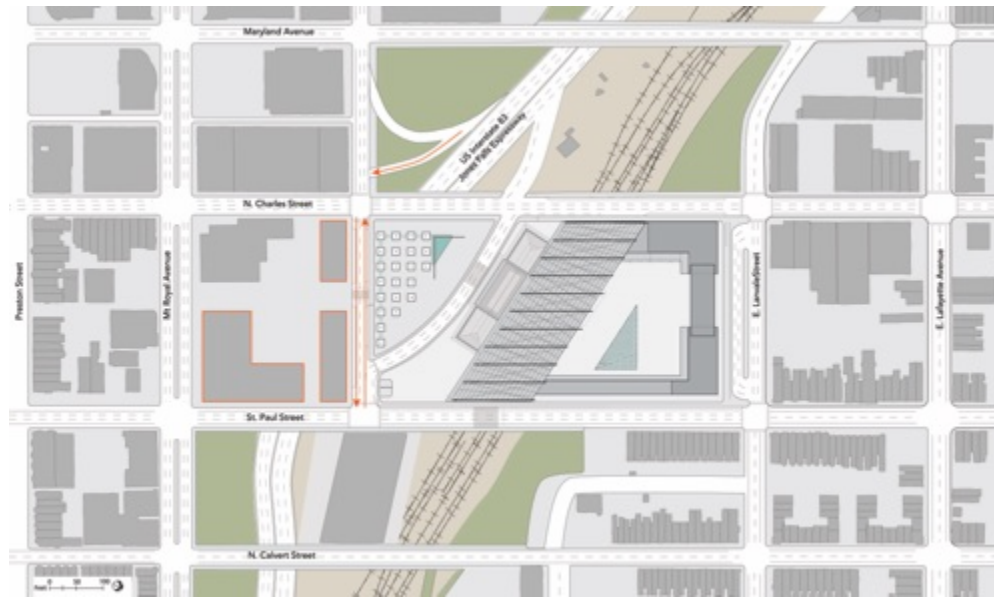


Figure 39. New site plan. Proposed buildings and roads indicated in orange.

