The Backbone of the Metropolis

How the development of rapid transit determined the becoming of the New York City Metropolis.

History Thesis

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Date: July 2008
Cover image: "The Subway", by George Tooker
1950, Egg tempera on composition board,
Collection of Whitney Museum of American Art

Source: "Subway City; Riding the trains, reading New York"; Brooks, 1997
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In the 1920s and 30s Robert Moses developed an intricate network of parkways around New York City. These were designed for the joy of driving.

Source: "The Power Broker"; Caro, 1975
Introduction

Grade separated urban rapid transit and the metropolis:

According to James Crawford, “...Transport technology has always affected both the growth and form of cities, and each new transport mode has left its stamp on urban form. When a new model is adopted, existing urban areas are forced into new uses and ever new forms and new development is arranged in accordance with the demands and capabilities of the new mode...” (Crawford, 2000, p. 54) This relationship between the development of new modes of transportation and the development of urban forms and configurations is what will be the general topic of this research.

Although there have been studies into the relationship between the existing urban fabric and the existing system of public transportation, for example in “Metropolitan Galaxies” (Parcerisa & de Ventos, 2002), a historical account of this relationship has hardly been made. The focus of research is either on urban development or development of transportation systems. A study into the relationship between public transport and urban form and configuration might give interesting insights into the development of the metropolis in the nineteenth and twentieth century.

Grade separated rapid transit systems, or metro systems are particularly interesting in their relationship to urban form and configuration. These underground or elevated rail systems for mass public transportation, or a combination of both, can be found in many of the world’s large cities. In 2002, there were more than a hundred cities in the world that had developed such a system of transportation. (Parcerisa & de Ventos, 2002, p. 4) These systems play an important role in enabling people to travel around these large cities, avoiding the often congested streets and the types of transportation that are grid-locked within them.

These rapid transit or metro systems can be defined as: “...a form of guided transport, independent of streets and other modes of transport, moving in its own channel, clear, fast and serving mass mobility, in cities that are or want to be metropolitan...” (Parcerisa & de Ventos, 2002, p. 3) This is also what makes them an interesting subject of research. They form a relatively autonomous system, which functions more or less independently from the street pattern on grade level and serves for the mobility of large numbers of people. They very much influence the way in which people use these streets and the adjacent buildings, as well as the city at large, by enabling them to travel large distances, virtually without interruption and congestion. These systems have a different relationship to urban form than other types of public transportation, like the autobus, which are much more dependent on the existing urban configuration itself. Through their relative independency underground train systems can exert a much bigger influence on the development of the urban form and configuration of the metropolis. (Parcerisa & de Ventos, 2002, p. 2) On the other hand they also engender a different, fragmentary perception and understanding of the city. Often the metro systems encapsulate their users underground and re-emerge them to completely different parts of the city, without knowledge of what is in between this location and the previous one.

New York, New York:

In researching the development of rapid transit systems in relation to the development of the metropolis, New York City forms a specifically interesting case study, for a number of reasons.

Firstly, the New York Rapid Transit system is one of the largest in the world, containing 1401 kilometers of single track and 437 stations. It serves the fifth largest number of users every day, after Tokyo, Seoul, Mexico city and Moscow. (Sort, 2005) Also it is one of the most well-known metro systems in the world and New York is arguably more closely associated and identified with its metro system than any other city in the world.

Secondly, during the period that the rapid transit system of New York was developed, the city went through a face of explosive growth and became one of the most important metropolises of the world. From 1820 to 1960 New York City was the port with the most traffic in the world (Sort, 2005, p. 40) and grew from 80.000 inhabitants in 1800 to some 6 million in 1925, making it the largest city in the world at that time. (Derrick, 2001, p. 10) During this same period the rapid transit system was developed, enabling the city to move its inhabitants up and down the island of Manhattan, making a huge geographic expansion possible. This analogue development of city and system enables us to study the dependency between the rapid transit system and the evolution of urban form. In most other cities, the city itself was considerably further developed when the metro was introduced, London and Paris for example, were already large metropolises in the second half of the nineteenth century, when they began building their metro systems.

On top of that, New York is an interesting example in the North American context. Whereas this part of the world is very much oriented towards car mobility, New York City is the only city in which the number of users on the metro outnumbers the other modes of transportation, carrying 1405 million users per year. (Sort, 2005) The overall public transport in New York City is responsible for 85% of all commuter traffic in the city. (Sort, 2005) Interestingly, New York City still had a strong development of suburbanization, like other American cities, although in this case engendered by public transportation, rather than car mobility. (Parcerisa & de Ventos, 2002, p. 4) This specific difference in comparison to other American cities makes it an interesting test case, as to how and why a metro system can gain and maintain such an important role in public mobility and the development of a city.

As Clifton Hood analyzes in the introduction to ‘722 Miles; The building of the subways and how they transformed New York’ “…The subway integrated New York geographically,
The development of Rapid transit and its influence on the urban composition of New York City

The development of the rapid transit network of New York in relation to the development of the urban form and configuration of the metropolis can be divided into several distinguished periods. The first period is the period before there was any form of Rapid Transit. During this period New York is dependent on horse drawn types of transportation, walking or sailing. During this period there are several technical advancements, like the invention of the steam engine, which eventually will allow for Rapid Transit. In the case of New York this period roughly starts with the introduction of the Commissioner’s Grid plan in 1811, when New York was still a small harbor city, which would determine the urban plan of the city. The end of this period is marked by the opening of the West Side and Yonkers Patent railway, the first elevated railroad of the city in 1868.

The Second period is the period in which the city acquires its first rapid transit system, the elevated railroads. The introduction of these railroads sparks a first wave of urbanization to the north of the Island of Manhattan. Meanwhile the overcrowding on Lower Manhattan becomes increasingly severe, raising the cry for more and better Rapid Transit. Eventually the development of electric traction opens up the possibility of an underground rapid transit system. This period is bound by the opening of the first elevated railroad in 1868 and the adaptation of the Rapid Transit Act in 1891, which allowed for the built of the first subways.

The third period is the era of the first underground rapid transit system in the city. The introduction of this system sparks a huge boom in the urban development of Manhattan. On top of that several new districts are added to New York City, by what is called ‘the Consolidation of Greater New York.’ This roughly establishes the boundaries to the city, as we know them now. The problems of overcrowding still remain large in this period and there is still a call for new subways. This period starts with the Rapid Transit Act in 1891 and ends with the approval of the Dual Contracts in 1913.

The final period that is dealt with is the period of the so-called ‘Dual Contracts’. This is the first big expansion of the subway system, following relatively soon to the opening of the first subways. The development of the Dual Contract subway lines was the catalyst to development of New York to the scale that we know it now. These lines dispersed the population over the whole of the metropolitan region and enabled poor working-class immigrants to move away from the slums. The Dual Contracts determined the current New York Metropolis. The period starts with the approval of the Dual Contracts in 1913 and roughly ends in 1932 when another expansion of the subways is opened.

The period from 1932 until now, is of lesser importance to the relationship between the development of Rapid Transit and development of the Metropolis. This has two specific reasons. Firstly, the expansion of 1932, the Independent system (IND) (Derrick, 2001, p. 237) did not open up vast areas of undeveloped land for the development of the Metropolis. The lines that were introduced by this system all went into areas that were already fed by the Dual Contract lines. Therefore this expansion was of lesser influence on the urban development of the city. On top of that the IND expansion didn’t increase subway ridership, the total number of users remained steady after its introduction and eventually started to fall. (See Appendix 2: Numerical data; Annual ridership 1901-1998) The introduction of the IND, the rapid transit development in New York City came to a standstill and there haven’t been any large expansions since. (Derrick, 2001, p. 238) This diminished the influence of the system on the development of the city.

The second factor that caused the standstill and the decline of the subway system from 1932 was the introduction of the automobile to the larger public, by Henry Ford in 1908. (Hood, 2004, p. 183) This started a shift of interest in America, away from public transportation. Especially after World War 1 the public interest moved towards the individuality of auto mobility. This led to the development of large highway networks in and around New York City, funded by government subsidies, as well as funds extracted from public transport budgets, a key influence to this development was Robert Moses. (Derrick, 2001, p. 237) Robert Moses started the development of an intricate network of ‘Parkways’ aimed at the pleasures of car travel, during the 1920s and developed it into the 1930s. (Caro, 1975, p. 8 & 9) (See: Image 1: The network of Parkways) Gradually cars became the determining factor for urban development. So-called ‘car culture’ and suburbanization became dominant factors for American town planning, especially after the 2nd World war, also in New York City.

For these reasons the analysis ends around 1932, when the Dual Contract lines were all finished and had their most important influence on the development of the city. The new period that came with the IND and the dominance of car-culture falls out of the scope of this research.

Furthermore, within each of the distinguished periods, an analysis will be made of several different topics, which relate to both rapid transit and urban development. Although each period will be looked at from the perspective of each of these topics, all will be dealt with in a continuous written account. This means that not all of the topics might be directly visible within the chapters. Especially the patterns of urban development, as well as the lines and nodes of the rapid transit system will mostly be dealt with through illustrations referred to in the written account. Also numerical and statistical data will be added as..."
an appendix, in order to maintain a clear overview and account of the events, as well as
the numbers. The subjects of comparison between the different periods, based on which
a historical account will be made of the relationship between rapid transit development
and development of the Metropolis in the case of New York City, are:

- The main events of the period, which can be found in chronological order, in: Appendix 1; Chronology.

- The crucial numerical data on track length, rolling stock, travelers and inhabitants,
which can also be found, grouped together in: Appendix 2; Numerical data.

- The technical advancements and developments in mobility and transportation,
which are to be found within the text mainly.

- The trajectories, nodes and urban expansions, which can be found in the text and are
explained by illustrations.

- The Urban composition and form; Urbanism and Architecture, which can be found
in the text and illustrations.

- The Socio-political context and background, which forms the heart of the text, as this
explains how and why the rapid transit system came into being and which position
it full-filled in the life of the New Yorkers.
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Image 2: ‘New York in 1782’

This map shows the settlement and topography of New York City in 1782 and is overlayed with the Grid Plan of 1880. The blocks with gray fill show the build up area.


Source: http://www.lib.utexas.edu/maps/historical/new_york_1782.jpg; The University of Texas at Austin, 2008
1. Pressure rising (1811-1868); New York City before rapid transit

The Eerie Canal: Trading innovations and explosive growth:

In 1811 New York City was far from being the largest city in the United States, let alone the world. It had around 120,000 inhabitants, including the boroughs of Brooklyn, Queens, Bronx and Staten Island. These were either separate cities or comprised of small towns at that time. By the end of the period covered in this chapter, around 1870, New York City had grown to a population of 1,478,000 inhabitants, making it the largest city in the United States. Especially the island of Manhattan had grown explosively from 96,000 to 942,000 inhabitants. (Derrick, 2001, p. 10) This underlines the main development, as well as the main problem of this period: Explosive growth of the population on a geographically confined location, formed by the Island of Manhattan.

The explosive growth of the population was engendered by a combination of critical trading innovations, that boosted the potential of New York City as a harbor, increasing the flows of imports and exports that passed through the city. (Hood, 2004, p. 30) This developed New York from a small mercantile and port enclave to the port with the most traffic in the world. (Sort, 2005, p. 40) Crucial in this development was the inauguration of the Eerie canal on the 26th of October 1825. (Hood, 2004, p. 29) The Eerie canal connected the Great Lakes Region and the Upper Mississippi Valley to the Atlantic Ocean, via the Hudson River. All sea cargo to the Northern part of America would now be carried over the Hudson River, past New York City, as this was the fastest transport route at the time. The Canal would remain to have a large impact and boost the New York Harbor, until it was surpassed by the New York Central Railroad after the Civil War. (Hood, 2004, p. 34)

Through the development of New York City as a harbor, the city’s economy flourished. By 1860 it accounted for one third of the country’s total imports and two-thirds of its exports. (Hood, 2004, p. 34) This also attracted thousands of people to the growing metropolis in search of fortune. New York became the most important entry point for immigrants to America. Almost every immigrant entered the nation through Ellis Island and many of them remained in New York in search of the American Dream.

This explosive increase in population and the unfavorable geography of Manhattan Island is what urged the development of a rapid transit solution. New York City is a sort of urban archipelago, with Manhattan, thirteen miles long and two miles across at its widest point, at the center of it. (Hood, 2004, p. 35) In the first half of the 19th century, most urban traffic was pedestrian, the only other option were horses and carriages, which were hardly affordable for anyone in the city. This limited the range of movement of people and thereby the extent to which the city could expand to house its people. Manhattan didn’t have the possibility to develop in a concentric circle; the only possible direction of urban development was north up the island. (Brooks, 1997, p. 8) This limited the options very much and density and congestion on lower Manhattan increased to an unbelievable level. The only means to relieve this pressure was to either move up north or to move across the river. In both cases a new means of transportation was needed to make commuting to lower Manhattan for work possible, because all the commercial activities and jobs of the city were concentrated there.

The Commissioner’s Grid Plan:

Around 1790, New York was the economic center of the New York Region, as well as the capital of the United States, but only had 30,000 inhabitants. (Derrick, 2001, p. 13) The build-up area only stretched northward as far as Canal Street, (See: Image 2: New York in 1782) since population growth was quite slow up to this period and inhabitants had no other form of transportation then their feet. This meant they needed to live close to where they worked.

The street system had developed without any overall plan up to this period. (Derrick, 2001, p. 13) This resulted in narrow and curvy streets. The lot sizes varied considerably, depending on each block’s shape. From 1790 to around 1810 there were more streets laid out to extend the city northward. (See Image 3: New York in 1836) One grid was placed on the east side to Houston Street, and another in the Greenwich Village area. (Derrick, 2001, p. 13) Further real-estate development beyond these areas turned out to be hindered by the lack of an official system of streets.

To solve this problem in 1811 a commission formed by the New York State Legislature approved to a gridiron street plan, designed by Surveyor John Randel. (See: Image 4: The Commissioner’s Grid plan) Starting from Houston Street, this grid plan ran up to 155th street, the northern border of what is now Harlem. (Derrick, 2001, p. 13) At that time it was believed to be improbable that the city would grow beyond this point in the near future. (Derrick, 2001, p. 293) The grid ran from east to west from 1st to 155th street, each street 50 to 60 Ft. wide, except the major thoroughfares, which were 100 Ft. wide. From north to south there were twelve avenues, each 100 Ft. wide. The only street that didn’t conform to the grid north of Houston was Broadway. Interestingly, the resulting intersections between Broadway and the Grid later became the city’s main centers of activity. The standard blocks within the grid were 200 by 800 Ft. in size, resulting in building lots of 25 by 100 Ft.

The grid was hardly altered in the further development of the city and became the blueprint of New York City’s expansion. When the city grew beyond Manhattan Island, the grid was simply extended. Almost the complete urban plan of New York was hereby in fact already determined by 1811. In the 1830-ies, when congestion of the North-South routes became increasingly problematic, two avenues were added to the scheme: Madison Avenue between 4th and 5th Avenue, and Lexington Avenue between 3rd and 4th Avenue. In the late 1940-ies another alteration was made to the rigid plan: In between 59th and 110th Street and 5th and 8th Avenue there was to be a big park, Central Park, in order to give the...
1. **New York in 1836**
   - This map shows the development of the build up area of New York City from the first settlement to 1836. The map is overlaid with the Grid Plan of 1880. The lines mark the boundaries of build up area.
   - Source: http://www.lib.utexas.edu/maps/historical/new_york_1836.jpg; The University of Texas at Austin, 2008

2. **The Commissioners Grid Plan**
   - This map shows the Grid Plan in the way has been developed up until 1880. It is essentially the same as the original 1811 plan, except for the addition of Central Park.
   - Source: http://www.lib.utexas.edu/maps/historical/new_york_parks_1880.jpg; The University of Texas at Austin, 2008

3. **New York 1880**
   - This map shows the topography of Manhattan Island. The overlaid streets plan if the 1880 Grid Plan.
   - Source: http://www.lib.utexas.edu/maps/historical/new_york_topo_1880.jpg; The University of Texas at Austin, 2008
This map shows the development of New York City and Brooklyn Heights up until 1842. The leap across the river is clearly visible here. The blocks with gray fill again mark the build up area.


Source: http://www.lib.utexas.edu/maps/historical/new_york_1842.jpg; The University of Texas at Austin, 2008
Up until the 1870-ies, half of the city’s million inhabitants lived below 14th Street, where business, as well as residences concentrated. (Cheape, 1980, p. 21) Until the 1930-ies, lacking alternative means of transportation, New York was a “walking city”, everything needed to be at walking distance. The developed area remained very small, although the population grew fast, which made density and congestion became enormously problematic. (Derrick, 2001, p. 14 & 15) In 1814 Robert Fulton was the first to set up a steam ferry between Manhattan and Brooklyn, which soon carried 200 million passengers a year. (Sort, 2005, p. 41)

This steam ferry was the first transportation device that enabled people to move out of the overcrowded and poor living conditions of lower Manhattan. Affluent businessmen soon moved across the river to start commuting to work by ferry and created America’s first commuter suburb in Brooklyn Heights. (Derrick, 2001, p. 15) (See: Image 6: New York in 1842)

Omnibuses and Horse cars:

In 1827 another public transport invention enabled a pressure relief, by allowing affluent people to move further from their work: the Omnibus. (See: Image 7: The Omnibus) This was a horse drawn covered carriage, which originated from the city of Nantes in France. These vehicles inspired the local stagecoach operator and stable owner Abram Brower to put several omnibuses into operation on Broadway. Before, his stagecoaches had only been used to travel longer distances, but never within the city itself. (Hood, 2004, p. 38) Omnibuses served along a fixed route, according to an established schedule and set fare. (Hood, 2004, p. 38) They were the primary form of transport in the 1830s and 1840s. However the slow and bumpy ride over the poorly maintained streets prevented further expansion. (Derrick, 2001, p. 15)

In the wake of this new transportation, some affluent families moved from their neighborhoods surrounding City Hall to less congested and crowded areas to the north. (Derrick, 2001, p. 15) In the center of the island, starting from Washington square north along Fifth Avenue and north of Bleecker Street, suburban neighborhoods for affluent businessmen began to appear. (Derrick, 2001, p. 15)

However, the introduction of the horse car by John Stephenson and the New York and Harlem Railroad in 1832 was a far more influential invention for the development of the city. (Hood, 2004, p. 37 & 38) (See: Image 8: The Horse car) The horse car operated on rails on the local streets and was pulled by a horse. (Derrick, 2001, p. 16) This form of transportation was considerably superior to the omnibuses, since it provided a far smoother and faster ride being on rails, rather than the street itself. The real development of this type of transportation only came during the 1850s.

