Paper 185

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# THE PLANNING AND DESIGN OF APPROACHES TO THE NEW BRIDGES WITHIN THE CITY OF NEW YORK

By HARRY TAYLOR*

WITH ABSTRACTS FROM THE DISCUSSION BY GEORGE E. SPARGO, EMIL H. PRAEGER, JOSEPH C. O'DEA AND THE AUTHOR

To trace the development of the elaborate approaches to the newer bridges within the City of New York it is necessary to review the older bridges as well as the newer ones and consider the purposes for which they all were built. Comparisons between the two are not drawn in a spirit of adverse criticism but to follow the development of conditions which today demand approaches especially designed for through traffic and reaching far from the bridge-heads.

I intend using the old East River bridges in this comparison. In each of these cases, as with all old bridges throughout the City, we find that the approaches merge as quickly as practicable with the existing street system adjacent to the bridge-heads. At best they connect with a wide avenue or boulevard. The best of these have been widened and improved subsequent to the building of the bridges, but all of them are subject to cross traffic, traffic lights, left-hand turns, mixed traffic of all kinds and parking close to the bridges. While I believe we may, with fair certainty, pride ourselves upon the fact that we are planning further ahead today than formerly, we must, with the same certainty, admit that it is our duty to do so, for we have seen a development in the use of the automobile which was beyond any imagination years ago. Let us examine the reasons for the building of the older bridges and what has happened since.

The rapid growth of this country in industry and population brought with it enormous demands for transportation of freight and men. Between 1880 and 1930 more than 27,000,000 people immigrated into the United States and the total population increased

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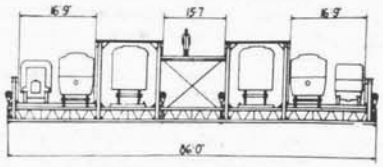
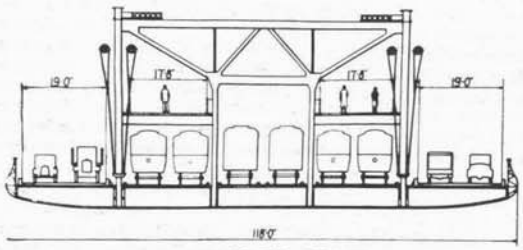
from 50,000,000 to 123,000,000. This gave a great impetus to building of bridges, particularly larger railroad bridges throughout the country. During this period the effect on cities was even more pronounced. The rapid influx of people due to the immigration and the inflow from farm to city, besides the normal increases, produced over-crowding and was followed by an overflow into suburbs. The travel of these people back and forth at definite periods between their homes and the mills, shops, stores and offices of the inner city created rush periods. Where large streams separated the sections of the city between which these immense crowds traveled, ferries became inadequate and forced the construction of long-span bridges to replace them. In New York City the East River created this problem and made necessary the construction of the Brooklyn, Williamsburg, Manhattan and Queensboro bridges. However, automobiles were still in their infancy and were not the primary consideration in the establishment of the facilities of the bridges and their approaches. It is also of interest to note that all these large bridges were built as toll structures with the idea that they would be at least self-sustaining and self-liquidating.

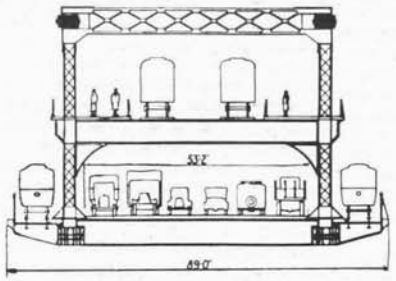
The Brooklyn Bridge was the first one to be realized after a long-felt need. It was suggested as far back as the first part of the nineteenth century, but at that time engineering knowledge had not developed sufficiently to design spans of the desired length nor was the necessity so great or the wealth of the community so able to finance it then as later. About 1840 considerable public attention was given to the subject but no definite steps were taken and interest waned. The public zeal was revived in 1857, however, when John A. Roebling, who had completed a suspension bridge over the Niagara River, suggested this type of bridge between Brooklyn and New York. The Civil War again interrupted the public interest and it was another ten years before an act passed the State Legislature on April 16, 1867, creating the New York Bridge Company, which was headed by Henry C. Murphy. John A. Roebling was appointed Chief Engineer on May 23, 1867. He proceeded with surveys and plans and out of three proposed locations chose the City Hall Park line as it would get the up-town traffic as well as the greater part of the down-town traffic in competition with the ferries. He also predicted a second bridge and a third would follow the first,—one to Williamsburg and the other across Blackwell's (now Welfare) Island. When these were built they would not compete as much as if the bridge were further north.