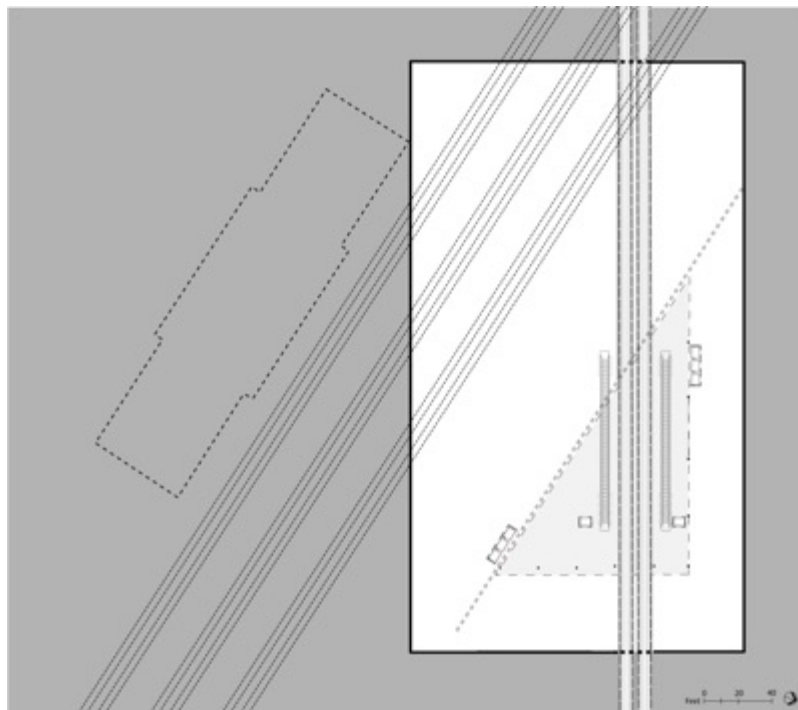


Figure 40. Plan: Maglev Platforms

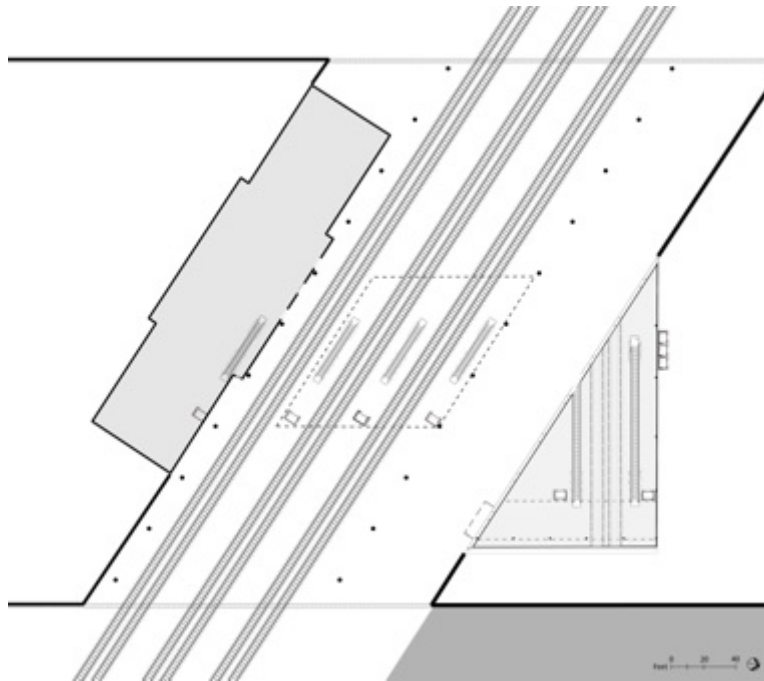


Figure 41. Plan: Regional Rail Platforms

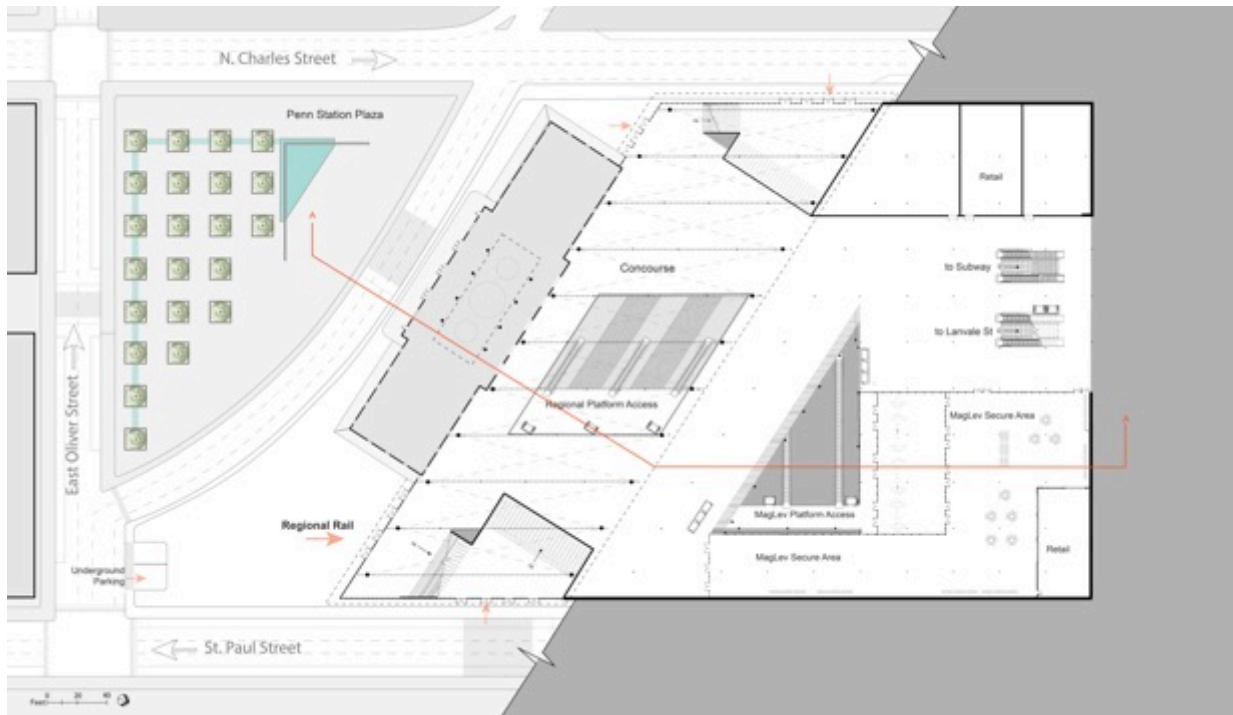


Figure 42. Plan: Concourse Level

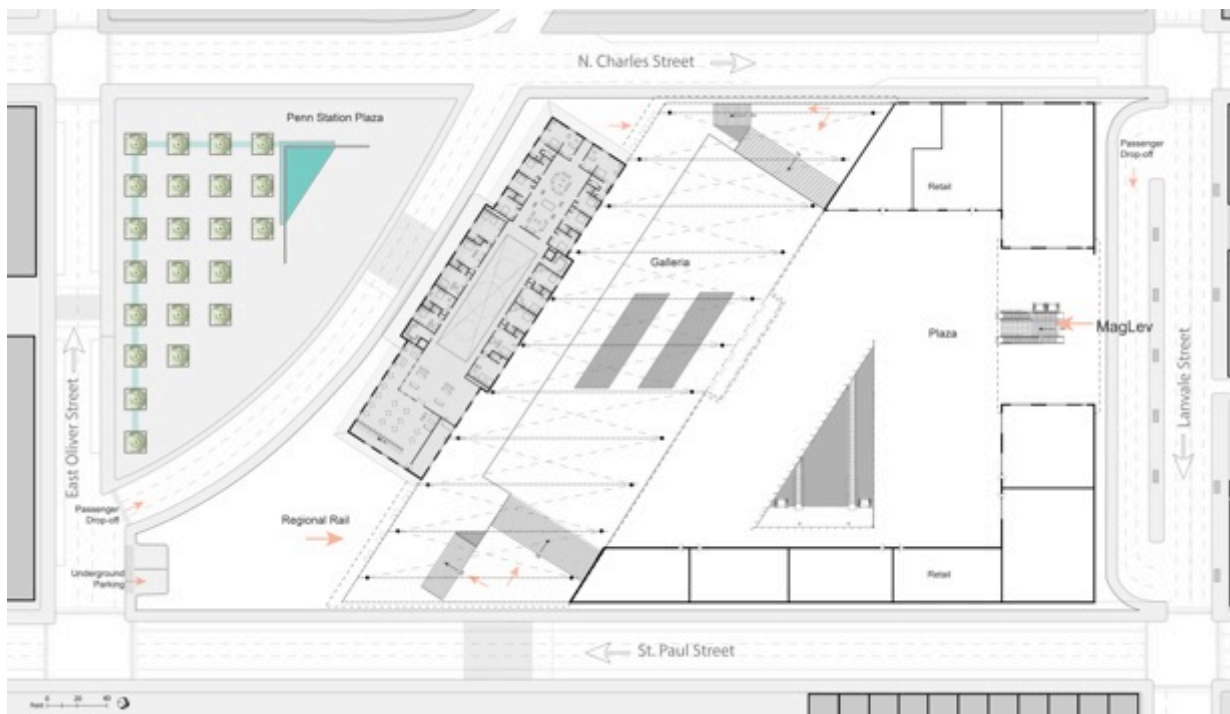


Figure 43. Plan: Galleria Level

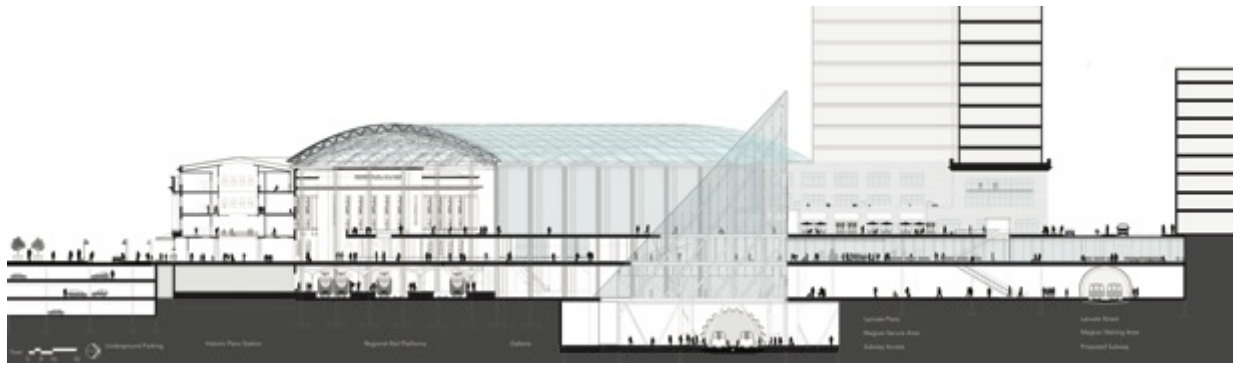


Figure 44. Section A-A

Program Placement



Figure 45. Program massing diagram

Conclusions

In order to make Penn Station an important economic node within Baltimore City, Region and Northeast Corridor, the station had to become more integrated with the city. The new infrastructure of maglev technology can only bring you to the city faster; it can't get you to your destination, "the last mile". It is this insertion into the city grid that can revitalize the urban fabric surrounding the station. The triangular form encapsulating the Maglev platforms stands prominently within the Plaza of the expanded Penn Station. This