At this point in time the suburbs in Brooklyn, as well as Jersey City and Hoboken, to which additional ferry services had been established, started to attract more and more people. This development was seen as “...a threat to New York’s prosperity...” (Derrick, 2001, p. 16) and the city’s leaders started up a campaign to sustain the attractiveness of Manhattan for the middle and upper class citizens, by developing an extensive horse car network that allowed them to move further up the Island. (Derrick, 2001, p. 16) Up to this point, this development was held back by political opposition and the interference of the omnibus companies. The decision to make the rails level with the street surface allowed the expansion of the network, without interfering with omnibus service. (Derrick, 2001, p. 16) In 1860, the horse cars carried 38 million riders annually and about 125.000 per day.

Segregation city: Upper class residences vs. Tenement housing:

By 1860 the area between 14th Street and 42nd Street had become almost completely developed, moving the barrier of concentrated settlement on Manhattan twice as far as it had moved in the previous two hundred years. (Hood, 2004, p. 39) (See: Image 5: New York 1880) The new neighborhoods were dominated by upper-class families, who built spacious brownstone or brick houses along the grid plan’s streets and avenues. (See: Image 9: Brick houses of the affluent) While their old homes and living quarters were transformed to warehouses, dry goods stores and other businesses. (Hood, 2004, p. 39)

Although the transportation developments of the first half of the nineteenth century allowed the upper and middle class citizens of New York City some space, Lower Manhattan kept increasing in population and density, with increasingly bad living conditions and housing quality for lower income people. (Derrick, 2001, p. 17) (See: Image 10: Lower Manhattan living conditions) Commuting was out of the question for the poorer inhabitants of New York and the pressure on the lower part of the city kept augmenting. (Hood, 2004, p. 39 and 40) Slowly, the improvements in transportation for the upper classes had helped to develop a strongly socially segregated city, with large slums and ghettos on the tip of Manhattan, were the workers lived who needed to remain within walking distance of their jobs. (Derrick, 2001, p. 17)

The Lower East Side, for example, became an important living quarter for these workers. Here, Landlords tried to put as many families as possible into the former homes of the wealthy, converted to small apartments. (Derrick, 2001, p. 17) As these existing buildings ran out, a new type of housing, the tenement was invented. This was the cheapest form of...
Image 7: (Left page) 'The Omnibus'
An advertisement made by the John Stephenson Company of New York City, around 1885. This advertisement shows what the original omnibuses in New York looked like. Essentially they were just stagecoaches that were used within the city.

Original source: New York Historical Society

Source: "722 Miles, the building of the subways and how they transformed New York"; Hood, 2001

Image 8: (Right page, left side) 'The Horse car'
Showing a horse car heading east on 42nd Street, towards 5th Avenue, around 1889.

Original source: New York Historical Society

Source: "722 Miles, the building of the subways and how they transformed New York"; Hood, 2001

Image 9: (Right page, right side) 'Horse car lines'
Map showing the horse car lines that were to be found on Manhattan around 1902.

Original source: Street Railway Journal, 16, October 13th, 1900

Image 9: ‘Brick houses of the Affluent’
View to the North-west along 5th Avenue, from 27th Street, around 1865. The areas further to the north had become a refuge from the slums on Lower Manhattan for those who could afford it. These areas were build up with large brick apartment houses.

Source: “New York 1880; Architecture and Urbanism in the Gilded Age”; Stern, Mellins and Fishman, 1999
Image 10: ‘Lower Manhattan living conditions’
Image showing the typical courtyard of the tenement house. Overcrowded, busy and full of clothes lines. This picture was originally taken by Jacob Riis for “How the other half lives”.

Source: “New York 1880; Architecture and Urbanism in the Gilded Age”; Stern, Mellins and Fishman, 1999
Image 11: ‘Horse car travel in New York’

Source: “Subway City; Riding the trains, reading New York”; Brooks, 1997
Proposals for rapid transit were developed in order to solve the congestion (Brooks, 1997, p. 10) in the wake of this mentality numerous prosperity to all…”

As Hood states: “...By the 1860s the phenomenal spatial expansion of New York City had clearly outstripped the omnibuses and railway […] One solution to this misery was rapid transit, which is defined as any type of mass transit that has its own right of way and does not compete for space with other vehicles […] By skirting the street congestion that delayed omnibuses and horse cars, these trains could achieve much faster speeds, spurring more urban expansion…” (Hood, 2004, p. 42)

On top of that, most New Yorkers saw rapid transit as being the savior to the city, it was thought to: “...restore civility, empty the slums, reclaim waste lands and bring prosperity to all…” (Brooks, 1997, p. 10) In the wake of this mentality numerous proposals for rapid transit were developed in order to solve the congestion problematic and enable the expansion of the city. But, in spite of this general attitude, most of these proposals didn't make it past the law or fell short in financing. They are however, important for the further development of a rapid transit system, as the made up the pretext to the actual building of such a system in 1868.

Considerations for early Rapid Transit proposals:

Already in the 1840s the first proposals for Rapid Transit railroads began appearing, most of them focusing on development along Broadway. (Brooks, 1997, p. 10) These proposals formed an important testing ground for ideas and possible solutions for engineering problems that needed to be resolved in order to develop a feasible Rapid Transit solution. The first important question was the type of grade separation, or where the rapid transit solution would be located in relation to the street. In this problem there were two possible options: either developing an Elevated structure above the street, popularly known as El, or developing an underground structure, commonly referred to as subway.

Secondly there was the question whether to go through Broadway, which would face strong opposition of the merchants who feared loss of income, or to go through the residential districts, which would agitate the homeowners. (Brooks, 1997, p. 10) Proposals for Broadway often dealt with the transit way as a second street, making it an elevated promenade to stroll and window shop, providing new opportunities for the merchants. A good example of this is the 1874 proposal by Alfred Speer, who proposed a city long conveyance platform, which would serve as a promenade and maintain the qualities of a fashionable Broadway. (Brooks, 1997, p. 12 and 13) (See: Image 12: Speer’s elevated proposal)

The third question was whether an elevated structure should go over the sidewalks, or down the middle of the street, in which also the admittance of daylight onto the street level needed to be considered. (Brooks, 1997, p. 10) John Randel, who was also the surveyor for the 1811 grid plan, proposed the ‘colonnade promenade’, to go over the sidewalks in 1846. This was a cast iron and glass structure that would provide a sheltered promenade on two levels and also admitted enough daylight through the glass onto the street and shop windows below. (Brooks, 1997, p. 13) Rufus Gilbert his 1871 proposal is exemplary for the solutions going down the middle of the street, most of which proposed a light, airy and ornamental structure. Gilbert offered to build graceful, open Gothic arches, made out of cast iron. (Brooks, 1997, p. 13) (See: Image 13: Gilbert Elevated)

The next question to resolve was how to create a fast service, while making frequent stops, to make the system convenient to use. William Hemstreet in 1866 proposed a system with three tracks on his ‘Elliptic Iron Arch Arcade’. This was an early version of the express-local system that would become trademark to the New York subway in the future. The middle track would run direct express trains downtown in the morning.
Image 12: ‘Speer’s elevated proposal’
Image showing the proposal for an elevated promenade on Broadway, by Speer. This proposal was called the: ‘Endless Railway Train’.

Original source: Frank Leslie’s Illustrated Newspaper; March 21st, 1874

Source: “Subway City; Riding the trains, reading New York”; Brooks, 1997
Image 13: ‘Gilbert Elevated’

Image showing the proposal for a pneumatic elevated railway to go over Broadway, by Rufus Gilbert. Original called: ‘Covered Atmospheric Railway’

Original source: Frank Leslie’s Illustrated Newspaper; March 18th, 1871

Source: “Subway City; Riding the trains, reading New York”; Brooks, 1997
Image 14: ‘Hemstreet’s proposal’
Image showing the proposal for another elevated railway system on Broadway. This proposal by William Hemstreet was the earliest version of New York’s signature express-local system, with three or four tracks. Originally called: “Elliptic Iron Arch Arcade”

Original source: Frank Leslie’s Illustrated Newspaper; March 6th, 1866

Source: “Subway City; Riding the trains, reading New York”; Brooks, 1997
and uptown in the evening, whereas the outside tracks would run local trains making frequent stops. (Brooks, 1997, p. 13 and 14) (See: Image 14: Hemstreet’s proposal)

Another problem to be resolved was how to get passengers from street level onto the elevated structure and also from the structure onto the moving vehicles, since frequent stopping would be inconvenient. Hemstreet, for example, proposed stairways in the adjoining buildings, connected to the platforms. (Brooks, 1997, p. 14) Randel proposed a screw shaft containing a sofa, on which the passengers could ride to platform level. After this they would enter a stationary tender car that would take them up to the main car, which was continuously moving. (Brooks, 1997, p. 14)

The question that in the end was most crucial for the development of rapid transit, especially for underground solutions, was the means of propulsion. The electric motor for transit was invented in Europe in 1879 and perfected for trains in 1890, which made the use of electric traction impossible at this point in time. (Derrick, 2001, p. 23) Steam engines were possible, but there was quite heavy opposition to their use, since people feared that severe accidents would happen if they would be used within the build-up area. (Brooks, 1997, p. 16) The Gilbert Elevated used pneumatic propulsion, to send his cars through a closed system of tubes; Alfred E. Beach proposed a similar system in 1868, this time in underground form. These proposals eventually turned out to be problematic, because they needed to accumulate enough air pressure, but also allowing people to enter the trains. (Brooks, 1997, p. 16 and 17)

Eventually, the first proposal that was actually built in 1868 was The West Side & Yonkers Patent Railway. This was an elevated railroad that used a system of cable propulsion with stationary steam engines located in underground vaults. (Brooks, 1997, p. 14) Randel proposed a screw shaft containing a sofa, on which the passengers could ride to platform level. After this they would enter a stationary tender car that would take them up to the main car, which was continuously moving. (Brooks, 1997, p. 14)

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**Mercantile elite and the moral crusade:**

There were two important political factors in the first half of the nineteenth century that strongly influenced the development of rapid transit schemes. Firstly, New York City was dominated by wealthy and influential mercantile and business elite, which on one hand stimulated the development of rapid transit proposals to expand the city, but on the other hand was wary of their favorable positions and their businesses. Since City or State financing for the proposals proved difficult, the support of this elite was required to really develop these proposals. In a lot of cases it proved very difficult to convince them of the usefulness and adequateness of a specific proposal. (Brooks, 1997, p. 17)

Secondly, between 1861 and 1865, the Civil War was being fought between the Northern and Southern states. Although New York City was far from the battlefield, the war did influence the life of the city and especially the social coherence in the city. Most importantly, the 1863 Draft Riots created awareness amongst a part of the city’s elite that something needed to be done to enhance the living conditions in the Lower Manhattan slums. Rapid transit became one of the means, by which people hoped to enhance this problematic.

The Draft Riots were at the height of the civil war, it was the largest outburst of violence the city had ever seen. The immediate cause of these riots was the drafting of immigrant workers as soldiers for the Union Army. (Derrick, 2001, p. 18) These riots were the catalyst for a systematic survey of the living conditions on Manhattan Island. In 1865 the Citizen’s Association, governed by the business elite, published a report that labeled the systematic overcrowding the major public concern. The report surveyed a density of 240.000 persons per square mile in lower Manhattan, creating a severe pressure on the living conditions. (Derrick, 2001, p. 19) The report led to the creation of the New York City Health Department, an organization that crusaded against disease and epidemic in the overcrowded districts. Next to that it led to the first Building regulations, the predecessor of the Zoning Law, approved by State Legislature in 1867. (Derrick, 2001, p. 20)

Although the report hadn’t proposed moving people out of Manhattan as a means to deal with the problematic, the link between transit, health and order became a popular argument to develop rapid transit. (Cheape, 1980, p. 28) Another reformer, looking for relieve for the poor living conditions in the slums was Dr. Rufus Gilbert, for whom rapid transit became a moral crusade. (Derrick, 2001, p. 22) (Hood, 2004, p. 50) He believed that: “…rapid transit would empty American hospital beds and reduce the high urban death rates by allowing the poor to move from the overcrowded, disease-ridden slums to the green hills of the surrounding countryside…” (Hood, 2004, p. 50)

The overcrowding, crime, violence and poor living conditions of Lower Manhattan, accumulating in the Draft Riots, had proven the need for expansion of the city to the North. The development of rapid transit was by now widely accepted as an adequate means to decrease congestion and density. Still, there remained two lines of thought on this matter: Either cheap rapid transit was a way of bettering the conditions of the laboring classes, or it offered an escape from the hustle of the city to the serenity of the suburb for the privileged few. (Cheape, 1980, p. 28) Either way, every year more people moved into Manhattan and the increasing congestion of population in lower Manhattan wasn’t soon going to fade. (Derrick, 2001, p. 22)

This image shows Charles T. Harvey testing the first elevated railway of the city for the first time in 1867. The picture was taken around Morris Street.

Source: "New York 1880; Architecture and Urbanism in the Gilded Age"; Stern, Mellins and Fishman, 1999
2. A little relief (1868-1891); Development of the first rapid transit solution: the Manhattan and Brooklyn elevated

The West Side & Yonkers Patent Railway:

The first Rapid Transit proposal that was actually built was the West Side & Yonkers Patent Railway, designed and build by Charles T. Harvey. It was the first elevated railway line in the world and opened on July 3th, 1868. (Hood, 2004, p. 49) The West Side & Yonkers Patent Railway was a privately owned and operated enterprise, which didn't require interference from the municipal government, a difficulty that cut short most of the earliest rapid transit proposals. (Cheape, 1980, p. 31) The elevated structure proved cheaper to build and did not require government subsidies, which suited the economic framework of the day, primarily based on private initiative. (Hood, 2004, p. 48)

Harvey’s proposal had received State Legislature in 1866 from the specially selected Committee on Rapid Transit, which had called for proposals to combat New York’s severe overcrowding. (Smith, 2000, p. 17) From the numerous plans received, eventually Harvey’s plan, in which stationary steam engines would propel trains on an elevated railroad by means of a cable, was passed and he was allowed the formation of a company to build such a proposal. (Derrick, 2001, p. 26) Although the Committee favored an Underground Railroad to an elevated one, it was considered to deserve consideration, since it was: “...most free of engineering difficulties and because of the use of cable traction [was] free from the pollution problems of steam locomotives…” (Smith, 2000, p. 17)

In 1867 the West Side and Yonkers Patent Railway Company received Legislature to build a line of half a mile long, extending from the Battery north along Greenwich Street and up 9th Avenue to 30th Street. Harvey built the line from the Battery to Cortland Street. (Derrick, 2001, p. 26) (See: Image 15: The West Side & Yonkers Patent Railway) When this stretch of line was build and opened in 1868, both the structure and the propulsion system failed to inspire much confidence. The cable was delicate and frequently broke, but the trains were able to gain a speed of fifteen miles an hour and the line became a success. Only a year later Harvey had extended the line up to 30th Street. (Hood, 2004, p. 49)

On the 24th of September, 1869, the Stock Market crashed and the Depression began. Harvey, like many others, lost his capital and went bankrupt. The West Side & Yonkers Patent Railway suspended its services. On November 15th, 1870, the company and its property was auctioned off for 960 dollars and reorganized as the New York Elevated Railway the following October. (Hood, 2004, p. 49) The new company proposed a 160 mile stretch of new lines, extending all the way to the north of Westchester county on Long Island. On top of that they discontinued the use of cable propulsion and introduced steam locomotives and resumed construction of what was now called the Ninth Avenue line. (Hood, 2004, p. 50) By the summer of 1875 the line was extended up to Central Park. (See: Image 16: The Ninth Avenue Elevated) At that time it was using ‘dummy locomotives’; engines camouflaged as passenger cars, not to frighten the horses below.

During May and June it carried 172,846 passengers, in the same period the following year, twice that number. (Boberick, 1982, p. 201)

The determining influence of Boss Tweed:

In the second half of the 19th century the political structure of New York City was a complex hierarchical system, with the “Boss” at its head. According to Cheape in ‘Moving the masses: “...As in most large 19th Century cities, a political machine dominated municipal government in New York. Headed by a boss, the machine’s hierarchy was built of precincts, districts and wards and fueled with cooperation, patronage and graft. At its zenith the boss’ power was reflected in his control of the branches of government: City council, the mayor’s office, and the local judiciary...” (Cheape, 1980, p. 30)

During the 1860s and '70s, New York was dominated by Tammany Hall Boss, William Marcy Tweed, who was the head of the democratic political machine. (Derrick, 2001, p. 27) Tweed owned a large share of interests in the numerous Horse car and Omnibus lines, (Smith, 2000, p. 22) from which he successfully extracted a large tribute. Once the first rapid transit proposals started being developed, he started to develop plans for the development of a rapid transit line that he could control himself. (Derrick, 2001, p. 27)

Tweed’s involvement in the Rapid Transit field is crucial for two reasons. Firstly he managed to convince many conservative New Yorkers that the City Government should have nothing to do with the financing, construction, or operation of rapid transit. (Derrick, 2001, p. 28) This attitude towards rapid transit development would turn out to create great difficulties for the financing and development of proposals in the years to come.