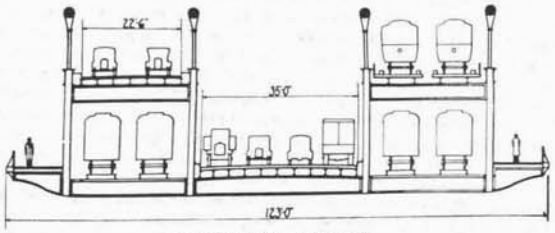

BROOKLYN BRIDGE
Opened 1883




WILLIAMSBURG BRIDGE
Opened 1903




QUEENSBORO BRIDGE
Opened 1909




MANHATTAN BRIDGE
Opened 1909

CROSS-SECTIONS OF OLDER EAST RIVER BRIDGES.

*Courtesy of Park Department and Parkway Authorities, City of New York.*

After considerable difficulties, Brooklyn subscribed $3,000,000 worth of stock and New York City $1,500,000, and $500,000 was to be subscribed privately. Eventually, the cost was $15,211,982.92, of which $483,000 was privately subscribed. Construction was started on October 25, 1869, and continued until the bridge was opened May 23, 1883. John A. Roebling died during the course of construction and his place as Chief Engineer was taken by his son, Colonel Washington Roebling.

The total length of the bridge was 6,016 feet and was, of course, a suspension bridge, with a main span of 1,595 feet 6 inches, the longest at that time. A study of a cross-section of the bridge will show the traffic needs of that day. It provided two roadways 16 feet 9 inches wide, two tracks for cable cars and a sidewalk 15 feet 7 inches wide. Locomotives were used to pull the cars during the lax periods as the cable operation was too expensive except for the rush periods. At first, the cars ran only across the bridge but, on January 23, 1898, street cars started to operate in the roadways and, on July 1, 1898, through trains were added. On January 27, 1908, the use of hauling cables for local trains was discarded entirely and through service on the elevated at all hours began. A glance at the toll rates gives a clear picture of the traffic of those days. On May 14, 1883, the following toll rates were set:

(1) Foot passenger, 1 cent.

(2) Passage in railroad cars, 5 cents.

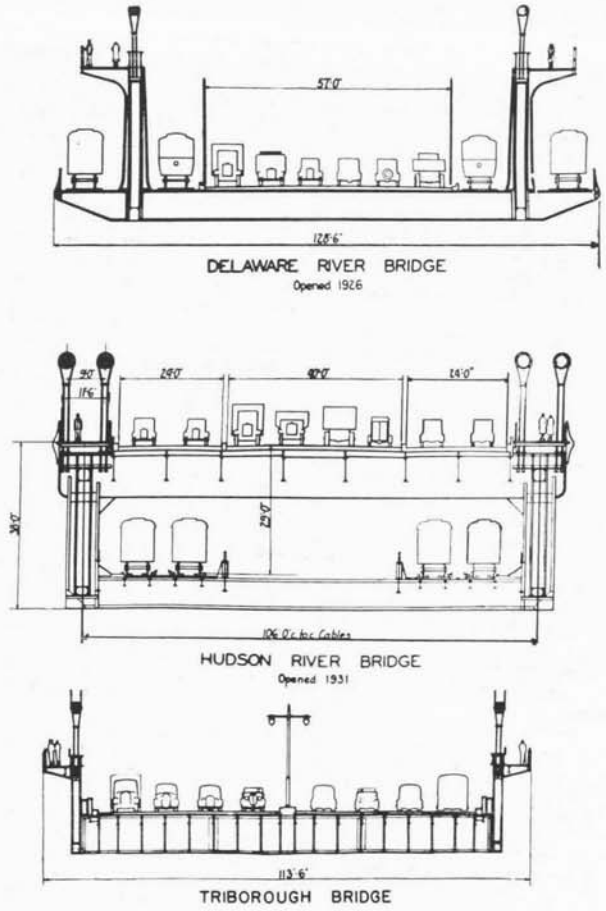
(3) Tolls for animals and vehicles:

One horse, or horse and man, 5 cents.
One horse and vehicle, 10 cents.
Two horses and vehicle, 20 cents.
Additional horses, each 5 cents.
Neat cattle, each 5 cents.
Sheep and hogs, each 2 cents.