form acts as a beacon to the city of the advent of a new technological age. Within the station itself, the form becomes a special object and serves as a locating device from all areas. The multiple entries to the enlarged station allow for permeability while holding the urban edge of the block. Access to the chosen mode of transport might be accessed quickly from one entry over the other, but passengers can easily navigate through the station to wherever they choose. The Plaza and Galleria serve as public amenity spaces. For this thesis, I left the program elements open to possibility. I imagine that retail, restaurants, kiosks, art exhibitions, temporary art installations, street artists, etc will populate the vast interior located above the regional rail tracks. Openings in the floors allow views of the regional rail platforms and will assist orienting the users of the station for way finding. The north end of the site, under Lanvale Street, I have indicated a possible location for a new subway line for Baltimore city. Again, the last mile of transit is imperative for an integrated transportation network.

The use of the right triangle throughout the design was an obvious choice given the geometry of the existing station. I ultimately came to use this form as a marker of what lies beneath the ground we stand upon. The large triangular form within the station, made of glass,

reveals the new maglev infrastructure. A smaller triangular form was used in front of the existing Penn Station to “answer” the gesture of the maglev void. This smaller triangle becomes a fountain and water feature in the plaza that overflows into a small, guided stream eastward until it disappears under the surface. I designed this in homage to the Jones Falls that has been buried underground. As the maglev void reveals the underground infrastructure, the plaza fountain reveals the underground natural elements.



Figure 46. Final Presentation Boards, actual size 24' x 8'