Secondly Tweed made a monstrous rapid transit proposal of his own, in the wake of which he planned to eliminate all the competition, including Harvey’s already existing elevated railway. He planned to construct a masonry viaduct, going through the middle of blocks from lower Manhattan up the East side to the Harlem River and up the West Side to Spuyten Duyvil, on which he would operate steam trains. (Derrick, 2001, p. 28)

Tweed managed to get the support of several renowned businessmen, who all bought stocks in Tweeds Railway Company and in 1871 his scheme was approved by the Legislature. The bill for his proposal didn’t specify through or on which street the viaduct was to go, thereby enabling Tweed to block any other transit proposal. On top of that he managed to persuade Governor Hoffman to veto a bill that allowed Alfred E. Beach to construct a subway and he tried to introduce a bill that approved the removal of Harvey’s elevated structure, on the allegation it was a safety hazard. (Derrick, 2001, p. 28) This last bill was vetoed by State Senator Erastus Corning, for whom Harvey had once worked. (Smith, 2000, p. 23)
Image 16: (Left Page) ‘The Ninth Avenue Elevated’
This image shows the Ninth Avenue elevated in its original state. At this point it was not a structure that inspired much confidence. This picture was taken looking north up Gansevoort Street in 1876.
Source: “New York 1880; Architecture and Urbanism in the Gilded Age”; Stern, Mellins and Fishman, 1999

Image 17: (Right page): ‘The Elevated lines of Manhattan’
Original track map and route schedule by the Manhattan Railway company.
Original name & source: Map and guide of the elevated railroads of New York City 1881 by Latimer, H. I.
Source: http://www.learn.columbia.edu/newyork/maps/jpg/el_rail_1881_rr004540.jpg; Columbia University, Department of Art History and Archeology, 2002
Image 18: ‘The Ninth Avenue Elevated rebuilt’ Image showing the Ninth Avenue Elevated on Greenwich Street, at Fulton Street in Lower Manhattan, on August 2nd, 1914. At this point the whole line had been refurbished. It would remain in service in this state until 1940.


Source: “Tunneling to the future, the story of the great subway expansion that saved New York”; Derrick, 2001
In 1871, the Tweed ring was discredited after the exposure of corrupt practices. This also led to the abandonment of the viaduct plan. (Derrick, 2001, p. 28) The downfall of Tweed freed the way for new Rapid Transit proposals, but the Depression of the early 1870s made it difficult to raise any capital, and most schemes were soon abandoned. (Derrick, 2001, p. 29)

The Husted Act and the Rapid Transit Commission:

After the depression of the 1870s, The Gilbert Elevated Company, which had come under new management, as well as The New York Elevated wanted to build new routes as soon as possible. In order to do so they needed State Legislature. (Hood, 2004, p. 50) The conservative businessmen, now governing New York, believed that the cheapest and most certain way of obtaining new rapid transit lines, was to construct elevated railroads with private funding. (Derrick, 2001, p. 29) These business leaders pushed for a general law to establish a procedure for the planning and implementation of Rapid Transit lines without the direct involvement of State Legislature. (Hood, 2004, p. 50) (Derrick, 2001, p. 29)

Based on their rallying, the Husted Act, which set the standard for rapid transit development for the coming two decades, was passed by the State Legislature in 1875. (Hood, 2004, p. 50) The Act gave the mayor of New York City the authority to appoint a five-man rapid transit commission, allowed to lay out routes and assign franchise to private operators to build, equip and operate the rapid transit facilities. (Hood, 2004, p. 50) The act limited government involvement to a bare minimum, from now on only deciding whether or not to approve a proposal. Once lines were constructed and in operation the commission had to go out of existence. (Hood, 2004, p. 51) (Derrick, 2001, p. 29)

On July 1st, 1875, the Rapid Transit Commission was formed and approved construction of four elevated lines two months later. The Gilbert Elevated now renamed: 'Metropolitan Elevated Railway', was to build two lines along 2nd and 3rd Avenue and the New York Elevated, already operating the 9th Avenue El, was to build a new line along 6th Avenue. (Hood, 2004, p. 51) (See: Image 17: The elevated lines of Manhattan)

Building the Els and The Manhattan Elevated Railway Company:

The New York Elevated Company was bought out in 1876 by Cyrus Field (Boberick, 1982, p. 201) and Simeon Church. They firstly pushed the 9th Avenue line northward to 53rd Street (Smith, 2000, p. 29) and in 1877 extended it to 61st Street and rebuilt the line completely as a two track, also doubling the fare to ten cents. (Boberick, 1982, p. 201) (See: Image 18: The Ninth Avenue Elevated rebuilt) The ninth avenue El had opened up the hard to reach areas beyond 42nd street for development. The at that time still rural mid-section of Manhattan was being transformed very fast as housing units were built, where there used to be only open spaces and business blossomed up and down the line. (See: Image 19: West Seventy-Third Street in 1880) While the West Side of northern Manhattan started to flourish, little changed for the underdeveloped and hard to reach suburban east side. (Smith, 2000, p. 29)

After both elevated companies began construction on the 6th and 3rd Avenue lines (Smith, 2000, p. 30), the prospect of elevated steam driven railways running through the streets of the city aroused a quite frantic opposition. (Boberick, 1982, p. 205) There was protest in various forms and throughout various media, ranging from illustrations of the El's horrors displayed in shop windows, to manifestos by different doctors warning for all the terrible diseases the El would bring about. (Boberick, 1982, p. 205) Especially for the owners of horse car companies in the direct vicinity of the Elevated lines, who faced the prospect of immediate extinction and the owner of contiguous shops in fear of the loss of value of their properties, the El posed a direct treat. In 1876 these two joined forces and took the two elevated companies to court, hoping to have the Husted Act declared unconstitutional. (Smith, 2000, p. 30)

After a year's delay, in November of 1877, the court ruled in favors of the elevated companies, removing all legal obstacles for construction. After this, both companies swiftly developed the rest of the badly needed city wide rapid transit system, running along the length of Manhattan on four iron bridges. The New 6th Avenue El was opened first on June 5th, 1878. This particular El didn't open up any new areas for economic development. According to Smith: "...It instead enhanced real-estate values for pre-existing businesses along the West Side by making it possible for an even greater number of people to be transported to and from Manhattan's central business district. It was a feeder route for the 9th Avenue El; easing congestion on that line while it was expanded north to 155th Street..." (Smith, 2000, p. 31)

In January 1878, the 3rd Avenue El was opened. This Line had a similar effect on the East Side of Manhattan as the 9th Avenue El had on the West Side. Until the end of the 1870s the Upper East Side had retained a rural feel, including rolling hills, open meadows and rambling brooks. (Smith, 2000, p. 31) (See: Image 20: The once rural Upper East Side) As soon as the elevated line appeared, construction started up and down the line, in this case mainly tenements to accommodate for the overspill of people from the Lower East Side. (See: Image 21: Tenement buildings) The number of people and the increase of traffic were so big that the 2nd avenue El soon became a necessity. (Smith, 2000, p. 32)

On September 1st, 1879, The Metropolitan and New York elevated lines were unified into a single large company, called 'The Manhattan Elevated,' under management of Jay Gould. This was primarily a lucrative exchange of stock, since the principals of all these three companies had been primarily the same since the passage of the Husted Act. (Boberick,
Image 19: ‘West Seventy-third Street in 1880’

Image shows W. 73th Street in between the 8th and 9th Avenue. The 9th Avenue elevated can be seen in the back. This area is starting to be developed as a sort of suburban refuge for the affluent.

Source: “New York 1880; Architecture and Urbanism in the Gilded Age”; Stern, Mellins and Fishman, 1999
Image 20: ‘The once rural upper East-Side’

Image showing a shanty town on 5th Avenue, around 90th Street. Around 1880, the Upper East Side still had a rural feel.

A ‘new law’ tenement, designed according to the 1879 amendment, that created the first rules for building apartments. Two-thirds of the city’s inhabitants lived in this type of buildings. This particular building 338 Cherry Street of 1887. Picture was taken in 1929.

Source: “New York 1880; Architecture and Urbanism in the Gilded Age”; Stern, Mellins and Fishman, 1999
1982, p. 208) The combined companies completed the 2nd Avenue El in 1880. The Second Avenue El operated from Chatham Square to 129th Street. The 2nd and 3rd Avenue Els ran parallel for over 100 blocks and both carried people from the Lower East Side slums into the new tenement neighborhoods up north. (Smith, 2000, p. 32) By 1880 the Elevated’s had reached the northern boundary of Manhattan Island at the Harlem River. (Derrick, 2001, p. 30)

**Towards a greater New York; Opening of the Brooklyn Bridge and ‘annexation’ of the Bronx**

On May 24th, 1883, the first bridge over the East River was opened: Brooklyn Bridge. After Fourteen years of planning and construction this was the first physical connection between the Island of Manhattan and the surrounding areas, ending its geographical isolation. (Smith, 2000, p. 33) The bridge was designed by John A. Roebling and Washington Roebling and was the longest suspension bridge in the world. (Stern, Mellins, & Fishman, 1999, p. 110) As it was put by the New York Times at the time: “...Is not only a bridge across the river, but almost equivalent to a bridge from City Hall to City Hall...” (Stern, Mellins, & Fishman, 1999, p. 117)

On the bridge there was a cable car, designed to handle the 37,000 daily commuters, who were now enabled to cross from Manhattan to Brooklyn in only five minutes. Although The New York Times at first feared that the bridge would mean the downfall and depopulation of Manhattan, the number of inhabitants in both Brooklyn and Manhattan kept growing fast. In ten years time Brooklyn went from 599,495 to 838,547 and Manhattan from 1,164,673 to 1,441,216 inhabitants. (Stern, Mellins, & Fishman, 1999, p. 120)

In Brooklyn, the development of Rapid Transit had been similarly problematic like Manhattan. Battles of financing and political infighting had delayed the early efforts of building a system here too. (Derrick, 2001, p. 30) On May 13th, 1885, the first elevated line was opened in Brooklyn: The Lexington Avenue line. (Smith, 2000, p. 34) The Brooklyn Elevated’s were born out of necessity, just like those in Manhattan. Especially after the opening of the Brooklyn Bridge the dispersal of commuters through the city had become increasingly difficult, as Omnibus and Horse car networks couldn’t handle the demand. Although Brooklyn did have some ‘mini’ railroads to resorts like Sea Beach and Coney Island, these didn’t prove to be of much help, since they weren’t geared towards daily commuting needs. (Smith, 2000, p. 35)

In Brooklyn, Rapid Transit development went much faster than in Manhattan. As soon as the Brooklynites realize that one line wouldn’t fulfill the commuter’s needs, more lines were started. (Smith, 2000, p. 35) From the east river terminal, soon three mayor lines fanned out across the city. (Smith, 2000, p. 35) These lines were located along Fulton Street, Myrtle Avenue and Lexington Avenue. An additional line went south along Fifth and Third Avenue to 65th Street. (Derrick, 2001, p. 32) In 1887 the Brooklyn Broadway Elevated was opened, towards Broadway ferry, this line was extended to the west in 1888 to reach the ferry and in 1893 northeast to reach the Brooklyn-Queens border in Cypress Hills. (Smith, 2000, p. 36)

When the Brooklyn elevated’s were built, most buildings surrounding them were wood-framed structures, mostly single family houses and private homes with front and back yards and picket fences. (Smith, 2000, p. 36) Along the routes of the elevated’s, soon tenement houses were erected, proving that urbanization was really about packing as much people in as little space as possible. Open spaces were replaced by multi-family dwellings to accommodate the growing populace. Along the lines, the first floors were almost invariably devoted to businesses and shops, creating vibrant communities. (Smith, 2000, p. 37)

At the turn of the century, the Brooklyn Elevated’s were second in size and scope only to those of New York. (Smith, 2000, p. 38) Several lines of the southern Brooklyn Els passed over the Brooklyn Bridge where one could transfer to the Manhattan Els paying another fare. (Derrick, 2001, p. 32) This was the start of a combined rapid transit network for the whole New York metropolitan region.

Another step towards the unification of a greater New York Metropolitan Region by means of Rapid Transit was the development of an elevated line in the Bronx by the Suburban Rapid Transit Company in 1886. (Derrick, 2001, p. 30) Service went from a new station at 129th Street and Second Avenue, across the river to 133rd Street and Willis Avenue in the “annexed district”. (Stern, Mellins, & Fishman, 1999, p. 77) The Bronx was now connected to Manhattan and became another suburb to accommodate for the overspill of people from lower Manhattan. Three years before it would officially be annexed by New York City. (Smith, 2000, p. 39)

At this point, New York City already had the largest mass transit system in the world, with more total mileage than London had at that time. (Hood, 2004, p. 55) The New Yorkers averaged three hundred mass transit trips each year per person. (Hood, 2004, p. 55) The Manhattan Railway Company carried 184 million passengers a year and the second largest, the Brooklyn Rapid Transit Company (BRT), 58 Million a year, representing about 850,000 riders a day. (Derrick, 2001, p. 32)

**The effects and flaws of the ‘Largest Rapid Transit System in the World’**

The development of the elevated, both in Manhattan and Brooklyn, opened up new land for settlement and stimulated a construction boom north of 42nd Street in Manhattan and the outlying sections of Brooklyn. The urban growth on the Island on Manhattan was uneven and incomplete; most of the vacant lots on the Upper East Side were built up by 1890. On the other hand, the Upper West Side and Harlem remained largely vacant.
Map of the northern part of New York in 1888. This map clearly shows the build up area around that time and the start of new neighborhoods around the elevated lines.

Although the new lines helped to open up new areas for New York’s booming population, the amount of land was never sufficient to create much better living conditions. Tenement houses or attached row houses formed most of the developments. (Derrick, 2001, p. 32) Although some people were enabled to move to less congested districts, most old neighborhoods still increased in population density; on top of that some of the newly developed districts became equally overcrowded, like East Harlem for example. (Derrick, 2001, p. 32)

After all, the elevated railroads did not live up to the expectations New York City had of a Rapid Transit system, for three main reasons. Firstly, it didn’t bring speed and comfort to the commuting traveler. The elevated system lacked the carrying capacity and the speed that was demanded by the rapid population growth. Very soon the demand became so high that the system became as overcrowded as the horse cars and omnibuses were before. Expanding the system proved to be difficult, due to space limitations. Especially in lower Manhattan, the creation of elevated lines and storage yards was out of the question. (Hood, 2004, p. 55) This immediately influenced public opinion about the elevated and complaints became frequent that New York had hardly advanced from the old days when there were only horse cars (Boberick, 1982, p. 210) and that the city had ruined her broad streets to no gain. (Boberick, 1982, p. 211)

Secondly, the elevated didn’t open up the countryside to the poor, relieving the pressure on the older neighborhoods of lower Manhattan. (Boberick, 1982, p. 209) The trains didn’t provide a connection that was easy and fast enough to enable enough people to move up north. Above 59th Street a lot of land remained undeveloped (Hood, 2004, p. 55) and in the lower regions tenement housing started to move northward up to central park. (Boberick, 1982, p. 209) The population of the city during the end of 19th century grew faster than the means of dispersing it, because they simply ran out of space. (Boberick, 1982, p. 210) The only way that the coming of the elevated could have brought urban redemption was if it would have been the other way around. Essentially: “...The Els helped the city transform into a larger version of itself and were soon overcrowded in their own right...” (Boberick, 1982, p. 210)

Thirdly, they created an environmental hazard, by being filthy and noisy, by blocking the sunlight from the streets and dropping cinders, ashes, oil, water and metal scraps onto the sidewalks. (Hood, 2004, p. 54) The original fears many New Yorkers had for the Els in retrospect turned out to be true. In 1890 John J. Derry, a Philadelphia engineer summed up the impact of the Els on New York: “...The El system obstructs light, privacy and air; is a nuisance from constant noise and drippings from the structure in inclement weather; the traffic is delayed by fogs, windstorms, snow, slippery rails and fires; it practically absorbs a street for structure and the cars and engines pass within 8 to 12 feet of house lines; it is a nuisance from cinders, smoke and dripping grease, produces injury to the eyes of pedestrians from constant falling of steel fillings from the grinding of car-wheels on rails, obliterated each street section were the stations are located; and the length of the train and capacity can never be extended beyond the limit of the strength of the structure...” (Boberick, 1982, p. 211)

Essentially, New York City needed a further development of its transit system, in order to cope with the ever increasing demand and deal with the still augmenting pressure on the rundown neighborhoods through overpopulation. Although the population had now started to spread up north, it still couldn’t disperse far enough in order to make living conditions agreeable for everyone.
Image 23: (Top left) ‘Exhibition at the Armory Hall’
Shows the working 1 to 1 scale model that Beach built for the Exhibition in order to win people over for pneumatic powered underground transport of people.


Source: “Subway City; Riding the trains, reading New York”; Brooks, 1997

Image 24: (Middle right) ‘The Beach underground Railway’
Engraving of the tunnel build by Beach underneath Broadway to test his means of propulsion and to win investors over for the support of his company.

Source: “Subway City; Riding the trains, reading New York”; Brooks, 1997

Image 25: (Bottom left) ‘The Arcade Railway’
Engraving of the proposal by Smith for his promenade and railway underneath Broadway.