Later various reductions in tolls were made and, on May 31, 1891, the tolls for foot passengers were abolished. On December 19, 1903, tolls were revised to 5 cents for a horse and 10 cents for two horses or an automobile, which applied on all East River bridges henceforth until all tolls were abolished on July 18, 1911. The bridge was taken over by the newly-formed Department of Bridges on January 1, 1898.

Let us now proceed to examine the other bridges of which the Williamsburg was next to be constructed. It was begun by the new

East River Bridge Commission but was taken over on January 1, 1902 by the Department of Bridges and was opened December 19, 1903. It was a suspension bridge with a main span of 1,600 feet (replacing the Brooklyn Bridge as longest by 4 feet 6 inches) and had a total length of 7,308 feet. The cross-section reveals that it




CROSS-SECTIONS OF VARIOUS BRIDGES.

*Courtesy of Park Department and Parkway Authorities, City of New York.*

provided two roadways 19 feet 11 inches wide, two rapid-transit tracks, four surface-car tracks and a footwalk 17 feet 8 inches wide. On January 30, 1932, the two surface-car tracks on the north side were abandoned and, on December 22, 1936, a new roadway 18 feet 2 inches wide was opened in place of it. This reflects the increased

demand for vehicular traffic accommodations since the opening of the bridge, although it by no means measures it. The added width was only the space available and not that desirable.

During 1901, work was started on the Queensboro Bridge in June and on the Manhattan Bridge in October. The Queensboro was opened to traffic March 30, 1909 and the Manhattan on December 21 of the same year.

The Queensboro Bridge was built as a continuous cantilever with a span of 1,182 feet across the west channel and a span of 984 feet across the east channel. It provided a roadway 50 feet 10 inches wide, one 9-foot 9-inch footwalk, two rapid-transit tracks and two surface-car tracks. On June 25, 1931, the upper-level roadway was opened. This was 22 feet 6 inches wide on the main structure and the need for additional lanes was so great that it was attempted to divide this into three lanes by running the cars in channels. This plan proved so unsatisfactory, however, that it was discarded after a few days' use and it is now used as a two-lane roadway. Here, again, a need for greater roadway capacity is evidenced but it is well to note that when traffic can clear away from the bridge-heads quickly there is no tie-up of traffic on the bridge itself. It is also very noticeable that tie-ups are more often a result of inability to get to or away from the Manhattan side of the bridge where the approaches are not nearly as good as on the Queens side.

The Manhattan Bridge, the last of the older East River bridges to be completed, is a suspension bridge with a main span of 1,470 feet and total length of 6,855 feet. It originally provided a 35-foot roadway, two footwalks, although the southerly one is the only one now in use, four rapid-transit tracks and four street-car tracks. However, on June 15, 1922, an upper-level roadway 23 feet 6 inches wide replaced the car tracks on the northerly side and, on May 18, 1931, an upper-level roadway 22 feet 6 inches wide replaced the car tracks on the southerly side, showing a constantly increasing need for vehicular facilities.

In passing, it would be well to note the width provided for each lane of traffic is in several instances very cramped. Eight and nine feet formerly were considered sufficient when vehicles were much slower and trucks and buses were very few. The 35-foot center roadway on the Manhattan Bridge is a particularly unhappy choice as it now must carry the trucking traffic in four lanes and it creates a very hazardous condition.