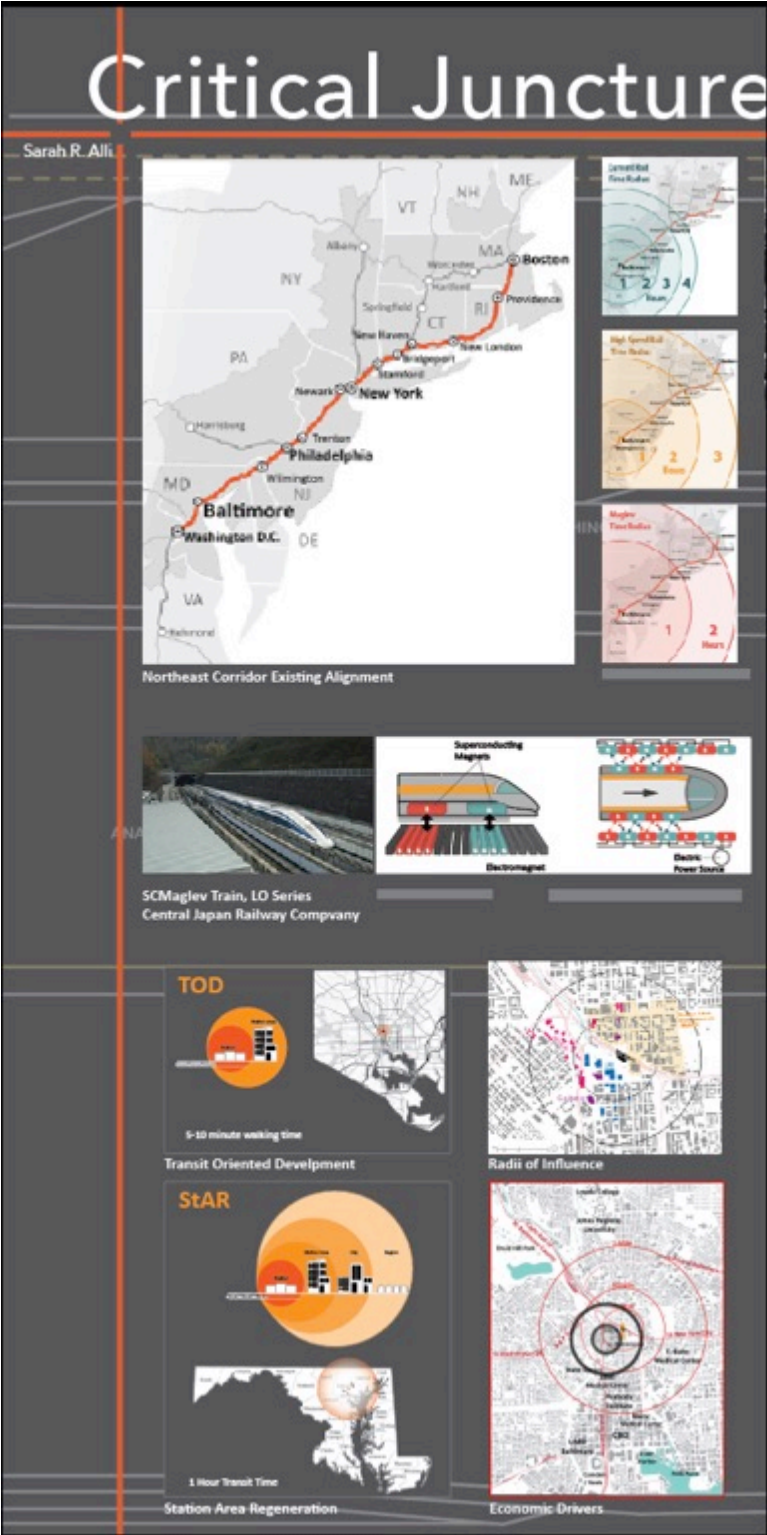


Figure 47. Board 1