Original source: Harper’s Weekly, March 19th, 1884

Source: “Subway City; Riding the trains, reading New York”; Brooks, 1997
3. Tunneling towards the future (1891-1913); The development of New York City's first subways

**Developing a solution to the transit problem: the Subway:**

By the mid 1880s it had become apparent that the elevated railroads weren't going to solve New York's transit problems. Overcrowding and congestion in the meantime had risen to an incredible level and the elevated lines were jammed to capacity. (Derrick, 2001, p. 33) An 1888 speech by Major Abram S. Hewitt before the Board of Aldermen, proposing a subway, reinigorated the city's interest to develop an underground Rapid Transit solution. (Cheape, 1980, p. 73)

The development of several technological advances, made it possible to really start considering the development of an underground solution. The most important one being the electric traction motor; this permitted safer and more efficient operation of subway trains, without problematic exhaust. The first electrical railway in the world was exhibited in 1879 in Berlin by Dr. Werner von Siemens. On December 18th, 1890, the first subway train using electrical power was introduced in London. (Derrick, 2001, p. 33) The First electrical trains in the United States were developed in 1879, by Frank J. Sprague, for the Chicago loop railroad. Electric propulsion promised speeds of up to 30 miles per hour, which meant a subway train would be able to transport people living 8 to 12 miles from lower Manhattan there in 45 minutes or less, including frequent stops. (Derrick, 2001, p. 33)

**Early proposals for a subway:**

After the passage of the Husted act in 1875 and the formation of a Rapid transit committee soon afterwards, the proposals for the development of a subway were numerous. Most of these proposals weren't developed any further and fell short of being built, in a lot of cases because of a lack of financial backing. Underground proposals had played an important role in the development of the rapid transit discussion from the start and some of them came really close to actually being built, already before there was a development of an elevated system.

The first to propose an underground rapid transit solution was Hugh Wilson in 1864. Wilson, who had witnessed the opening of the Metropolitan Railway in London, proposed an entirely covered twelve mile stretch of track. Lacking a better means of propulsion, Wilson proposed to use steam engine. In order to deal with the exhaust he proposed to use pipes carrying the air onto surface level and then release it through hollow cast-iron lamppost, placed at 100 feet intervals. (Brooks, 1997, p. 18) In the end Wilson's proposal was delayed when Alfred Craven, the engineer of the Croton Aqueduct, feared that the underground railway would damage the water pipes, which were also underneath Broadway. Although Craven reversed himself in 1866, Wilson already faced fierce competition from two other subway proposals. (Brooks, 1997, p. 20)

The first competitor was Alfred Ely Beach. An important advantage Beach had to his opponent was the fact that he was a publicist, as well as inventor and Rapid Transit promoter. In 1846 he had purchased the small magazine, called: 'The People's Journal' and renamed it 'The Scientific American'. This soon became America's most popular periodical for science and engineering and many Rapid Transit proposals were firstly published through this magazine. (Brooks, 1997, p. 20)

Beach proposed to build a pneumatic tube for passenger transport. He hoped that a pneumatic propulsion system would go around the problems that were caused by steam engines and as such the city would embrace it as the favorable alternative. (Brooks, 1997, p. 20) In fear of opposition by Tammany Hall boss Tweed, Beach never revealed to the public he was looking to build a passenger railway. (Derrick, 2001, p. 27) He instead proposed to construct a pneumatic railway to transport packages and in 1866 he got permission by the Legislature to do so.

In 1867 he presented his real intention was to transport people in on exhibition in Armory Hall at 14th Street. (See: Image 23: Exhibition at the Armory Hall) In this exhibition he actually set up a working 1 to 1 model of his pneumatic railway. Although the Legislation he’d received only allowed a pneumatic dispatch for packets, he secretly built a tunnel, nine feet in diameter and 312 feet long, designed to transport people. (Brooks, 1997, p. 21) (See: Image 24: The Beach underground Railway) Beach got a lot of New Yorkers to try his pneumatic tunnel and meanwhile he got important architects and engineers to write him statements of support that the large buildings of Broadway weren’t endangered by his structure. (Brooks, 1997, p. 22 & 23) Beach managed to pass a bill granting the construction of his actual proposal in 1873, after being vetoed of twice. By then the depression had already begun, which made it impossible for Beach to raise enough capital. (Brooks, 1997, p. 27)

The other competitor to Wilson's scheme was Melville C. Smith, who proposed a second street underneath Broadway in 1866. (Brooks, 1997, p. 27) (See: Image 25: The Arcade Railway) There were to be shopping windows and wide sidewalks, naturally illuminated from above through light wells. In the middle of the arcade would be four tracks with local and express trains drawn by steam locomotives. (Brooks, 1997, p. 27) Despite of the support he received for his scheme, Smith campaigned for nearly two decades, but never got legislation to build his proposal. Four times it was vetoed by New York governors.

According to the New York Times: "...Off all the numerous schemes of rapid transit that have been organized, flourished for a season, and eventually made shipwreck on the rugged reefs of the law, the New York Arcade Railway came nearest to practical fruition and enjoyed the greatest share of public favor and confidence..." (Brooks, 1997, p. 30)
During the 1860s and 70s, there were numerous other proposals for underground transit, several of which got approved by State Legislature. None of these proposals every made it to completion, due to political and financial difficulties. Either they were opposed by Tammany hall Boss Tweed, who was trying to build his own rapid transit scheme, or the failed to raise capital, in most cases due to the depression on 1973. (Derrick, 2001, p. 27) A good example of this is the New York City Central Underground Railway Company, which was given permission to build a subway up Fourth Avenue and Madison Avenue in 1868, but failed to raise money, although several renowned businessmen were involved in the company. (Interborough Rapid Transit, 1991, p. 15) due to opposition by boss Tweed. (Derrick, 2001, p. 27)

**Abram S. Hewitt and the Rapid Transit Act:**

The first step towards the actual development of the subway was made by Abram S. Hewitt, popularly referred to as the father of modern Rapid Transit in New York City. (Cudahy, 1995, p. 19) On multiple occasions he stressed the importance of Rapid Transit and he especially urged municipal ownership. (Interborough Rapid Transit, 1991, p. 16) In 1887 Abram S. Hewitt became the major of New York City.

A great leap forward came, when the Rapid Transit Act was signed by Governor David B. Hill on January 31st of 1891. (Hood, 2004, p. 56) In the tradition of the 1875 Husted Act, this act provided that a board of five rapid transit commissioners were to develop general plans and routes for an underground railroad, obtain the consent of local authorities and property owners or the Supreme Court and then auction the right to build and operate the railroad to a corporation. (Interborough Rapid Transit, 1904, p. 16) Again private capital was sought to develop the plans and run the system. Private ownership was widely regarded as the best way to keep the public treasury safe from corruption. (Hood, 2004, p. 56)

Under the act a new Rapid Transit Commission was formed, headed by William Steinway. (Hood, 2004, p. 57) This Commission issued a plan for a subway in October of 1891. There were to be two routes: One from South Ferry, up Broadway to the Bronx and one forking off at Union Square, up Madison Avenue and in to the Bronx as well. On December 29th, 1892, the commission tried to auction a 999-year franchise contract, but no serious bid was tendered. (Hood, 2004, p. 59) This was partly due to opposition from Jay Gould and Russel Sage, the owners of the Manhattan Railway Company. These two men hoped to force the Rapid Transit Board into accepting their own plans for expanding the elevated railway network. (Derrick, 2001, p. 34)

By early 1894, it was clear that private financing of the subway was highly unlikely. (Derrick, 2001, p. 35) Richard T. Wilson, a banker, tried to convince the New York City Chamber of Commerce to lobby for public investment in rapid transit. (Hood, 2004, p. 61) Here he found a willing audience. For the Chamber of Commerce the subway was an answer to two problems: Firstly, the need to gain an edge on other seaports. Secondly, a solution to Manhattan’s horrendous street traffic. (Hood, 2004, p. 62 & 63) At this point in time the density of traffic was becoming increasingly problematic, because the first skyscrapers that were being build spilled more and more people and traffic onto the streets, already "swollen beyond the bursting point." (Hood, 2004, p. 63)

Eventually Hewitt proposed a formula, where municipal funds would finance the building of the subway, but a private company would build and operate it. This would persuade the company to finish the building as soon as possible. (Derrick, 2001, p. 35 & 36) Since the chamber of commerce was highly weary of both the Municipal Government and the Tammany Hall bosses, they sought to invest themselves, the mercantile elite, with complete authority over the development of the subway. (Hood, 2004, p. 64 & 65) Therefore the bill proposed the installation of a new Rapid Transit Commission, in which five of eight seats were to be held by prominent members of the chamber of commerce. The rest of the positions could be filled by the commission itself, insulating it from government interference. (Derrick, 2001, p. 36) With the amendment of the Hewitt formula, Governor Roswell P. Flower signed the second version of the Rapid Transit Act into law on May 22nd, 1894. (Hood, 2004, p. 65) This act fundamentally changed the way Rapid Transit would be developed in the future. (Hood, 2004, p. 65 & 66)

**The Board of Rapid Transit Commissioners:**

The so-called 'Board of Rapid Transit Railroad Commissioners' or 'Rapid Transit Commission’ (RTC) was installed to replace the Steinway Commission soon after. (Derrick, 2001, p. 36) The new Board was to devise a general plan for new Rapid Transit lines. The Board’s first proposal, issued on February 16th, 1895 was almost identical to Steinway Government proposal. On May 22nd, 1896, the proposal was dismissed by the Supreme Court, which ruled that it didn’t live up to the statutory requirement that it would cost less than 50 million dollars. (Hood, 2004, p. 68)

In despair over this veto, the Board entered into negotiations with the Manhattan Railway Company for the construction of an elevated railway, in order to resolve the crisis. (Hood, 2004, p. 68) This led to a new proposal by William Steinway, who wanted to avoid having the Board making the same mistake as his commission. (Hood, 2004, p. 68) His proposition would go up east, from City Hall to Grand Central Terminal, across 42nd Street to Longacre Square to the west side, up Broadway to 96th Street, here dividing into two branches, one under Broadway to Harlem and eventually the Bronx, the other running up Lennox Avenue to Bronx Park. (See: Image 26: The first subways) This compromise was accepted by the Board on August 6th, 1896. (Hood, 2004, p. 68 & 69)
Image 2B: ‘Cut ’n’ Cover’

Construction of the subway on 64th Street and Broadway. This clearly shows the idea of the Cut and Cover method. First the street is removed, then a trench is dug out, the subway is constructed and afterwards the trench is covered up again.

Source: “The New York Subway; It’s construction and equipment”, Interborough Rapid Transit, 1904
The consolidation of Greater New York:

At this point, there was another major change, which would very much influence the development of New York City, as well as that of Rapid Transit in relation to the City. In the fall elections of 1897, Tammany Hall candidates took over the Municipal government, which meant the Democrats now ruled New York City. This delayed the development of the subway proposal, which had been developed by the Republic Mercantile Elite. More importantly, this Municipal Government decided for the Consolidation of the Greater New York Metropolitan Region. (Derrick, 2001, p. 38) This meant that, starting January 1st, 1898, New York City would be made up of five different boroughs, consolidated into one City, under one democratic Municipal Government. (Derrick, 2001, p. 38) From now on, not only Manhattan and the Annexed District, the Bronx, would be part of the City, but also the former city of Brooklyn and the Municipalities of Queens and Staten Island.

The consolidation had a dual effect on the development of Rapid Transit. Firstly, the Consolidation focused the public’s attention not on what was, but on what it could become. A lot of the most advanced urban theorists of that period believed that the subway would shape and stabilize the spaces of the new city, as it had the ability to both concentrate industry and disperse homes. (Brooks, 1997, p. 54) This vision also became the general public opinion, which paved the way for Legislation of new proposals. On the other hand, the Municipality of New York also acquired the large debts of Brooklyn, Queens and Staten Island in the Consolidation. This became a direct argument to halt subway development, since this would consume more of the city’s funds under the Rapid Transit Act. (Derrick, 2001, p. 39) The Municipality favored expansion of the Elevated, because the Tammany leaders were involved in the Manhattan Railroad Company and it wouldn’t have to cost the city money. (Derrick, 2001, p. 39) The Board, which had to approve of rapid transit expansion ad well, blocked this development, but in turn needed the Cities approval for its own propositions. (Derrick, 2001, p. 39)

August Belmont and Contract No. 1:

Eventually this status quo was broken open by the Municipal Government and by March 1898, the contract for the subway received final approval. (Derrick, 2001, p. 40) Soon after, the Rapid Transit Commission opened the bidding for its franchise. (Hood, 2004, p. 69) Finally, on January 15th of 1900, The Board received two bids, from capitalists willing to deal with the construction of the first subway lines. The Board accepted John B. McDonald’s bid on January 16th, being the low-bidder of the two. (Derrick, 2001, p. 41) Now the subway was finally going to be built.

Although McDonald was a renowned contractor, there was one big problem for McDonald in order to complete the contract: he didn’t have enough money for the required 7 million dollar bond deposit, to be deposited with the city comptroller, the city’s highest financial officer. (Hood, 2004, p. 70) He found August Belmont prepared to provide for the financial backing. He wasn’t a well known transit investor at that time, but did have a large fortune as a successful banker and head of his own investment house and American agent of the Rothschild houses of London and Paris. On February 21st, 1900, Belmont and McDonald signed what is called ‘Contract No.1’, to built, equip and operate New York’s subway for a period of 50 years, renewable with another 25 years. (Hood, 2004, p. 71)

The Rapid Transit Subway Construction Company: Building the Subway:

The Rapid Transit Subway Construction Company, which would build the subway, was formed immediately afterwards and by March 24th of 1900, ground was broken for the first subway. (Derrick, 2001, p. 41) Actual construction began on March 26th, according to the plans that were drawn up by William Barclay Parsons, the chief engineer of the Board of Rapid Transit Commissioners. (Hood, 2004, p. 84)

There were two main engineering difficulties that Parsons had to account for in the original plan. Firstly there was the choice of motive power for the Subway. (Hood, 2004, p. 79) At the time the plans for the first subway were developed, a technological revolution started to enter into the realm of Rapid Transit: electric propulsion, which eventually turned out to be the logical choice for the subway. (Hood, 2004, p. 79) But at the time of the first plans, electric traction was still in its infancy and Parsons could not be confident that this technology would be sufficient for the high-speed subway of North-America’s largest metropolis. (Hood, 2004, p. 81) In 1894, Parsons went for a survey of existing rapid transit systems in Europe, which was at the forefront of rapid transit operations. At this point, London had just opened its latest subway line: ‘The City and South London Railway’. This subway was the first to use electric propulsion. (Hood, 2004, p. 81) Although these subways were far from ideal, Parsons understood them as a gigantic step forward from London’s steam powered subways. Stations and Carriages were clean and well-ventilated and passengers didn’t ruin their clothes or inhale noxious fumes. Also this subway had lower fuel, repair and labor costs than the other London Railroads and suffered few mechanical breakdowns, proof enough for Parsons to choose electricity as motive power. (Hood, 2004, p. 82)

The second difficulty for the engineering of the subway was found in the difficult geological conditions of Manhattan. (Hood, 2004, p. 75) In 1891, Parsons had discovered, while drilling test holes for the Steinway commission, that the rock formations in the soil of Manhattan followed an odd U-shaped contour. At Whitehall Street in the Battery it came to 20 feet from the surface, dropped to a depth of 163 feet at Duane Street and remained there under Greenwich Village and climbed to 16 feet at 30th Street. (See: Image 27: Section of the geology of Manhattan) This had large consequences for the formation of the City, as well as the subway system. The rock formations coming close to the surface in Lower and Midtown Manhattan is what spawned the development of...
the two main business districts. This soil type enabled the building of the skyscrapers by being an excellent solid foundation. In the case of the subway it posed difficulties, since going through the different types of soil that were at the ‘regular’ depth for the subway would create a lot of engineering difficulties and also not deliver a stable construction. 