Let us now look at the use of these bridges as it has developed through the years. In all cases except the Brooklyn Bridge there is

a rapid increase from about 1916 to the present, with slight decreases during the depression years. The counts of vehicular traffic which I will quote are based on a 24-hour traffic count and are not strictly accurate as an average day over the year. On the Brooklyn Bridge in 1901 there were 3,960 vehicles per day; in 1921 there were 8,529 vehicles. From 1922 to 1924 autos were excluded and for those years the counts were 1,739, 1,341 and 1,328, respectively. In 1925 the count resumed with 9,261 and doubled the next year with 18,581, due, I believe, to restrictions on horse-drawn vehicles. From then it traveled to 25,940 in 1937, with 1936 the top year with 25,971.

EAST RIVER BRIDGES—24-HOUR TRAFFIC COUNT OF VEHICLES—1901 TO 1937

| YEAR | BROOKLYN | MANHATTAN | WILLIAMSBURG | QUEENSBORO | TOTAL |
|---|---|---|---|---|---|
| 1937 | 25,940 | 82,502 | 56,232 | 86,463 | 251,137 |
| 1936 | 25,971 | 88,465 | 48,249 | 83,729 | 246,414 |
| 1935 | 24,518 | 86,531 | 44,087 | 98,098 | 253,234 |
| 1934 | 23,818 | 83,874 | 46,288 | 103,151 | 257,131 |
| 1933 | 22,585 | 69,549 | 45,217 | 99,829 | 237,180 |
| 1932 | 24,287 | 63,631 | 43,170 | 98,054 | 229,142 |
| 1931 | 24,888 | 69,670 | 38,381 | 86,978 | 219,917 |
| 1930 | 22,540 | 65,828 | 48,565 | 90,259 | 227,192 |
| 1929 | 29,992 | 69,301 | 47,992 | 87,385 | 234,670 |
| 1928 | 22,247 | 59,453 | 41,183 | 71,618 | 194,501 |
| 1927 | 22,669 | 56,103 | 38,933 | 64,208 | 181,913 |
| 1926 | 18,581 | 57,187 | 36,096 | 59,488 | 171,352 |
| 1925 | 9,261 | 61,271 | 35,320 | 61,029 | 166,881 |
| 1924 | 1,328 | 50,956 | 28,955 | 35,085 | 116,324 |
| 1923 | 1,341 | 43,449 | 26,299 | 29,335 | 100,424 |
| 1922 | 1,739 | 37,668 | 22,870 | 28,094 | 90,371 |
| 1921 | 8,529 | 26,733 | 19,922 | 20,829 | 76,013 |
| 1920 | 5,188 | 20,785 | 17,480 | 17,858 | 61,311 |
| 1919 | 6,605 | 20,915 | 16,419 | 18,801 | 62,740 |
| 1918* | .... | .... | .... | .... | .... |
| 1917 | 5,060 | 14,359 | 10,277 | 13,431 | 43,127 |
| 1916 | 4,590 | 11,272 | 9,314 | 9,858 | 35,034 |
| 1915 | 4,359 | 9,400 | 8,838 | 9,505 | 32,102 |
| 1914 | 3,983 | 7,616 | 7,191 | 7,207 | 25,997 |
| 1913 | 4,214 | 6,046 | 7,417 | 6,574 | 24,251 |
| 1912 | 3,913 | 4,823 | 5,924 | 3,644 | 18,304 |
| 1911 | 3,574 | 4,446 | 5,292 | 2,352 | 15,664 |
| 1910 | 3,023 | 3,713 | 5,562 | 2,417 | 14,715 |
| 1909 | 5,044 | .... | 5,591 | .... | 10,635 |
| 1908 | 4,138 | .... | 4,145 | .... | 8,283 |
| 1907 | 3,625 | .... | 4,305 | .... | 7,930 |
| 1906 | 3,805 | .... | 4,209 | .... | 8,014 |
| 1905 | 3,702 | .... | 3,099 | .... | 6,801 |
| 1904 | 3,638 | .... | 2,893 | .... | 6,531 |
| 1903 | 3,677 | .... | 1,835 | .... | 5,512 |
| 1902 | 3,938 | .... | .... | .... | 3,938 |
| 1901 | 3,960 | .... | .... | .... | 3,960 |

* No count taken in 1918.