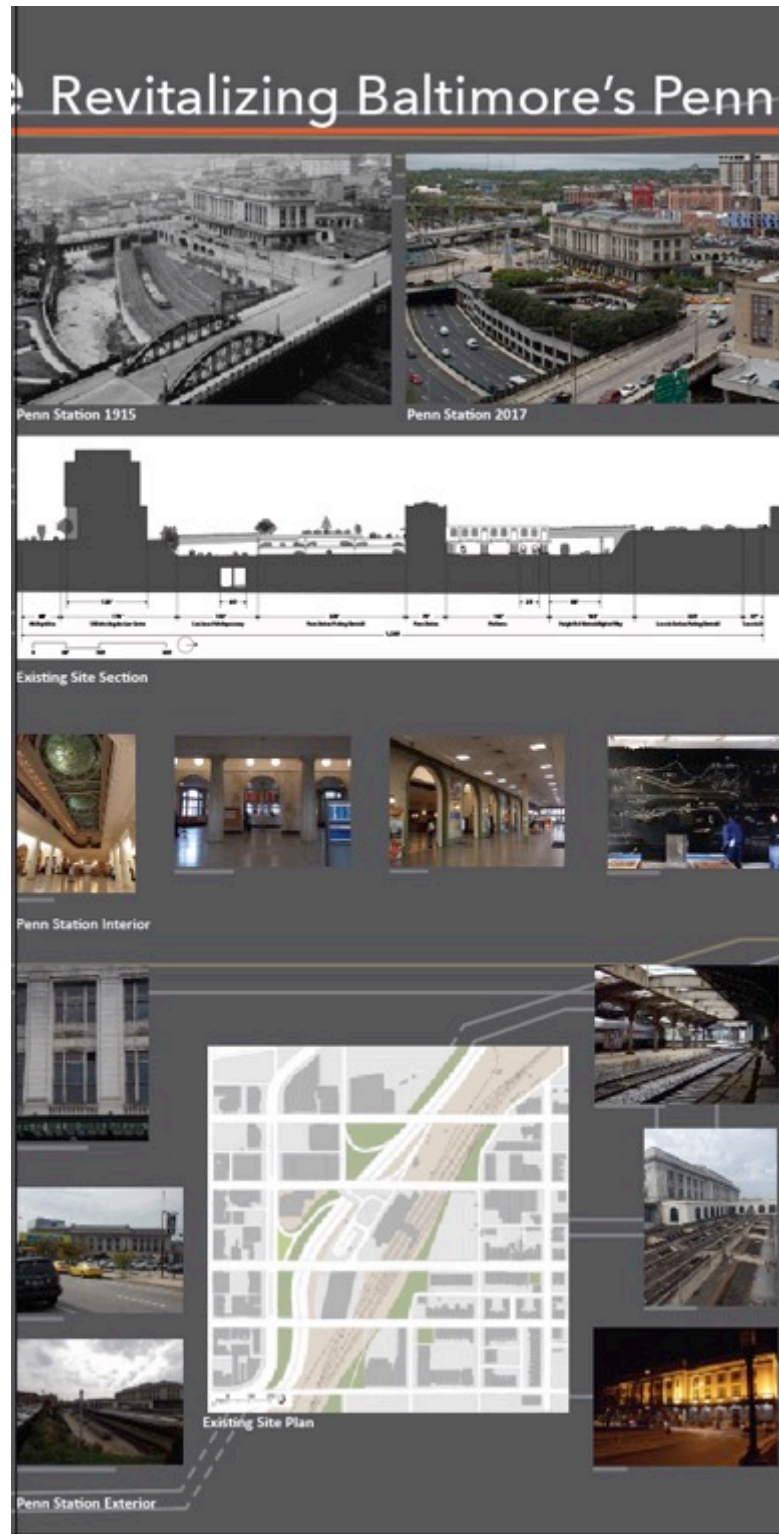
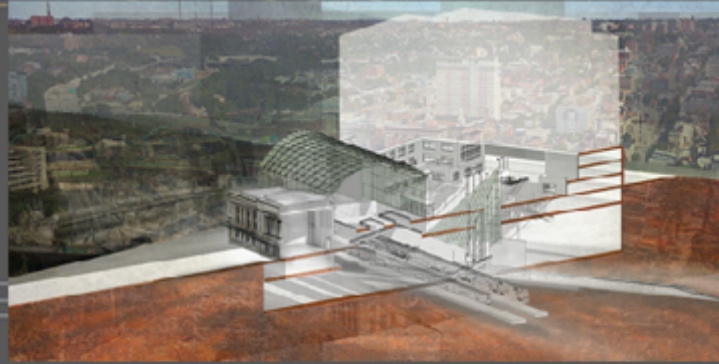