(Hood, 2004, p. 83) This gave Parsons two options: Either digging the subway at around 200 feet deep, where it would go through solid bedrock, but elevators, escalators and ventilators would be needed; Or to build the subway in 15 to 20 feet from the surface, where it would be above all the rock formations. This would mean that sewers, water pipes and electric cables would have to be removed and relocated elsewhere. Still, Parsons advised the method of staying close to the surface for the construction of the subway, mainly because using a cut ‘n’ cover method would be much cheaper and easier to build. (Hood, 2004, p. 83 & 84)

The actual construction of the subways was done almost entirely by hand. In 1900 building technology was very primitive and steam shovels and bulldozers were hardly available. Seventy-seven hundred workers, mainly Irish and Italian, dug the subway out of raw earth with hand tools, for a wage of 2 to 2.5 dollars a day. (Hood, 2004, p. 85) The cut and cover method (See: Image 28: Cut ‘n’ Cover) consisted of the following: The laborers would remove the surface of the street. Afterwards, the street was excavated to 15 or 20 feet, which would be easy in soft soil, but very hard in the rock sections above 10th street, where drills and dynamite needed to be used. The workers had to shore up the existing buildings, go around underground storages and relocate sewers and utilities. In the trench a structural framework of steel and concrete would be erected, which would house all the subway’s equipment and carry the weight of the street. This method could only be used on 52% of the total length. Due to Manhattan’s hilly topography a wide variety of structures needed to be used, in order to keep the tracks at grade. Viaducts (See: Image 29: Manhattan Bridge) and rock tunnels (See: Image 30: Central Park Tunnel) needed to be used on large sections of the lines as well. (Hood, 2004, p. 86) The bedrock in Manhattan proved a treacherous opponent, because it was fairly inconsistent and incoherent. On top of that there were a lot of underground pools, springs and wells, whose water made the rock highly unstable. (Boberrick, 1982, p. 229) Especially the tunneling made a lot of casualties under the workers, either through accidents with the highly explosive dynamite or caving of the tunnel sections. (Hood, 2004, p. 86 to 90)

Eventually 54 workers and civilians died during the construction of the first subways. (Hood, 2004, p. 90)

The Interborough Rapid Transit Company and the first extension; Contract No 2:

In April 1902 the company that would operate the railway was formed: The Interborough Rapid Transit Company, or IRT. In the same year, the Board of Rapid Transit Commissioners already planned and developed an extension of the network, under the east river into Brooklyn, to connect the newly consolidated city, as an amendment to Rapid Transit Act. This route was to pass from near City Hall, under the East River to Flatbush Avenue and connect to The Long Island Railroad Company Terminal on Atlantic Avenue. The proposal received approval in 1901 and was opened up for auction under the same conditions as the previous contract. The extension of the original plan was also contracted and built by the Rapid Transit Subway Construction Company and to be operated by the IRT. (Interborough Rapid Transit, 1991, p. 21) In September 1902, the contract for the extension, now known as ‘Contract No.2’, was signed. (Derrick, 2001, p. 43)

On top of that, in January of 1903, the IRT acquired a 999-year lease of the Els from the Manhattan Railway Company, hereby assuring harmonious operation of the Els and the subway, including the Brooklyn extension. (Interborough Rapid Transit, 1991, p. 21) All the lines in the two contracts were completed between 1904 and 1908. The actual first segment of line opened between City Hall and 145th Street and Broadway on October 27th, 1904. (Derrick, 2001, p. 43)

The impact of the first subway on the Metropolis:

The Subway below, as well as above the surface was built to be a civic monument, not merely a pedestrian municipal service. It came to be seen as one of the main engineering achievements of the era and also had the aesthetics to go with this. The subway’s architects were Heins and LaFarge, who had also built America’s largest church, the Cathedral of St. John the Divine. (Hood, 2004, p. 93) These architects were known for their exotic, individualistic style, mirroring Walt Whitman’s most intimate poetry. (Stern, Mellins, & Fishman, 1999, p. 18) They made some of the subway stations works of art in themselves, the flagship station being City Hall with arches, leaded glass skylights and chandeliers. (Hood, 2004, p. 93) (See: Image 31: City Hall Station) Rafael Guastavino, a Spanish born architect assumed chief responsibility for this particular station and designed the arched, chapel-like track sections. (Boberrick, 1982, p. 262) All the stations were renowned for their tile mosaics, natural vault lighting and especially the ceramic bas-reliefs that depicted neighborhood themes. (Hood, 2004, p. 93)

Above the surface the IRT was equally attractive. A well known example is the McKim, Mead & White façade of the IRT powerhouse. (See: Image 32: The IRT Powerhouse) This building was made to resemble a classical temple paying homage to modern industry. Another notable feature was the glass kiosks covering stairs and exits. (See: Image 33: The subway kiosk) They soon became the IRT trademark structure, cleverly designed to enhance riders comfort and guide the traffic flows smoothly through separate lanes. (Hood, 2004, p. 94)
Image 30: (Left page) ‘Central Park Tunnel’
One of the tunnels that needed to be built in order to deal with the geography of Manhattan Island.

Source: “The New York Subway; its construction and equipment”, Interborough Rapid Transit, 1904

Image 31: (Right page) ‘City Hall Station’
The most elaborate station of the new line. It came to be seen as a civic monument. Although no longer in use, the station still exists, but is hardly accessible to the public.

Source: “The New York Subway; its construction and equipment”, Interborough Rapid Transit, 1904
Image 32: 'The IRT Powerhouse'
The Elaborate powerhouse for the IRT lines by McKim, Mead & White.

Source: "The New York Subway; it's construction and equipment", Interborough Rapid Transit, 1904
Subway Kiosk at Columbus Circle. The cast iron kiosks, the entries to the subway stations. These elaborate entrances became the trademark structures for the first subway lines.

Source: “The New York Subway: It’s construction and equipment”, Interborough Rapid Transit, 1904
Although the new subways didn’t open up vast amounts of lands for new residential developments, and did not provide a serious relief for the overcrowded housing situation, they did have a great impact on the urban development of Manhattan and the diminishing of congestion. The swift express service, provided by its four track build, brought vast reaches within easy travelling time of downtown. The advantage of higher speeds and accordingly shorter travelling times did spark of a gigantic construction boom that fundamentally altered neighborhoods and quickly build up empty areas to very high density. (Hood, 2004, p. 101) (Derrick, 2001, p. 45) In the wake of the subway especially the areas of Times Square, The Upper West Side and the Bronx entered into a new era. (Hood, 2004, p. 101)

Before 1904, Times Square, which was at that time still called Longacre Square, was one of New York’s most unpleasant neighborhoods. It housed horse related businesses and was full of prostitutes and thugs after dark. On the other hand it did already have good possibilities for development, being around the transport hub where Broadway, 7th Avenue and 42nd Street met. This had in the 1880s and 90s already attracted a few cultural establishments. With the coming of the IRT, Times Square became directly connected to the new rapid transit network, providing easy access to the neighborhood. This attracted the Hotel Astor, among New York’s largest and elaborate hotels and the Times Building, owned by newspaper publisher Adolph Ochs. Ochs convinced the city to rename the square and introduced the tradition of celebrating New Year on Times Square in 1905. (Hood, 2004, p. 102) On top of that a lot of theaters were attracted to Times Square and it became: “...a concentration of theatrical businesses in that one area the likes of which has never been seen in New York before...” according to the ‘Real Estate Record and Builders Guide’ of 1906 (Hood, 2004, p. 103) Hood describes it as follows: “…By the 1920s, Times Square had evolved into a spectacular entertainment district devoted to, rapid unceasing change as a form of pleasure. Times Square brought about the squalor and excitement of Coney Island’s amusement parks into the heart of the city…” (Hood, 2004, p. 104) The Subway made it possible for Times Square to become an entertainment center that never closed, where anything was always possible. (Hood, 2004, p. 105)

As late as 1900, the Upper West Side, which was in between 59th Street to 110th Street from Central Park to the Hudson River, was a sprawling, far from fully developed district. The densest development was around the 9th Avenue elevated, along Columbus Avenue. It grew rapidly between the 1880s and 90s, with upper-middle-class row houses along the streets and elegant apartment buildings along the avenues. (Hood, 2004, p. 105 & 106) (See: Image 22: ‘Northern New York in 1888’) When the subway arrived, a construction boom began. Between 1905 and 1913 the assessed value of the land above Amsterdam Avenue rose 33%. The main thoroughfares West end, Riverside Drive and Broadway, acquired distinctive personalities. West-end became a solidly middle-class avenue with huge multi-story apartment buildings. Riverside Drive became a luxurious and leisurely promenade, offering beautiful views over the Hudson, lined by fine apartment buildings with extremely luxurious apartments. (Hood, 2004, p. 107) Broadway soon became the main artery, big 10 to 14 story apartment buildings with elevators were erected, with ground floors full of retail. The Upper West Side became a densely populated, heavily built-up urban center. (Hood, 2004, p. 108) However, in Harlem along Lenox Avenue, where luxurious apartments were built in large numbers over a short time, a lot of vacant apartments appeared. These began to be rented to African-Americans and many were subdivided. Harlem became a major center of African-American life and culture.

In the Bronx, along the Lenox Avenue and Broadway branches, rapid and comprehensive urban development happened. (See: Image 34: The empty Bronx) In the words of Hood: “…The subway set off a wave of construction that engulfed both sections…” (Hood, 2004, p. 109) Very illustrative are the photographs of the 1910 street subdivisions laid out on the grass. (See: Image 35: The future streets arrive) In the Bronx an important role was played by speculators and most importantly by Charles T. Barney. Barney became a director for the IRT and organized a syndicate to buy land in Inwood and the Bronx, based on inside IRT knowledge. (Hood, 2004, p. 110) The builders who bought these plots encountered severe financial pressures to repay their loans and needed to construct and sell rapidly. Therefore they mostly developed tenement buildings, 6373 were erected from 1914 to 1904, making the Bronx synonymous with low-income housing. (Hood, 2004, p. 111) But the Bronx developments did do something to relief the slums a little, according to Hood: “…To working class New Yorkers who longed escape from Manhattan’s crowded slums, the Bronx represented a way station on the road to the middle class. Although the poorest could afford neither the time for commuting nor the rents, the Bronx was a possibility for most semiskilled and skilled workers…”(Hood, 2004, p. 111)

In some way the subway represented an indirect municipal subsidy to the private construction industry who built new housing and to low-income tenants who inhabited it. Due to its high speeds and capacity it opened up outlying sections of Manhattan and the Bronx to provide decent accommodations for some working class families. As the Real Estate Board has put it in ‘Apartment building construction in Manhattan, 1902-1953’: “...The subway’s enduring legacy was that the lives of New York’s poorer citizens became fuller and more productive...” (Hood, 2004, p. 112)
Image 36: ‘The Woolworth Building’

This building was opened in 1913 and was the tallest building in the world at that point. From the first decade of the 20th century, skyscrapers would start to become a common sight in New York. The only convenient way to transport all the people using these buildings to and from the Wall Street area was the subway.

Source: “Tunneling to the future, the story of the great subway expansion that saved New York”; Derrick, 2001
4. Finally far enough (1913 – 1932); The Dual contracts manage to relieve the pressure on the tenement districts

The need for expansion of the system:

After the development of the Contract no. 1 and no. 2 subways, the decision makers on New York’s Rapid Transit proved to be unable to provide the city with the transport system it needed. Although expansion became a large issue in the City’s politics, it took another ten years after the opening of the first subway, before an expansion of the system came into being. In the meantime the population of the city grew with about 100.000 people each year; (See: Appendix 2; Numerical Data: Population of Greater New York) most of the newcomers were poor and went to live in the old tenement districts in Manhattan and Brooklyn. This continuously increased the pressure on these neighborhoods. Only when public health and safety of the city became threatened by the poor living conditions in the tenement districts, the development of new transit lines to disperse the population was taken seriously. (Derrick, 2001, p. 46)

The day after the subway opened in October 1904, the New York Tribune announced: ‘The birth of the subway crush’. The Subway turned out to far more popular than anyone had anticipated and no matter how many trains the IRT put into service, the stations and trains remained packed to the last millimeter. Especially the express services turned out to be immensely popular. (Hood, 2004, p. 113) Instead of just extracting passengers from other means of transportation, the subway encouraged New Yorkers to travel more frequently. Between 1904 and 1914, the average number of rides per person, per year on public transport went from 274 to 343. (Hood, 2004, p. 114) In the same period annual ridership totals went from 384 million to 837 million passengers. (Derrick, 2001, p. 44) (See: Appendix 2; Numerical Data: Annual Ridership 1901-1998) The IRT tried to keep up with this grow rate by modifying the existing subway to hold more people. Platforms were lengthened to serve longer trains, cars were modified to have more entrances and signaling was adjusted to shorten the headway between the trains, so more trains could be run. (Hood, 2004, p. 114)

The problems of the subway were also aggravated by the behavior of the New Yorkers in public transportation. Their extraordinary individualistic behavior made the ride on the subway an unpleasant experience, especially during rush hours. New Yorkers felt little social pressure not to push and shove steal seats or cut in line. This often caused to the trains to run of schedule as they were delayed by passengers running amuck. (Hood, 2004, p. 115) On top of that, the subways were very socially diverse and one of the only public places where every kind of New Yorker mingled on a regular basis. Although some people believed that the city’s race and class differences might be resolved during rush hour, this melting pot phenomenon often exploded into confrontation between different ethnicities, classes and genders. (Hood, 2004, p. 117) Sexual harassment, for example, was very frequent on the crowded trains, this eventually lead to separate compartments for women on the trains. (Hood, 2004, p. 119) The shear unpleasantness of the crowded subways very soon led to strong call from businessmen and media alike that more subways had to be build to relieve ‘the subway crush’.

The Rapid Transit Commission was eager to develop new lines. Already in 1902, chief engineer Parsons was instructed to come up with: ‘a comprehensive scheme or plan of rapid transit for the whole city’. (Derrick, 2001, p. 49) This plan wasn’t meant to be developed immediately, but as soon as the city’s funds and private capital would permit. For Parsons, the main focus of the plan was to develop an integrated system that included the existing IRT and BRT lines, to create a system for the city as a whole. (Derrick, 2001, p. 50) This plan developed into a scheme including two types of lines, one to be developed by the IRT and one by a competing company, after the Metropolitan Railroad Company was found willing to compete with the IRT in 1904. (Hood, 2004, p. 121) The discussion about competition between rival rapid transit companies now started to become an important factor for the development of future Rapid Transit schemes. (Derrick, 2001, p. 53)

The IRT monopoly:

By 1905, the operation of the subways had proven to be a very lucrative business. (Cudahy, 1995, p. 35) A business August Belmont would rather keep to himself. He firmly opposed the building of new subways that were aimed at alleviating overcrowding. The crux to this opposition was that Belmont actually profited from this overcrowding: ‘Heavy traffic supplied more income for roughly the same capital and operating outlay; […], the profits are in the straps’. (Hood, 2004, p. 123)

Belmont particularly objected the 1905 proposal by the Rapid Transit Board. This plan didn’t restrict itself to built-up areas that would generate large numbers of passengers, but also included a lot of lightly traveled routes, creating a pressure on the revenues. (Hood, 2004, p. 123) Still he entered into negotiations with the Rapid Transit Commission, to hold off the actual development of proposed lines. (Hood, 2004, p. 124) Meanwhile, Thomas Fortune Ryan, the chairman of the Metropolitan railroad, entered into the negotiations with a different agenda. He actually never intended to really develop the lines that were proposed, but he wanted to force Belmont into a merger, by threatening with competition. He knew that the IRT was making a lot of money and its stocks were popular on Wall Street. (Derrick, 2001, p. 57) In December 1905, Belmont began to believe his company was threatened by the Metropolitan and agreed to the merger. He created a powerful new 220 million dollar holding company, under which both the Metropolitan and the IRT would continue to exist: ‘Interborough-Metropolitan. (Hood, 2004, p. 124)

An end to the mercantile elite:

The merger of the two companies took the Rapid transit commission and the public by surprise, whereas they though there was finally some competition in the field, the monopoly had just enlarged itself. The Commission lacked the power to do something about the new situation. (Hood, 2004, p. 124) There was no means by which they could force the company to negotiate building new subways. The commercial aristocracy
The Lower East Side knew many streets as congested as the one in this picture, Orchard Street (1898). This was the most congested district in the world at the time.

Source: “Tunneling to the future, the story of the great subway expansion that saved New York”; Derrick, 2001
that made up the Rapid Transit Commission was losing grip. (Hood, 2004, p. 125) The Commission was plunged into deep political trouble, as they failed to secured public interest. (Derrick, 2001, p. 61) By January 1906, the subway riders, real estate developers and urban reformers were demanding the abolition of the Rapid Transit Commission. (Hood, 2004, p. 126) The group that had the most influence in the political downfall of the Rapid Transit Commission was the ‘Progressives’. This was a movement that urged assimilation of immigrant workers in big city slums, sought to break organized corruption and counter the monopolies of big companies that dominated the economy. Urban Rapid Transit was one of the key issues of these reformers, as they believed it was an instrument in achieving two major goals: urban dispersal and anti-monopoly. (Hood, 2004, p. 127)

An important publication for the progressive movement was 1890’s ‘How the other half lives’, by Jacob Riis, in which the poor living conditions of lower-class workers living in the Five Points slum were exposed. It showed the city the unsanitary conditions, the absence of running water, overcrowding, infectious diseases, crime, pauperism and radicalism. Where the contract No.1 subways had had the unintended consequence of urban dispersal of poor immigrants, it was now made into a conscious priority by the progressive movement. The subway would help immigrants to settle in suburban towns, far from the poor living conditions in the Lower East Side, as exposed by Riis. (Hood, 2004, p. 127)

The progressives blamed the Rapid Transit Commission for letting the IRT and Belmont do whatever they want, to the extent that they now ‘govern’ the city. In order to avoid this kind of monopolies in the future, the progressive Citizens’ Union proposed the Elsberg Bill in 1903. This bill would separate construction and operation contracts for new subways and reduce the lease from 50 to 25 years and allow easier revocation of the contracts by the city. (Hood, 2004, p. 127) The Elsberg bill was quickly approved in reaction to the Interborough-Metropolitan merger, which undermined public confidence in the Rapid Transit Commission. (Hood, 2004, p. 130) Soon after, more and more progressives argued for tougher restrictions and wanted to dissolve the Commission and create a new authority with more power. (Hood, 2004, p. 131) This sentiment grew especially strong when the IRT kept on refusing to cooperate with new development plans that were put forward. (Derrick, 2001, p. 68)

The 1906 gubernatorial elections brought about a change for the politics of rapid transit development. Charles Evans Hughes was elected governor and soon after gave legislation to what is known as the ‘Page-Merrit Bill’, which created two regulatory commissions for the City and the State of New York to carry out the public interest in relation to all the public works. (Hood, 2004, p. 131) On July 7th 1907 the Public Service Commission for the First District (PSC) replaced the former Board of Rapid Transit Commissioners. (Derrick, 2001, p. 68) The Mercantile elite lost its power over Rapid Transit matters.

Besides this important political change, another important political alteration had taken place with the Consolidation of Greater New York. At that point the Board of Estimate and Apportionment was reinvigorated to have legislative authority over law-making, the City’s budget and franchises. (Hood, 2004, p. 142) On top of that, a 1900 law gave this Board the power to appropriate municipal resources for Rapid Transit and in 1905, also veto of the location of subway routes. (Hood, 2004, p. 142) This restructured and newly empowered authority became a key factor in subway politics.