Manhattan Bridge opened to traffic, December 31, 1909; Williamsburg Bridge opened to traffic, December 19, 1903; Queensboro Bridge opened to traffic, March 30, 1909.

The Manhattan Bridge was as follows: 1910—3,713 vehicles per day; 1916—11,272 vehicles; 1936, tops, with 88,465; 1937—82,502.

The Williamsburg Bridge shows: In 1903—1,835; 1916—9,314; 1937—56,232, the top year.

The Queensboro Bridge shows: In 1910—2,417; 1916—9,858; 1934—103,151, the top year, and in 1937—86,463. It quite evidently has been cut somewhat by the opening of the Triborough Bridge.

It must be apparent to all of us who have lived through the last twenty years that the most astonishing change in the method of travel has been in the increased use of the automobile. Rapid transit has made great strides but, as you see from an examination of the old bridges, this was anticipated from the first bridge and its needs have been more adequately provided for through the creation of subways and tunnels as well as elevated lines which in no way are interfered with by our crowded streets. With the automobile there is a distinct difference from the old way of travel by horse-drawn vehicles.

Many great highway systems have been built outside of the cities. Speeds have constantly increased and the range is no longer local but unlimited. Travel is fast and time has become essential. The automobilist is therefore willing to pay for the use of through routes providing undelayed travel.

With the depression came a number of aspects which changed the financial picture in regard to the building of long-span bridges. Where municipalities and government agencies hitherto could build bridges only by borrowing funds, which were paid back from general taxation, the possibility now offered itself to build, maintain and amortize the costs of first-class bridges within a reasonable number of years. With the depression came a demand for creative work, which made the use of this method all the more desirable. The opportunity was quickly seen and taken. Practically all long-span highway bridges built in recent times are toll bridges. Included among these were the bridges of the Port of New York Authority, the New Orleans, the Triborough, the Golden Gate, San Francisco-Oakland Bay bridges, Henry Hudson Bridge and the Marine Parkway Bridge. As the demand for these bridges was created by automobile traffic, it became necessary to put the various projects on a paying basis by developing routes leading to them, which would make their use preferable to other existing free structures. This served a double purpose in that it advanced the construction of routes, which were sorely needed to relieve the congestion on the street systems, and also by

eliminating congestion at bridge-heads. It made usable the full capacity of pavement widths placed on the bridge. This, in turn, reduced the cost of bridge structures in that it was unnecessary to provide pavement areas which at times on the older bridges merely acted as traffic reservoirs. The problem finally resolved itself to the following:

1. That it was advantageous to build the structures as toll bridges.

2. That, in order to be self-liquidating, it was necessary to be as economical in design as possible.

3. From the standpoint of both financial income to these projects and also for the relief of congested street systems, as well as to provide a more enjoyable and satisfactory use of the automobile, it was necessary to provide express traffic arteries long distances from the bridge-heads.

In New York City, the problem of traffic relief was acute and a logical system of through-traffic arteries was a necessity, in any case. Therefore, a system had been developed which covered the entire City and the construction of this system had been carried forward as fast as possible and planned ahead for many years. This in New York City to a large extent took the form of parkways. This program was headed by Park Commissioner Robert Moses, a man of exceptional ability as an organizer and administrator. As head of the Triborough Bridge Authority, the Marine Parkway Authority, the Henry Hudson Parkway Authority, the Long Island State Park Commission and the State Council of Parks, as well as the Park Department of the City of New York, he is able to coordinate the efforts of all these agencies in the development of a connected system in and adjacent to the City of New York. In this way, the approaches to the Triborough, the Henry Hudson, the Marine Parkway and the Whitestone bridges become links in a great system and where it became impossible to carry the approaches further from the various projects through their own funds, the activities of the other agencies were brought to bear to supply the missing links.

A study of the map will show the existing as well as the proposed system.

In Westchester County we have the Sawmill River Parkway leading from upper New York State into the Henry Hudson Parkway at the New York City line on the westerly side of The Bronx. The Bronx River Parkway leads into the center of The Bronx and the

Hutchinson River Parkway carries into the easterly part. In Westchester the Cross County Parkway connects the Sawmill River, Bronx River and Hutchinson River parkways. The Merritt Parkway leads from the Hutchinson River Parkway into Connecticut and eventually it is proposed to carry across that state to its northeast corner comparatively near Boston.