Figure 48. Board 2

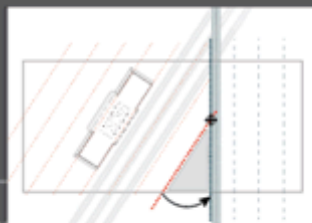
Station with MagLev



View Facing Northwest



New Site Plan



Grid Shift + Rail Alignment



Program

Figure 49. Board 3

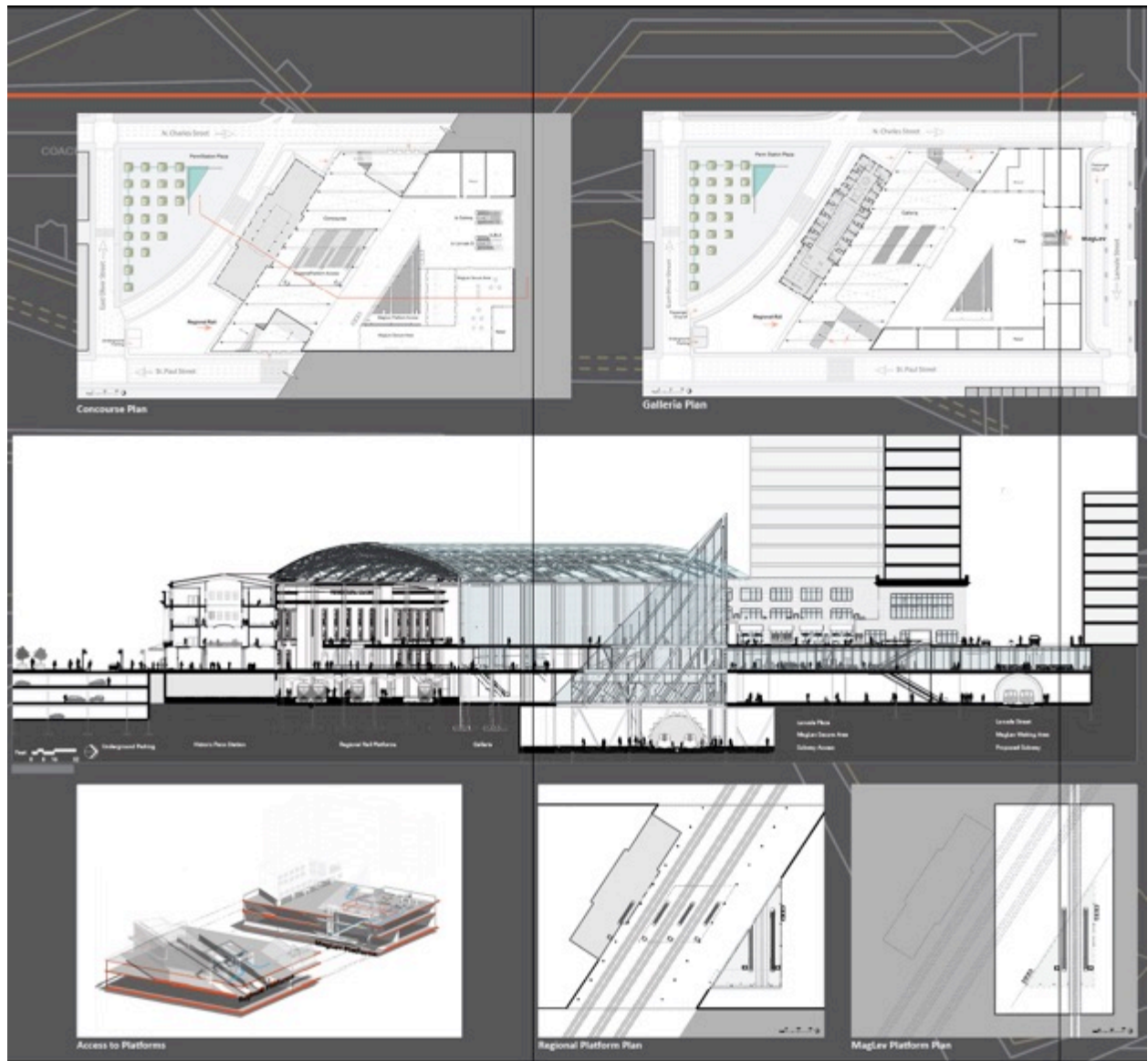


Figure 50. Board 4

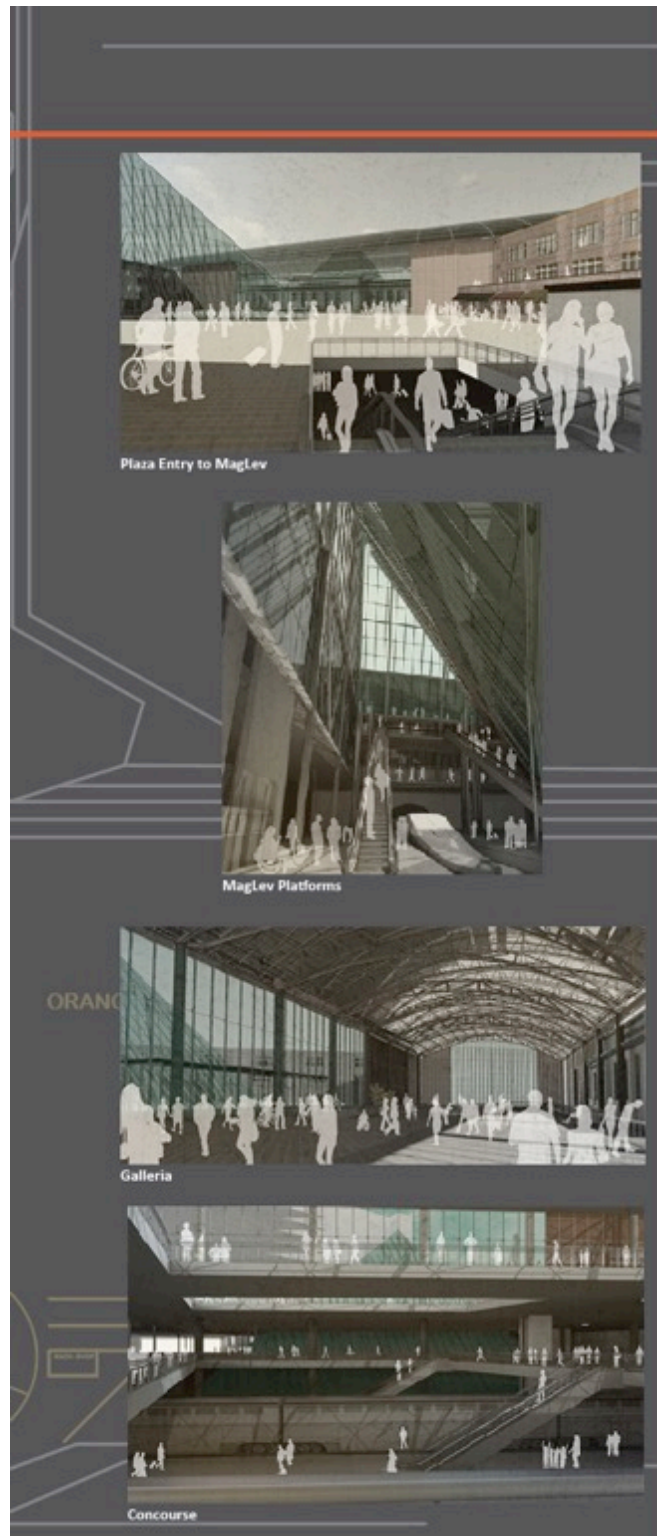


Figure 51. Board 5

This thesis was conceptualized as one that would design a train station within a city. I had no preconception about what form or style the new station would have. In fact, I was somewhat distraught when I visited the existing Penn Station and found that it functioned perfectly well as a small train station. At the time I was searching for a “problem” within the station itself. I quickly came to realize that the design is only partially about the station building and more about the urban design proposal and the efficiencies required for transportation connections. When I began to imagine the influx of people and businesses that would be associated with the maglev, the size of the station needed to match that scale of influence. I was asked by one of the critics during my final review about the scale of the new station to the old station. In his opinion, the new building was overshadowing the old. I agree with his assessment, but this was my intention: it SHOULD overshadow the old building. The new station should not destroy the old building but give homage to it as the old grandfather of rail that has spawned the magnificent new age of rail travel.

“This thesis seeks to examine what happens when a purposeful intervention is made at Baltimore’s Penn Station; one that accommodates the future Maglev as part of the Northeast Corridor. An augmented and fully integrated mass transit system can make Penn Station an important economic node in the city and the Greater Baltimore Region. The station expansion and design of the surrounding plazas can revitalize the urban fabric and make Penn Station a destination unto itself.”