**Augmenting social pressure:**

With the Consolidation, New York City took on its present boundaries, including the Bronx, Queens, Staten Island and the formerly independent city of Brooklyn. The population of the consolidated metropolis was growing rapidly. (Derrick, 2001, p. 92) (See: Appendix 2; Numerical Data: Population of Greater New York) The majority of people around 1910 lived in the densely populated corridors extending up to eight miles from city hall. Neighborhoods were either located at walking distance of job concentrations or organized as commuter suburbs around streetcar and elevated lines or the first subways. (Derrick, 2001, p. 94)

Most of the economic activity and jobs were located in the lower part of Manhattan. New York continued to serve as the nation’s premier port, with all related functions crowding the shorelines of the east river in Lower Manhattan and Brooklyn and the Hudson River on the West Side up to 59th Street. Next to that, New York remained to be the dominant financial center. This created major centers of business and white collar jobs around Wall Street in Lower Manhattan and around Midtown, one third of the city’s jobs in total. Between 1900 and 1910 the first of the city’s skyscrapers were started to be build, to accommodate the required office space. (See Image 36: The Woolworth Building) And to complete the congestion, 321,000 of the 593,000 factory jobs in the city were still located south of 14th Street, in so-called lofts, all the way down to Wall Street. This was the densest concentration of factory jobs in the world. (Derrick, 2001, p. 93 & 94)

100,000 new residents were added each year, many of which were poor and relatively unskilled. This forced them to take the lowest level jobs and live in the worst kind of housing. (Derrick, 2001, p. 93) These people would find shelter in the districts with the poorest living conditions, mainly concentrated in Lower Manhattan (East & Central Harlem, Greenwich Village, Hells Kitchen and the Lower East Side) and in some parts of Brooklyn, where there were good connections to the Island of Manhattan. (Williamsburg, Bushwick and Brownsville)

The most famous and problematic area was the Lower East Side, where the population density would exceed 600 persons per acre in several sections. This area was only two square miles in size, less than a half percent of the city’s total area; it contained 15
Many of the tenements contained workshops, in which small companies were making all kinds of products. Especially the garment industry did this a lot. This particular one is on Ludlow Street in the Lower East Side. The picture was originally taken by Jacob Riis for his book: “How the other half lives”.

Source: “Tunneling to the future, the story of the great subway expansion that saved New York”; Derrick, 2001
percent of the population. In contrast, the districts more than eight miles from city hall had densities below 10 persons per acre, contained 73 percent of the city’s land and 18 percent of the population. (Derrick, 2001, p. 95 & 96) (See: Image 37: Lower East Side Living Conditions) The Lower East side and other poor areas consisted mostly of tenement buildings; mostly brick four to six story buildings, containing four apartments on each floor, with no natural lighting and ventilation to most of the rooms. The tenements usually contained a hundred to a hundred and fifty residents per building and on top of that many of these very small apartments were workshops. (Derrick, 2001, p. 97) (See: Image 38: Tenement workshop)

In 1879 the tenement House act was passed to improve housing conditions. From now windows for each room and an indoor toilet for every 20 residents were required. These new requirements were met by two toilets for each floor and an airshaft along each interior side of the building. The airshafts proofed to be of little to no use, supplying only foul air and darkness, instead of fresh air and sunlight. (Derrick, 2001, p. 98) When the continuously poor conditions were exposed by progressive reformers, increasing public concern was raised about the ‘congestion of population’. (Derrick, 2001, p. 101) Especially with the ‘indirect consequences of congestion’: the high rates of disease, epidemic, crime, violence and social dislocation, making the situation even worse. (Derrick, 2001, p. 100)

Although awareness was increasing by means of publications, like Jacob Riis his ‘How the other half lives’, it proved to be difficult to alleviate the conditions in the shuns. (Derrick, 2001, p. 106) Public health measures, education and housing reform, did not stop new people from moving into the old tenements, nor did they relieve existing overcrowding. According to popular opinion in 1910, the most feasible solution to the congestion problem was a massive expansion of rapid transit. The theoretical base for this perspective was created by Charles Cooley in 1894, in his article: ‘The Theory of Transportation’. He put forward the idea that “…transportation underlies social development and is at the same time determined by that development…” (Derrick, 2001, p. 107) He stated that people needed cheap and efficient rapid transit to enable them to move to suburban areas but continue to work in the center of the city. According to his theory, transit planning needed a comprehensive plan and unifying methods, and therefore had to be done by a public body, for the good of society as a whole. (Derrick, 2001, p. 108) This attitude marked a fundamental change and paved the way for new proposals to be developed as soon as these ideas became common ground.

Towards a solution:

Between 1900 and 1910, all kinds of efforts were made to move people out of Manhattan and into the outer boroughs. In the eyes of a lot of reformers, developing public works that connected Manhattan Island to the rest of the city were of crucial importance. The first to actually be completed after the first subways were opened, were the Williamsburg Bridge in 1903 and the Queensboro and Manhattan Bridges in 1909. Immediately after they opened, new neighborhoods started to form around their ramps. (Hood, 2004, p. 136)

The Public Service Commission put forward plans for a new subway in May 1908, six months after the commission was established: The Triborough system. (Derrick, 2001, p. 88) It would comprise of three major routes, in Manhattan, the Bronx and Brooklyn, totaling 144 miles of track. The estimated costs of implementing the Triborough system were 150 million dollars. The system was especially designed to counter the monopoly of the IRT and relocate poor Manhattanites to the outskirts. (Hood, 2004, p. 136) (See: Image 39: The Triborough proposal) Originally this plan was designed by the former Rapid Transit Commission and part of the build was already on the way when the PSC came into office. (Hood, 2004, p. 137)

With the 1909 elections several key figures were put into office, which had ideas on Rapid Transit that aligned with those of the PSC. This made the prospects of reaching a solution for the subway very soon look very good. (Derrick, 2001, p. 88 & 89) The New Board of Estimate that went into office on January 1st, 1910, contained a few men who would play a decisive role in the development of future plans. Firstly, Manhattan Borough President George McAneny was a fierce advocate of subway development as a tool to combat congestion of population. Furthermore there were Comptroller William A. Prendergast and John Purroy Mitchel, who was a consistent opponent of the IRT’s proposals. The new major, William J. Gaynor, although being a democratic candidate, had also been a virulent attacker of the IRT monopoly. (Derrick, 2001, p. 123 & 124) Within the PSC the most important men were Chairman William R. Willcox and Commissioners Edward M. Bassett and Milo R. Maltbie. They wanted to build as many subway lines as possible to combat congestion. (Derrick, 2001, p. 124) All three of them favored a good subway design, which stimulated rational land development, distribution of population and traffic, without encroaching too much on the private market. (Hood, 2004, p. 139) (Derrick, 2001, p. 125)

The Triborough proposal did not completely satisfy the aims of the PSC. The aim of dispersing the population conflicted with the goal of competing with the IRT. Since the system needed to be independent, lines couldn’t be pushed too far into the outskirts, for they needed to be profitable. To many reformers this was a matter of priorities, with Belmont holding its monopoly, no subways were to be built anyway. (Hood, 2004, p. 139) Despite of large support from progressive organizations and neighborhoods along the routes, there were considerable factors of opposition: the conservative businessmen from the downtown area, united in the Chamber of Commerce. (Hood, 2004, p. 140)

Still, in January 1910, the Board of Estimate and the PSC went on to discuss the contracts for the development of the Triborough. All of a sudden, Major Gaynor changed his
Image 39: ‘The Triborough proposal’
Map showing the 1908 Triborough proposal by the PSC for the development of new subways. This plan was not built.

Source: “Tunneling to the future, the story of the great subway expansion that saved New York”; Derrick, 2001
Map showing the proposal of the IRT of December 1910, by which they intended to knock their opposition out of the running in order to maintain their monopoly position. This plan was also not build.

Source: "Tunneling to the future, the story of the great subway expansion that saved New York”; Derrick, 2001
Image 41: 'IRT Dual system proposal'

Map showing the actual lines that were built according to the 'Dual Contracts' in 1913 for the IRT branch.

Source: "Tunneling to the future, the story of the great subway expansion that saved New York"; Derrick, 2001
Image 42: “BRT Dual system proposal”
Map showing the actual lines that were build according to the ‘Dual Contracts’ in 1913 for the BRT branch.

Source: “Tunneling to the future, the story of the great subway expansion that saved New York”; Derrick, 2001
Map showing the Dual System as it was built up in the period from the signing of the contracts in 1913 to around 1920.

Source: "Tunneling to the future, the story of the great subway expansion that saved New York"; Derrick, 2001
mind in favor of an expansion of the IRT and opposed the Triborough system. (Hood, 2004, p. 144) (Derrick, 2001, p. 125) This did not affect the outcome of the vote and the Triborough contracts were approved in August 1910. On September 1st the contracts were advertised, one under private operation and funding and one under municipal funding. There turned out to be no bids under private funding, a hard setback. This made the Triborough developments come to a standstill. (Hood, 2004, p. 144 & 145)

In November 1910, William G. McAdoo, the president of the Hudson and Manhattan Railroad Company (H&M), developed a plan based on the Triborough plan linking to his company’s subways under the Hudson. (Hood, 2004, p. 145) This was picked up by the PSC immediately. Belmont took this proposal very seriously as well, seeing serious competition for the first time, he decided to knock the H&M out of the running. (Hood, 2004, p. 147 & 148) On December 5th, the IRT Chairman T.P. Shonts submitted a new proposal to the PSC, including two new subways connecting to the Contract No. 1 line. (See: Image 40: IRT December 1910 proposal) This proposal scared of the investors for H&M, leaving McAdoo short of funding. He withdrew his proposal on December 5th 1910. (Hood, 2004, p. 148 & 149)

Frustrated in their efforts, the PSC was willing to once again enter into negotiation with the IRT about expansion of the subway. (Derrick, 2001, p. 125) But as Major Gaynor still supported the IRT and Mitchel and Prendergast were still hoping for private construction of the Triborough, the Board of Estimate remained “deadlocked” for the rest of the year. (Hood, 2004, p. 150)

**Development of the Dual System:**

On January 10th, 1911, Edwin W. Winter of the Brooklyn Rapid Transit Company (BRT), proposed a plan for new subways to the PSC. Brooklyn had many commuters to Manhattan but the company had only one line that shuttled across the East River: the Brooklyn Bridge EL. Winter’s proposal was to take over the Fourth Avenue and Bridge loop subway, both of which were already under construction, to resolve this problem. (Hood, 2004, p. 151) At this point Manhattan Borough President George McAneny stepped forward to break the deadlock over subway development, with a completely new approach. (Derrick, 2001, p. 153) McAneny and several members on the PSC moved to restart the developments. They found support in the recommendations from the Commission on Congestion of Population, appointed in 1910 by Major Gaynor. This new committee recommended developing a long-range plan for rapid transit expansion, zoning and land use restrictions and the regulation of building heights and volumes, earlier on proposed by McAneny himself (Derrick, 2001, p. 154)

McAneny boldly proposed to combine the IRT and BRT proposals, in order to break the deadlock. And on January 19th 1911, the Board of Estimate decided to create a new transit committee, which would negotiate with the Public Service Committee, The Brooklyn Rapid Transit Company and the Interborough Rapid Transit Company, to develop new proposals for the subways. This marked a turning point in rapid transit development. (Hood, 2004, p. 154) (Derrick, 2001, p. 157) The Triborough system was now no longer being considered as an option. During the following months of negotiation, the idea was that the city would participate with either the IRT or BRT or both to extend New York’s system. (Derrick, 2001, p. 158)

The committee soon agreed with the PSC on the routes and financial terms they wanted to obtain from the IRT and BRT. Through March and April of 1911, the Committee negotiated with both transit companies separately, in order to see if the City could come to terms with them. The IRT came up with an additional development plan, which promised to open vast amounts of land in Queens for residential and commercial development. (See: Image 41: IRT Dual System proposal) The BRT planning acquired a more citywide focus, in which the key development was a main trunk line that would run up the spine of Manhattan from the Battery to Central Park South. (Hood, 2004, p. 155) (Derrick, 2001, p. 161) (See: Image 42: BRT Dual System proposal)

On June 13th 1911, the Transit Committee released the McAneny Report that outlined the structure for the new subways, which would become known as the Dual System. The report proposed the municipality to join forces with the IRT and BRT to build 87 miles of subway route, costing 249.4 million dollars in total. (Hood, 2004, p. 155) (Derrick, 2001, p. 174) The city would furnish 123 million dollars, the IRT 75.8 million and the BRT 50.4 million.

The report proposed several interesting financial constructions. Firstly there was the financial construction by which the subway’s gross revenues would be divided, in which everyone would get refunded his expenses first and the remainder of profits would be divided equally. This also included that, if the revenue was too small, the expenses would be repaid from the city’s tax income. Secondly there was the idea of ‘pooling’, which meant that the subways and els were made into one financial unit, pooling their receipts together, which gave the city a gigantic integrated system for the price of several subways. (Hood, 2004, p. 156) (Derrick, 2001, p. 156) Thirdly there was the ‘preferential’. This was an amount of money given to the BRT only, equal to the net profit the company was making the year before opening the new lines. This amount was meant to compensate the BRT for building new lines in outlying sections that would generate less passenger revenue. This would compensate the BRT for allowing business inefficiency in the name of the public good. Hereby the reformer’s goal of population dispersal could be accomplished. (Hood, 2004, p. 156)

Of course this turned out to be problematic in the approval of the report. August Belmont objected to the fact the IRT didn’t receive a preferential. (Derrick, 2001, p. 188 & 189)
DEAF, DUMB AND BLIND TO ALL EVIL

PUBLIC PLEDGES PRIVATELY REPUDIATED

BOROUGH PRES. M’ANENY:
“The city must be kept in the position where it can build its own subways for itself, and where its control of them will be absolutely undisputed. I can conceive of no contingency under which the city would or should be required to do differently.”

MAYOR GAYNOR:
“The city will build these subways. We do not intend that a single subway or a franchise for it shall be passed over to these men—Mr. Belmont and Mr. Ryan. They have got their clutches into the present subway. They now want to build these subways, and get them and do the same thing over with them. We say Never! Never!”

COMPTROLLER PRENDERGAST:
“Every benefit offered by the Interboro can be secured to the city by building of AN INDEPENDENT SUBWAY and the GREAT PRINCIPLE FOREVER ESTABLISHED that the citizens of New York SHALL CONTROL THEIR OWN PROPERTY.”
But in November of 1911 Belmont returned to the negotiation table, as he realized that his monopoly would end, regardless of his approval of the contracts. Belmont used his monopoly to get McAneny to grant the IRT a preferential as well, amounting to almost 9 percent of the total investment of the old and new subways. (Derrick, 2001, p. 198)

Of course, this spurred fierce protests from such reformers as John Purroy Mitchel and publisher William Randolph Hearst. (See: Image 44: Against the Dual Contracts) In spite of all the criticism that was raised in newspapers and politics against this concession the Board of Estimate approved the Dual System on May 24th of 1912. (Hood, 2004, p. 158)

(Derrick, 2001, p. 210)

On March 19th 1913, the officials of New York City and the IRT and BRT signed Contracts No.3 and No.4. (Hood, 2004, p. 158) By 1920, most of the lines would be in operation and the city would have the largest rapid transit system in the world totaling 619 miles of tracks. (Hood, 2004, p. 159) (Derrick, 2001, p. 231) Finally greater New York was unified, leaping across the east river, binding Manhattan and the Bronx and opening thousands of acres for new developments. (Hood, 2004, p. 160)

The impact of the Dual System and its creators:

With the completion of the contract there was provided for eight crossings of the East River, were there used to be only two. (Hood, 2004, p. 162) Hereby the dual system actually managed to relieve the congestion of population, developed by the rapid population growth at the beginning of the 20th Century. It was now made possible for middle-class and working-class families to move out of the overcrowded tenement districts. The new lines opened up so much land, that most of the neighborhoods that were built along them had a pleasant mix of apartment houses and single- and two-family homes, instead of tenement buildings. The net growth of population of the city from 1910 to 1940 almost completely took places in these new ‘subway suburbs’, while the population in the older congested areas decreased. (Derrick, 2001, p. 231) (See: Appendix 2; Numerical Data: Population change by district) On top of that, the Dual System lines also ensured the long-term vitality of Manhattan’s central business district. The lines enabled the employees, which filled in the increasing number of jobs, to easily commute from their home to their work. (Derrick, 2001, p. 232)

The number of travelers on the subway system increased rapidly when the new lines opened and actually the number of riders per mile of track would never again be as high as when the dual system had opened. In 1912, the IRT carried 303 million passengers, by 1926, it would carry 785 million, and the all-time high was reached in 1930 when it carried more than 986 people. The BRT carried 172 million in 1912, by 1926 it carried 621 million riders and in 1930 714 million people were carried, also never again equaled. In 1930 the total number of users was slightly above two billion. (Derrick, 2001, p. 233) (See: Appendix 2; Numerical Data: Annual Ridership 1901-1998)

For McAneny and his allies, the new rapid transit lines were a “…basis for city building…” (Derrick, 2001, p. 240), with which their primary goal was to disperse the population. But in order to be most effective in their urbanistic development scheme, they had to be: “…accompanied by other measures such as the creation of a city planning commission and the passage of zoning laws and building height restrictions…” (Derrick, 2001, p. 240) Interestingly, besides from developing the Dual Contract subways, McAneny and his fellow reformers managed to implement some of these influential measures as well. McAneny managed to develop a building code and the Zoning Law.

