

# PLEASE STAND AWAY FROM THE PLATFORM EDGE: A CLOSER LOOK INTO THE NEW YORK CITY SUBWAY

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## INTRODUCTION

The New York City Subway system is one of the most extensive and complex subway systems in the world. The subway system consists of 472 stations and 665 miles of revenue track length, serving the boroughs of Brooklyn, Manhattan, Queens, and The Bronx. Carrying three million passengers daily and over one billion annually, the system is one of the most heavily used mass transit systems worldwide. The system continues to run as one of the world's oldest subway systems as a combination of three legacy companies known as the Interborough Rapid Transit (IRT), Brooklyn-Manhattan Transit (BMT, formerly Brooklyn Rapid Transit or BRT), and Independent Subway System (IND). Currently, the city of New York owns the system, operating under the New York City Transit Authority, a company of the state-run Metropolitan Transportation Authority (MTA). The system serves as an engineering feat, employing various methods of construction in its expansion into the massive system used today.

# HISTORY

Prior to construction, New York City was already sprawling with elevated lines; however, ridership was increasing and the existing system faced overcrowding. Competing with Boston, the city entered a race to construct a subway system to satisfy passenger demand and put New York City on the map for an iconic mass transit system.

**1870** - American inventor Alfred Ely Beach first proposed an underground subway in Manhattan, and he built a prototype pneumatic subway that spanned one block under Broadway.

**1904** – The first subway opens on October 27th, spanning 9.1 miles and 28 stations from City Hall to 145th Street in Manhattan. American civil engineer William Barclay Parsons (see Fig. 1), chief engineer of the IRT, used the **cut and cover** construction method and designed the four-track local/express layout.

**1913** – The IRT, BRT, and the City of New York sign the Dual Contracts, leading to expansion of the subway system and continued operation through private companies. From this point, underground and elevated lines expand to the outer boroughs of Brooklyn, Queens, and the Bronx.

**1932** – The IND subway system opens the Eighth Avenue Line on September 10th as the first line owned and operated by the City of New York. The mostly four-track underground line spanned from 207th Street to Chambers Street in Manhattan.

**1940** – The City of New York bought the BMT and IRT companies, unifying the system as fully publicly owned.

**1968** – The NYCTA, formed in 1953, is placed under the control of the state-owned MTA.

**2015** – The 34th Street – Hudson Yards station on the Flushing Line opens on September 13th as the first brand new station opened in 25 years.

**2017** – The Second Avenue Line opens on January 1st as a 1.8-mile-long stretch featuring three new stations: 72nd Street, 86th Street, and 96th Street, all along Second Avenue on the Upper East Side of Manhattan. The deep-level tunnels were constructed using **tunnel boring** technology.

# HOW IT WORKS

## Source of Traction Power

- Con Edison provides up to 27kV of electricity to NYCTA power substations.
- Voltage is reduced and converted 625 DC Volts fed to the **third rail** (See Fig. 10).

## Physical Specifications

- **Track gauge:** standard gauge (4 ft, 8.5 in)
- Stations constructed in various types (underground, elevated, embankment, open-cut). Between 525 ft -660 ft long.
- Highest station above ground: Smith - 9th Street station (see Fig. 11), Culver Line, Brooklyn (88 feet above street level).

- Deepest station: 191st St Station (see Fig. 12), Broadway - 7th Avenue Line, Manhattan (180 feet below street level).
- A Division (formerly IRT): 51ft long, 9 ft wide.
- B Division (formerly BMT/IND): 60ft to 75ft long, 10 ft wide.

## Fixed Block Signaling

- Track is divided into blocks or also known as track circuit
  - Divided by **insulated joints** in the rails
- One of the rails is used for signaling purposes
  - Uses AC power
- As the wheels pass by the blocks, the wheels short-circuit two rails and trigger signal and safety systems using a **relay**
  - Signal turns red if a block is occupied by any portion of the train
  - Signal is clear (green or yellow) when there are no trains in the blocks

## Train Stops

- T-shaped bright yellow rod
- This forces any trains that attempts to pass a red signal to come to a stop
- When the stop is raised to the tripping position, it triggers the train's emergency stop brakes
- Operated either electronically or pneumatically
  - In case electric power or air pressure fails, a heavy mechanical spring raises the stop to the tripping position
  - If conditions are safe, the signal system forces the stop back down.
- Does not automatically raise when train passes by

- Stops do not come up until the end of train passes next signal

## **Standard Home Signals**

- Can be identified by an X and a number on one of the signals identification plates
- Contains two signal masts

### **Top Mast**

- Top Green indicates train can proceed at allowable speed
- Top Yellow indicates proceed with caution
- Top Red means stop and stay

### **Bottom Mast**

- Bottom Green indicates main route
- Bottom Yellow indicates diverging route
- Bottom Red means no route is established, stop and stay

## **KEY WORDS**

- **Joint:** a metal bar that joins two rails together
- **Insulated joints:** ensures no current flow across the joint.
- **Top mast:** conveys condition or track occupancy
- **Bottom mast:** conveys the route that associated switch is set for
- **Relay:** a switch that operates on the principles of electromagnetism and electrical control.

- **Cut and cover:** construction method used to build shallow tunnels by digging a trench, constructing the tunnel, and covering by rebuilding the surface. It is the oldest method of tunnel construction.
- **Tunnel boring:** construction method used to build deep, circular tunnels by using a tunnel boring machine.
- **Third rail:** raised metal conductor rail used to supply DC traction power to subway cars.
- **Track gauge:** distance between two rails.

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