Point 1 – “accommodates Maglev as part of the Northeast Corridor”. This station

design places the Maglev in alignment with the orthogonal city grid for 2 reasons. It helps to re-align the existing station with the urban fabric. It may also help alleviate some of the existing problems of the current track alignment: too many curves.

Point 2: “augmented and fully integrated mass transit system”. The proposed subway line underneath Lanvale Street was indicative of the type of transit networks needed to make Baltimore a thriving city once more. It is not enough to have unregulated ride sharing, bike paths and streetcars. We need to place more emphasis on mass transit infrastructure that moves people efficiently into, throughout and out of the city. I would have loved to propose more if time had allowed.

Point 3: “station expansion and design of surrounding plazas to revitalize the urban fabric”. On this point I was only able to make the suggestion of revitalization. My design provided many spaces for this to happen but fell short in proposing what those uses could actually be. The placement of the components of a multi-modal station including the vertical circulation, entry points, security and general programmatic elements became quite a puzzle to work. If I were to continue designing this station I would address a couple of issues: the materiality of the barrel vaulted train shed form – I feel there is too much glass in the current design, the facades and forms of the urban plaza of the new portion of the station – while the massing is appropriate some of the details of uses, circulation and façade detailing need to be addressed, the exterior of the new station needs to be articulated and detailed to compliment the surrounding buildings- while the station needs to be recognizable it also needs to look like it belongs in Baltimore.

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