On February 27th 1913, the Commission of Building Heights was established by the Board of Estimate. (Derrick, 2001, p. 242) The commission was chaired by former member of the PSC, Edward M. Basset. In December 1913, they submitted a report that recommended an amendment that allowed to divide New York City into zones and to regulate the heights of buildings and the location of trades and industries. (Derrick, 2001, p. 242 & 243) On July 25th 1916, the Board of Estimate approved the new zoning law. The Law divided the city into three types of zones: residential, business and unrestricted areas, which were assumed to become industrial areas. On top of that it contained a building code, limiting the heights and volumes of buildings within each zone. This law would change building in New York City permanently, as it accomplish two major goals. Firstly, it forbade industrial functions to invade the housing districts, as had been the case in the tenement districts, and secondly it restricted commercial activity to designated streets. (Derrick, 2001, p. 243 & 244)

In combination with the Zoning resolution and the building code, the subways developed new residential districts, which were strongly horizontally organized. These horizontal city developments could be called ‘Subway Suburbs’, depending on the definition of suburb. (Derrick, 2001, p. 244) (See: Image 45: The Subway Suburb) After World War 1 especially, large areas of the Bronx, Brooklyn and Queens were build up with a mix of apartments, single- and two-family houses that allowed for low population densities and much more open space, grass and trees. These areas weren’t suburban by the popular American definition, as they were not completely dependent on cars and exclusively built up from single-family homes. But the residents themselves felt as if they were living in a suburban area, especially compared to the tenement districts of Manhattan and Brooklyn. (Derrick, 2001, p. 245)

The height of development of these areas was between 1910 and 1940. During this period, the composition of the city changed completely. (See: Appendix 2; Numerical Data: Population change by district) The newly developed areas were inhabited by middle and working class people, who commuted to their work in other parts of the city. (Derrick, 2001, p. 245) Areas like the Lower East Side, especially south of Houston Street dramatically decreased in population, even up to 63%. (Derrick, 2001, p. 246) Where in 1910 54% of the population had lived within four miles of City Hall, in 1930 this was
Aside from the general dispersal of people, the Dual system did actually relieve the pressure on the tenement districts and the poor working-class families. As was noted by Peter Derrick, in a quote from historian Marion Casey: "...Much of the residential mobility in New York from the 1920s to the 1950s had "little relation to vertical mobility in either occupation or class"..." (Derrick, 2001, p. 251) Whereas the period from the opening of the first subway to the first world war had mostly known upper-middle class travelers, after the completion of the Dual System, the majority became working-class commuters. (Hood, 2004, p. 180) Clearly, McNamery and the progressive reformers had managed to achieve their main goal: relieve of the tenement districts, dispersal and better living conditions for the poor working-class and breaking of the monopoly in mass transit.

**The Subway suburb:**

The residential development that might best describe the phenomenon of the subway suburb is probably Jackson Heights. This area was developed in the area that used to be called 'Trains Meadow', which was a completely rural part of the borough of Queens in 1900. (Hood, 2004, p. 168 & 169) In 1909, Edward A. McDougall started the Queensboro Corporation, to develop this rural area. Before World War 1 this area grew very slowly, as it was extremely inaccessible and the first inhabitants can be seen as true pioneers. (Hood, 2004, p. 173) From April 21st, 1917, the Queensboro subway line opened up Jackson Heights, now only a 22 minute travel from Grand Central terminal. (See: Image 47: Jackson Heights advertisement)

Between 1917 and 1919, McDougall devised a masterplan for Jackson Heights as an exclusive garden suburb for the Upper-Middle class. This plan was influenced by the British Ebenezer Howard’s garden city, which would combine the sociability of the town with the healthfulness of the countryside. (Hood, 2004, p. 174) McDougall wanted to control the whole development process, as he conceived of Jackson Heights as planned and self-contained suburban haven within city limits. As opposed to traditional suburban planning, he did develop mostly apartment houses. (Hood, 2004, p. 174) (See: Image 48: The Jackson Heights Apartment house) These apartment houses were of a very high standard and most of them were owned by their residents. (Hood, 2004, p. 175)

The Queensboro Corporation, in its integrated way of real-estate development, wanted to promote social cohesion and foster a distinctive way of life. (Hood, 2004, p. 176) The company intervened in all aspects of Jackson Heights, also the lives of its inhabitants. It had specific rules of conduct and selected residents, to ensure "...likeminded middle-class residents with similar social backgrounds, occupational levels and cultural values..." (Hood, 2004, p. 176) Essentially Jackson Heights was a sort of gated community avant la lettre.

But in this particular case the restrictions to the residents eventually developed into a systematic exclusion of Jews from the neighborhood. (Hood, 2004, p. 177) In the end, the great Depression of the 1930s forced McDougall to alter his neighborhood completely, as he was unable to sell all the apartments. Jackson Heights became completely build up and lost its garden suburb configuration, to become an urban neighborhood. (Hood, 2004, p. 178)

**Booming business in Manhattan:**

Another important development related to the Dual Contracts is the growth of Midtown Manhattan as a business district. (Derrick, 2001, p. 249) Where this had been a predominantly residential area until the 1890s, the newly developed connectivity sparked its transformation into a commercial district. (Derrick, 2001, p. 249) Next to the new rapid transit lines, two new railroad stations, Pennsylvania station (1910) and Grand Central Terminal (1913) sparked a new influx of commuters. (Derrick, 2001, p. 249) The amount of office space in Manhattan increased rapidly over the years. In 1920 there was about 40 million square feet of office space in Lower Manhattan, in 1935: 55 million and in 1963: 98 million. The Midtown area grew even faster. In 1920 there was 20 million square feet, in 1935: 60 million and in 1963: 160 million.

This development was strongly related to the building of numerous skyscrapers in both Midtown and Lower Manhattan. The development of the skyscraper and the subway are two strongly interrelated phenomena, some even say part of a vicious circle. (Brooks, 1997, p. 116) According to Lewis Mumford: "...The subways increase land values. Real estate promoters, to make their more expensive land pay, built taller buildings. The new towers required more subways to bring office workers, which further increased land values. New that the land was even more fabulously expensive, skyscrapers had to be even taller in order to be profitable and this led to even more congested subways..." (Brooks, 1997, p. 116)

The most well known skyscrapers of New York City were actually built in the 1930s, in the wake of the completion of the Dual System. The Chrysler Building, for example, was completed in 1930. (Stern, Gilmartin, & Mellins, 1987, p. 606) (See: Image 49: The Chrysler Building) Another example, the Empire State building was completed in 1931. (Stern, Gilmartin, & Mellins, 1987, p. 610) (See: Image 50: The Empire State Building) The Rockefeller Center, which was completed between 1931 and 1940, might be the most intricate example of the new interdependent relationship of skyscraper and subway that developed. (Stern, Gilmartin, & Mellins, 1987, p. 658 & 660) (See: Image 51: The...
Map showing the expansion of the city in 1917. The grid has now developed further on and most of Brooklyn is covered by now. Small neighborhoods start to appear along the tracks of the new Dual Contract lines.


Source: http://www.lib.utexas.edu/maps/historical/new_york_city_1917.jpg; The University of Texas at Austin, 2008

Advertisement by the Queensboro Corporation for its Jackson Heights Garden Suburb, 1923. Especially the short journey by subway is advertised. Also the corporation's 'screening' of new residents is stated.


Image showing the floorplan and a picture of a block of apartment houses in Jackson Heights.

Source: "New York 1930; Architecture and urbanism between the two world wars"; Stern, Gilmartin & Mellins, 1987
New Quick Subway Service by B.R.T.—Broadway Line to Jackson Heights


Running Time

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<tr>
<th>Destination</th>
<th>Time</th>
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<tbody>
<tr>
<td>5th Ave. at Central Park at Jackson Heights</td>
<td>10 minutes</td>
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<tr>
<td>Times Square—East River</td>
<td>12 minutes</td>
</tr>
<tr>
<td>Shopping District—34th Street</td>
<td>24 minutes</td>
</tr>
<tr>
<td>Electric Office District—City Hall at Jackson Heights</td>
<td>36 minutes</td>
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</table>

Jackson Heights Elevator Garden Apartments, 5, 6, and 7 rooms, 2 and 3 bedrooms, are offered on the Jackson Heights Tenant-Ownership Plan. Liberal terms arranged for those whose social and business references are acceptable. Residents at Jackson Heights are now enjoying the golf course, tennis courts, children's playgrounds, gardens, etc.

The Queensboro Corporation 59 East 42d St. New York, N.Y.

SELECT YOUR APARTMENT NOW

For Immediate or Full Occupancy

Broadway B.R.T. Subway from any Vanderbilt Station next to Jackson Heights. Take Kresge route of Queensboro Bridge Bus.

Subways at 26th St., Jackson Heights.

By Buses from St., 11th Avenue Bridge, Jackson Ave. (SoHo Boulevard), to 50th St., Jackson Heights.
Image 49: 'The Chrysler Building'

The 1930 Chrysler building. One of the most well-known skyscrapers in New York City.

Source: "New York 1930; Architecture and urbanism between the two world wars"; Stern, Gilmartin & Mellins, 1987
Rockefeller Center and the Subway. This building complex even had its own subway station, directly feeding the towers from below with commuters from all over New York City.

Although it remains a question what exactly influences what in terms of development, overcrowding and congestion, it is clear that the skyscraper depends on the subway and the other way around. The skyscraper needs a supply of people and the subway needs a destination to supply people to. In fact, the combined development of the Dual system, dispersing the people and supplying the business districts, and the skyscraper supplying large amounts of space for business, largely determined the urban configuration of New York City as we know it.
The 1931 Empire State Building. Another one of the most well known skyscrapers in New York City, built around the time of the Dual Contracts.

The Rapid Transit system in New York City, with its underground and elevated railroads, has clearly been a very important factor in the development of the New York City metropolis as we know it today. Not solely as a means of transportation through the vast amount of land that is covered by the city, but also as a means of development for the city’s spatial configurations, organizational patterns and even building typologies. New York’s developmental history is probably more closely interwoven with the development of its rapid transit system than any other city in the world. The subways and elevateds enabled the northward expansion on the island of Manhattan, unified the five boroughs into one megalopolis, dispersed the population from the tip of Manhattan, sparked the development of the city’s first suburbs and eventually created the breeding ground for the high densities and skyscrapers, as we know them from today’s Manhattan.

A couple of factors have been crucial to how this relationship between the City and its transportation has developed. The most important factor is probably the geography of the city itself. The fact that the center of the city, Manhattan, is a longitudinal, narrow island bound by rivers on all four sides prevented the city from having a ‘natural’ urban development in a concentric form. As soon as the population of the city started to grow, a means of crossing the rivers and transporting people to and from where the jobs were became the sole preconditions to expansion. Without this, the city was destined to fail and would have probably become of much lesser importance to America and the world. Rapid Transit was the means by which both preconditions could be fulfilled. Development was destined to go hand in hand, by lack of an alternative that could meet the requirements for development of the Island.

Next to that, the time frame in which the city had its most rapid period of expansion coincided perfectly with technological advancements that enabled rapid transit to become the backbone of the development of the city. The invention and development of the steam engine enabled the first elevated trains to be run, when the pressure of population growth started to become problematic towards the second half of the 19th Century. Later, the development of electric traction came exactly in time to enable the development of the subways, which would start to relief the pressure of increasing overcrowding and congestion at the beginning of the 20th Century. By the time the focus shifted towards other types of mobility and the automobile became the dominant means of transportation after World War 2, the city had already more or less expanded to its contemporary boundaries and the subway had had its largest impact on urban development. Of course the coming of the automobile again changed the configuration of the city, but in New York it never really surpassed rapid transit as the backbone of the city. This was largely due to the problematic congestion through the combination of the grid plan and difficult geography of the city.

Another strong influence in the development of the relationship between the development of Rapid Transit and the development of New York City is the persistent believe of engineers and reformers in the transformational capabilities of transportation. Although the elevated, as well as the first subways, didn’t really transform the city as much as was hoped for, a push for development of the system remained. Rapid Transit was seen as the most, if not the only, plausible way of enabling poor working-class families to move out of the slums. This was seen as the primary solution to problems of congestion and overpopulation. Repeatedly Rapid Transit was promoted and developed as a tool for urban development and dispersal. Being promoted as such, land speculation and apartment building along the lines of the future trajectories was sparked immediately. Structures were built even before a single piece of track was laid out. It was to be expected that people would soon be dropped off in large numbers along these trajectories. The development of Rapid Transit lines appealed strongly to the New Yorkers their entrepreneurial mentality, guided by which, they soon built up a city along their path.

In a relatively short period of about 100 years, New York City grew from a small harbor town, to the largest metropolis in the world at that time. The Rapid Transit system forms an intricate part of this growth process. The four periods distinguished in the course of this research, each mark a distinct stage in the development of the system, but also in the becoming of the Metropolis. The direction and scale of the introduced system each time determined the step forward that could be taken by urban development. Therefore it is safe to say, that without its Rapid Transit system, New York City would have never become the metropolis as we know it now.
Image S1: ‘The Rockefeller Center and the Subway’
Image showing the Rockefeller center proposal, drawn on a map with all the rapid transit lines surrounding the building, emphasizing the necessary connection of the subway to the complex.

Source: “New York 1930; Architecture and urbanism between the two world wars”; Stern, Gilmartin & Mellins, 1987
Bibliography

Books:


Websites:


Appendix 1:

Chronology:

**Period 1: Pressure rising (1811-1868); New York City before the trains**

- 1811: Introduction of the commissioner’s grid plan.
- 1814: Opening of the Manhattan Brooklyn steam ferry by Robert Fulton.
- 1825: Opening of the Erie Canal.
- 1827: First horse drawn omnibuses in service.
- 1832: First Horse car line in service (rail).
- 1842: Opening of the Croton Aqueduct, supplying fresh water to Manhattan.
- 1847: John Randel’s ‘colonnade promenade’ proposal for elevated transport.
- 1850: Expansion of Horse car service and leveling of rails and street surface.
- 1852: 683 omnibuses in operation.
- 1860: 14th to 42nd street developed as affluent residential neighborhood.
- 1860: 38 million Horse car users yearly (125,000 a day).
- 1861: Start of the American civil war.
- 1863: Opening of the world’s first subway in London.
- 1863: Draft riots: Violent protest in lower Manhattan by (mainly) Irish workers against being send off to war.
- 1864: Hugh Wilson’s Metropolitan Railway proposal for an underground railway.
- 1865: End of the civil war.
- 1865: Beginning of the “Gilded Age”, that gave rise to the development of the railways.
- 1866: Melville C. Smith’s Broadway beneath Broadway proposal for an additional level underneath the existing street level.
- 1867: Alfred Ely Beach’s pneumatic railway proposal in exhibition.
- 1867: Franchise by the State Legislature given to Charles T. Harvey and the West Side & Yonkers Patent Railway to develop a line of half a mile along Greenwich Street.
- 1868: New York City Underground Railway Company subway proposal: A line running from City Hall to the Harlem River with steam locomotives.
- 1869: September 24th, Black Friday, the Stock market crash that started the Great Depression.
- 1869: Bankruptcy of the West Side & Yonkers Patent Railway.
- 1871: Legislature to build a subway for A.E. Beach, vetoed by Governor John Hoffman.
- 1871: demise of the ‘Tweed ring’ after exposé of Boss Tweed’s corrupt practices.
- 1872: The New York City Rapid Transit Company subway proposal: A line from City Hall to the New York & Harlem railroad at 59th Street. Headed by Cornelius Vanderbilt.
- 1872: Dr. Rufus Gilbert receiving franchise for a west-side elevated route.
- 1873: Dr. Rufus Gilbert bankruptcy, Gilbert Elevated buys the franchise.
- 1875: Passing of the Husted Act, which led to the appointment of the Rapid Transit Commission.
- 1879: The Metropolitan (formerly: Gilbert) and New York Elevated, consolidated into one company: The Manhattan Elevated Railway Company.
- 1879: First electrical railway in the world, Dr. Werner von Siemens, Berlin.
- 1880: Ninth, Second and Third Avenue El reach Harlem River.
- 1881: Central tunnel Railway Company subway proposal.
- 1883: Opening of the Brooklyn Bridge.
- 1885: Opening of the first elevated line in Brooklyn.
- 1886: Suburban Rapid Transit Company opens drawbridge and elevated line to the Bronx.
- 1888: Abram S. Hewitt pleads for development of a Subway System before the Board of Aldermen.

**Period 2: A little relief (1868-1891); Development of a rapid transit solution: the Manhattan and Brooklyn elevated**

- 1867: Steinway Commission formed to develop a subway under the Rapid Transit Act.
- 1891: Passing of the Rapid Transit Act, for the development of a subway system.
- 1891: Steinway Commission formed to develop a subway under the Rapid Transit Act.
- 1891: Manhattan Railway Company acquires the Suburban Rapid Transit Company.
- 1892: The Steinway Commission tries to auction a 999-year franchise for the development of the subway and fails.
- 1893: The Manhattan Railway Company develops a proposal for an expansion of the elevated, under supervision of George J. Gould.
- 1893: Stock market crash: 1890s financial crisis begins.
- 1894: Vote for a subway system under municipal ownership, as proposed by Abram S. Hewitt: Rapid Transit Commission formed.
- 1895: RTC proposes its first subway plan.
1896: The Underground Railroad Company of the City of New York subway proposal.
1896: Disapproval of the RTC Scheme by the Supreme Court.
1896: Another negotiation with Gould for the construction of new elevated lines.
1896: William Steinway proposes a compromise scheme for the subway.
1897: Opening of America’s first subway in Boston.
1897: Rapid Transit Underground Railroad Company subway proposal.
1897: Frank J. Sprague: Electric subway cars introduced in Chicago.
1898: The Steinway compromise scheme is approved.
1898: Unification of the five boroughs into the greater New York Metropolitan region.
1898: RTC officially rejects the elevated as a possible solution to New York’s transit problems.
1899: Bidding is opened for the subway franchise by the RTC.
1900: John B. McDonald receives the franchise for the subways.
1900: August Belmont is called in to help, due to a lack of capital; he decides to finance the building, equipment and operating of the subway.
1900: The Rapid Transit Subway Construction Company is formed, headed by McDonald.
1902: The Interborough Rapid Transit Company (IRT) is formed to franchise the subway.
1902: Electrification of the elevated lines by the Manhattan Railway Company.
1903: The IRT acquires the 999-year lease of the elevated from the Manhattan Railway Company.
1903: Opening of the Williamsburg Bridge.
1904: October 27th: Opening of New York’s first subway by Major George B. McClellan.

Period 4: Finally far enough (1913-1932): The Dual contracts manage to relieve the pressure on the tenement districts

1904: Merger of the IRT and the Metropolitan Street Railway company.
1907: Committee on Congestion of Population in New York formed.
1907: Rapid Transit Commission dissolved.
1907: New York State Public Service Commission (PSC) formed, to take control of subway matters.
1906: Elsberg Bill.
1908: IRT commences service through east river tunnel to Brooklyn.
1908: Williamsburg Bridge opened, BRT Elevated cross into Manhattan.
1909: Start of the 4th Avenue Subway build by the BRT.
1909: Opening of the Manhattan Bridge and Queensboro Bridge.
1910: PSC proposes the Triborough system.
1911: Construction begins on upper Lexington Avenue Subway.
1913: Signing of the Dual contracts, combining subway service of Manhattan and Brooklyn.
1914: Start of World War 1.
1915: First Dual contract lines in service.
1917: Last Horse car line closes.
1918: Malbone Street Wreck.
1918: End of World War 1.
1921: Installation of the Transit Commission.
1923: BRT becomes BMT and is reorganized.
1924: Beginning of the development of a motorway network (Robert Moses and the State Parks Commission), in the end causing developers to lose interest in the subway.
1931: Completion of the final elements of the Dual Contracts.

Period 5: After the introduction of the independent system:

1932: Introduction of the independent system (IND).
1938: 6th Avenue El abandoned.
1940: Unification of IRT, IND and BRT under municipal operation.
1940: 9th Avenue el, Manhattan portions 2nd Avenue el, 5th avenue el and portions of Fulton street el abandoned.
1940-1945 World War 2
1941: Remainder of 2nd Avenue el and service over Brooklyn Bridge abandoned.
1953: Installation of the Transit Authority.
1953: Rockaway line purchased as expansion of the subway service.
1955: 3rd Avenue el abandoned.
1956: Eisenhower system of Interstate and defense highways.
1957: Last street cars in New York (The Road Gang).
1966: Thirteen days public transport strike.
1968: Metropolitan Transit Authority (MTA) in control.
1969: Myrtle Avenue el abandoned.
1971: SIRT (Staten Island Rapid Transit) becomes part of the MTA.
1981: New York State Legislature declares a transport emergence. Massive funding to rehabilitate the declined subway system.
2001: World trade center attacks
Appendix 2:

Numerical data:

**Annual Rapid Transit Ridership, 1901-1998 (in Millions)**

<table>
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<tr>
<th>Year</th>
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Source: "Tunneling to the future, the story of the great subway expansion that saved New York"; Derrick, 2001
### Population of Greater New York by Borough, 1790–1997 (in Thousands)

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$^a$ Totals may not add due to rounding.

$^b$ Greater New York was not formed until 1898.

$^c$ 1997 U.S. Census Estimate.

SOURCE: U.S. Census and Emanuel Tobier.
### Population Change in New York City by Districts, 1910 and 1940

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<td>271,653</td>
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<td>-22.2</td>
</tr>
<tr>
<td>4. East Harlem</td>
<td>335,266</td>
<td>235,813</td>
<td>-29.7</td>
</tr>
<tr>
<td>5. Lower West Side</td>
<td>246,469</td>
<td>131,786</td>
<td>-46.5</td>
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<tr>
<td>6. West Side</td>
<td>239,451</td>
<td>200,463</td>
<td>-16.3</td>
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<tr>
<td>7. Upper West Side</td>
<td>178,066</td>
<td>262,691</td>
<td>47.5</td>
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<td>8. Harlem</td>
<td>191,454</td>
<td>231,283</td>
<td>20.8</td>
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<tr>
<td>9. Washington Heights</td>
<td>54,331</td>
<td>236,414</td>
<td>335.1</td>
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<td>MANHATTAN TOTAL</td>
<td>2,331,542</td>
<td>1,889,924</td>
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<tr>
<td>10. South Bronx</td>
<td>283,932</td>
<td>545,374</td>
<td>92.1</td>
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<tr>
<td>11. West Bronx</td>
<td>96,781</td>
<td>514,782</td>
<td>431.9</td>
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<tr>
<td>12. East Bronx</td>
<td>50,267</td>
<td>334,555</td>
<td>565.6</td>
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<td>BRONX TOTAL</td>
<td>430,980</td>
<td>1,394,711</td>
<td>223.6</td>
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<td>13. Long Island City</td>
<td>62,763</td>
<td>233,587</td>
<td>272.2</td>
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<td>14. Jackson Heights</td>
<td>32,932</td>
<td>199,987</td>
<td>507.3</td>
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<tr>
<td>15. Flushing/Bayside</td>
<td>37,165</td>
<td>154,327</td>
<td>315.3</td>
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<td>16. South Queens</td>
<td>138,705</td>
<td>670,938</td>
<td>383.7</td>
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<tr>
<td>17. Rockaway</td>
<td>12,476</td>
<td>38,795</td>
<td>211.0</td>
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<td>QUEENS TOTAL</td>
<td>284,041</td>
<td>1,297,634</td>
<td>356.9</td>
</tr>
<tr>
<td>19. Old Brooklyn</td>
<td>370,014</td>
<td>318,894</td>
<td>-13.8</td>
</tr>
<tr>
<td>20. Bedford</td>
<td>204,204</td>
<td>283,475</td>
<td>38.8</td>
</tr>
<tr>
<td>21. Bushwick</td>
<td>270,518</td>
<td>272,667</td>
<td>0.8</td>
</tr>
<tr>
<td>22. Bay Ridge</td>
<td>166,261</td>
<td>489,116</td>
<td>194.2</td>
</tr>
<tr>
<td>23. Flatbush</td>
<td>79,846</td>
<td>394,215</td>
<td>393.7</td>
</tr>
<tr>
<td>24. Brownsville</td>
<td>196,439</td>
<td>361,927</td>
<td>84.3</td>
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<tr>
<td>25. Coney Island</td>
<td>33,561</td>
<td>342,625</td>
<td>921.0</td>
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<tr>
<td>BROOKLYN TOTAL</td>
<td>1,694,351</td>
<td>2,698,215</td>
<td>65.1</td>
</tr>
<tr>
<td>26. Staten Island</td>
<td>85,969</td>
<td>174,441</td>
<td>102.9</td>
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<tr>
<td>NEW YORK CITY TOTAL</td>
<td>4,766,883</td>
<td>7,454,995</td>
<td>56.4</td>
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</table>

*Districts devised by Consolidated Edison Company.

Opening dates of the Dual Contract lines

Source: "Tunneling to the future, the story of the great subway expansion that saved New York"; Derrick, 2001

<table>
<thead>
<tr>
<th>Contract No. 3 (IRT Lines)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Seventh Avenue Line</td>
<td>July 1, 1918</td>
</tr>
<tr>
<td>2. Lexington Avenue Line “H” System</td>
<td>July 17, 1918</td>
</tr>
<tr>
<td>3. Jerome Avenue Line</td>
<td>August 1, 1918</td>
</tr>
<tr>
<td>4. Pelham Line</td>
<td>July 17, 1918</td>
</tr>
<tr>
<td>5. White Plains Road Line</td>
<td>December 20, 1920</td>
</tr>
<tr>
<td>6. Seventh Avenue Line Connection To Brooklyn</td>
<td>December 13, 1920</td>
</tr>
<tr>
<td>7. Flushing Line</td>
<td>April 15, 1919</td>
</tr>
<tr>
<td>GCT to Queensboro Plaza</td>
<td>June 22, 1915</td>
</tr>
<tr>
<td>Queensboro Plaza to 103rd St. To Times Square</td>
<td>April 21, 1917</td>
</tr>
<tr>
<td>To Main St.</td>
<td>March 14, 1927</td>
</tr>
<tr>
<td>8. Astoria Line</td>
<td>January 21, 1928</td>
</tr>
<tr>
<td>9. Eastern Parkway Line</td>
<td>February 1, 1917</td>
</tr>
<tr>
<td>To Utica Ave.</td>
<td>August 23, 1920</td>
</tr>
<tr>
<td>To New Lots Ave.</td>
<td>October 16, 1922</td>
</tr>
<tr>
<td>10. Nostrand Avenue Line</td>
<td>August 23, 1920</td>
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</table>

<table>
<thead>
<tr>
<th>Contract No. 4 (BRT Lines)</th>
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</thead>
<tbody>
<tr>
<td>1. Broadway Line</td>
<td>January 5, 1918</td>
</tr>
<tr>
<td>Whitehall St. to Times Square</td>
<td>August 1, 1920</td>
</tr>
<tr>
<td>To Queensboro Plaza</td>
<td></td>
</tr>
<tr>
<td>Connection to DeKalb Ave. Station via Manhattan Bridge</td>
<td>September 4, 1917</td>
</tr>
<tr>
<td>Connection to DeKalb Ave. Station via Tunnel</td>
<td>August 1, 1920</td>
</tr>
<tr>
<td>2. Centre Street Loop</td>
<td>August 4, 1913</td>
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<tr>
<td>Williamsburg Bridge</td>
<td>May 30, 1931</td>
</tr>
<tr>
<td>to Chambers St.</td>
<td></td>
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<tr>
<td>Chambers St. to Battery</td>
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</tr>
<tr>
<td>3. Astoria Line</td>
<td>February 1, 1917</td>
</tr>
<tr>
<td>4. 14th St.–Eastern District Line</td>
<td>June 30, 1924</td>
</tr>
<tr>
<td>Sixth Ave. to Montrose Ave. To Broadway Junction, Brooklyn</td>
<td>July 14, 1928</td>
</tr>
<tr>
<td>To Eighth Ave.</td>
<td>May 30, 1931</td>
</tr>
<tr>
<td>5. Jamaica Line</td>
<td>July 3, 1918</td>
</tr>
<tr>
<td>6. Brighton Line</td>
<td>August 1, 1920</td>
</tr>
<tr>
<td>7. Fourth Ave. Line</td>
<td>January 15, 1916</td>
</tr>
<tr>
<td>To 86th St.</td>
<td>October 31, 1925</td>
</tr>
<tr>
<td>To 95th St.</td>
<td>July 21, 1917</td>
</tr>
<tr>
<td>8. West End Line</td>
<td>March 16, 1919</td>
</tr>
<tr>
<td>9. Culver Line</td>
<td>June 22, 1915</td>
</tr>
<tr>
<td>10. Sea Beach Line</td>
<td>February 22, 1915</td>
</tr>
<tr>
<td>12. Fulton St. (Liberty Ave.) Extension</td>
<td></td>
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# PASSENGER EQUIPMENT ROSTER

## I: Equipment purchased by the Interborough Rapid Transit Corporation prior to the 1940 unification

<table>
<thead>
<tr>
<th>CAR NUMBER</th>
<th>NAME OR DESIGNATION</th>
<th>BUILDER</th>
<th>DATE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>3340</td>
<td>August Belmont</td>
<td>Wason</td>
<td>1902</td>
<td>1</td>
</tr>
<tr>
<td>3341</td>
<td>John B. McDonald</td>
<td>Wason</td>
<td>1902</td>
<td>1</td>
</tr>
<tr>
<td>2000–2159</td>
<td>Composites</td>
<td>Wason, St. Louis &amp; Jewett</td>
<td>1903</td>
<td></td>
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<tr>
<td>3000–3339</td>
<td>Composites</td>
<td>Wason, St. Louis, Jewett &amp; Stephenson</td>
<td>1903–4</td>
<td></td>
</tr>
<tr>
<td>3342</td>
<td>First steel car</td>
<td>PRR</td>
<td>1903</td>
<td></td>
</tr>
<tr>
<td>3344</td>
<td>Mineola</td>
<td>Wason</td>
<td>1904</td>
<td>1</td>
</tr>
<tr>
<td>3350–3649</td>
<td>Gibbs Hi-V</td>
<td>ACF</td>
<td>1904–5</td>
<td>2</td>
</tr>
<tr>
<td>3650–3699</td>
<td>Hi-V deck roof</td>
<td>ACF</td>
<td>1907–8</td>
<td>3</td>
</tr>
<tr>
<td>3700–3809</td>
<td>Hi-V motors</td>
<td>ACF</td>
<td>1910–11</td>
<td></td>
</tr>
<tr>
<td>3810–3849</td>
<td>Hi-V motors</td>
<td>Standard Steel</td>
<td>1910–11</td>
<td></td>
</tr>
<tr>
<td>3850–4024</td>
<td>Hi-V motors</td>
<td>Pressed Steel</td>
<td>1910–11</td>
<td></td>
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<tr>
<td>4025–4038</td>
<td>Lo-V Steinway motors</td>
<td>Pullman</td>
<td>1915</td>
<td>17</td>
</tr>
<tr>
<td>4037–4160</td>
<td>Lo-V River motors</td>
<td>Pullman</td>
<td>1915</td>
<td></td>
</tr>
<tr>
<td>4161–4214</td>
<td>Lo-V River motors</td>
<td>Pullman</td>
<td>1915</td>
<td></td>
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<tr>
<td>4161–4222</td>
<td>Lo-V Steinway motors</td>
<td>Pullman</td>
<td>1915</td>
<td>15,17</td>
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<tr>
<td>4223–4514</td>
<td>Hi-V trailers</td>
<td>Pullman</td>
<td>1915</td>
<td>16</td>
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<tr>
<td>4515–4564</td>
<td>Lo-V trailers</td>
<td>Pullman</td>
<td>1915</td>
<td>15,17</td>
</tr>
<tr>
<td>4555–4576</td>
<td>Lo-V Steinway motors</td>
<td>Pullman</td>
<td>1916</td>
<td>15,17</td>
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<tr>
<td>4577–4699</td>
<td>Lo-V motors</td>
<td>Pullman</td>
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<td>4700–4770</td>
<td>Lo-V Steinway motors</td>
<td>Pullman</td>
<td>1916</td>
<td>17</td>
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<tr>
<td>4771–4810</td>
<td>Lo-V motors</td>
<td>Pullman</td>
<td>1916</td>
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<td>4811–4965</td>
<td>Lo-V trailers</td>
<td>Pullman</td>
<td>1916–17</td>
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<td>4956–5302</td>
<td>Lo-V motors</td>
<td>Pullman</td>
<td>1917</td>
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<tr>
<td>5303–5377</td>
<td>Lo-V trailers with compressors</td>
<td>Pullman</td>
<td>1922</td>
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<tr>
<td>5379–5402</td>
<td>Lo-V trailers</td>
<td>Pullman</td>
<td>1922</td>
<td></td>
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<tr>
<td>5403–5502</td>
<td>Lo-V motors</td>
<td>Pullman</td>
<td>1922</td>
<td>4</td>
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<tr>
<td>5503–5627</td>
<td>Lo-V motors</td>
<td>ACF</td>
<td>1925</td>
<td></td>
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<tr>
<td>5628–5652</td>
<td>Lo-V Steinway motors</td>
<td>ACF</td>
<td>1925</td>
<td>17</td>
</tr>
<tr>
<td>5653–5702</td>
<td>Lo-V World's Fair cars</td>
<td>St. Louis</td>
<td>1938</td>
<td>17</td>
</tr>
</tbody>
</table>

All of the above noted equipment has been retired from passenger service, although selected cars have been retained for nonrevenue service.

Note: PRR indicates Pennsylvania Railroad and ACF is the American Car and Foundry Company.

## II: Equipment purchased by the Brooklyn Rapid Transit Corporation and the Brooklyn-Manhattan Transit Corporation prior to the 1940 unification

<table>
<thead>
<tr>
<th>CAR NUMBERS</th>
<th>NAME OR DESIGNATION</th>
<th>BUILDER</th>
<th>YEAR</th>
<th>NOTES</th>
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<tbody>
<tr>
<td>2600–2899</td>
<td>Standard motors</td>
<td>Pressed Steel</td>
<td>1920–22</td>
<td>25</td>
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<tr>
<td>4000–4049</td>
<td>Standard trailers</td>
<td>Pressed Steel</td>
<td>1924</td>
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<tr>
<td>6000–6120</td>
<td>Triplex</td>
<td>Pressed Steel</td>
<td>1925–28</td>
<td>4, 8</td>
</tr>
<tr>
<td>7003</td>
<td>Green Hornet</td>
<td>Pullman</td>
<td>1934</td>
<td>9</td>
</tr>
<tr>
<td>7029</td>
<td>Zephyr</td>
<td>Budd</td>
<td>1934</td>
<td>9</td>
</tr>
<tr>
<td>7044–7013</td>
<td>Multi-section units</td>
<td>St. Louis</td>
<td>1936</td>
<td>9</td>
</tr>
<tr>
<td>7014–7026</td>
<td>Multi-section units</td>
<td>Pullman</td>
<td>1936</td>
<td>9</td>
</tr>
<tr>
<td>8000–8005</td>
<td>Bluebird</td>
<td>Clark</td>
<td>1938, 1940</td>
<td>8</td>
</tr>
</tbody>
</table>

>Note: all of the above noted equipment has been retired from passenger service.

Source: "Under the sidewalks of New York (2nd revised edition ed.)"; Cudahy, 1995
Track mileage


(On Maps) Steam Surface Railroads which were later improved as a part of the existing Rapid Transit System