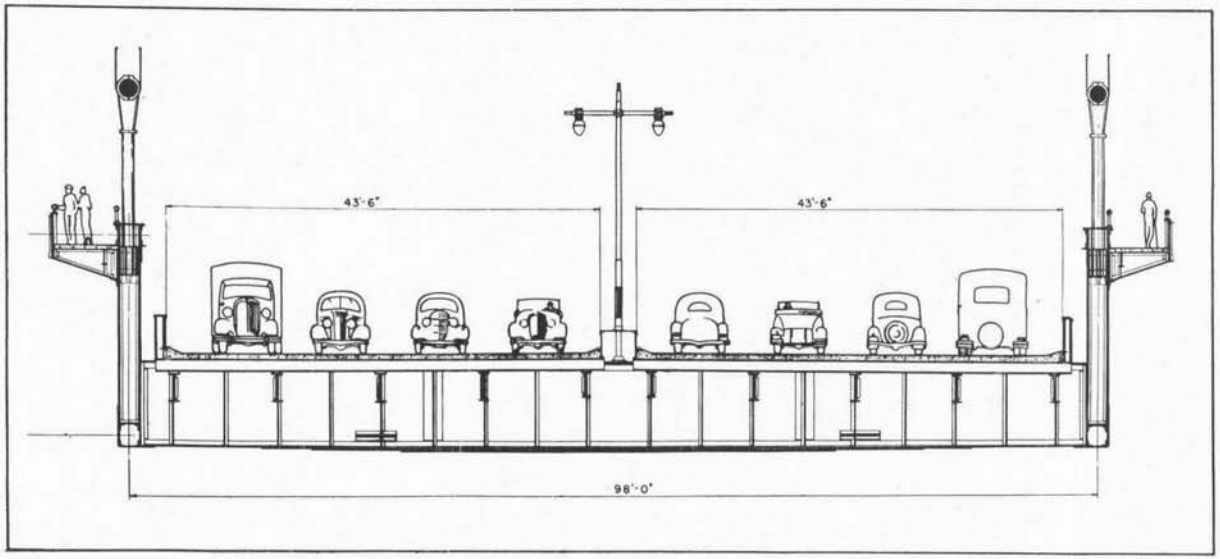
Inside New York City in The Bronx, the Hutchinson River Parkway has been extended to Eastern Boulevard which leads to the Triborough Bridge through Whitlock Avenue and Southern Boulevard. This route is to be improved further as an express mixed-traffic artery. The Hutchinson River Parkway is to be extended further as a direct connection to the Whitestone Bridge.

The Bronx River Parkway is to be extended southerly to Eastern Boulevard and through that artery feed both the Triborough and Whitestone bridges. The Mosholu Parkway, which will be rebuilt and extended, leads from the Sawmill and Henry Hudson parkways to the Bronx River Parkway Extension and the Bronx and Pelham Parkway will cross-connect to the Hutchinson River Parkway.

The Henry Hudson Parkway, starting from the Sawmill River Parkway, leads through The Bronx, over the Henry Hudson Bridge into Manhattan and along the Hudson River to 72nd Street, joining the West Side Express Highway carrying to Canal Street. On the way, it connects with the George Washington Bridge and the Midtown and Holland tunnels leading to New Jersey and the Eastern States. In the future, the West Side Express Highway will lead to the Battery-Hamilton Avenue Tunnel and an express highway which will connect with the Shore Parkway or Brooklyn Circumferential Parkway (connecting with the Marine Parkway Bridge to the Rockaways) and leading by way of the Southern Parkway and Cross Island Parkway back to the Whitestone Bridge and the Bronx parkways. We should realize in passing that this system makes a complete loop around the City of New York (excepting Staten Island).

In central Queens we have the Interborough Parkway, Grand Central Parkway, Grand Central Parkway Extension and Whitestone Parkway connecting with the Triborough and Whitestone bridges and providing inter-travel with Eastern Long Island through the Northern and Southern State parkways.

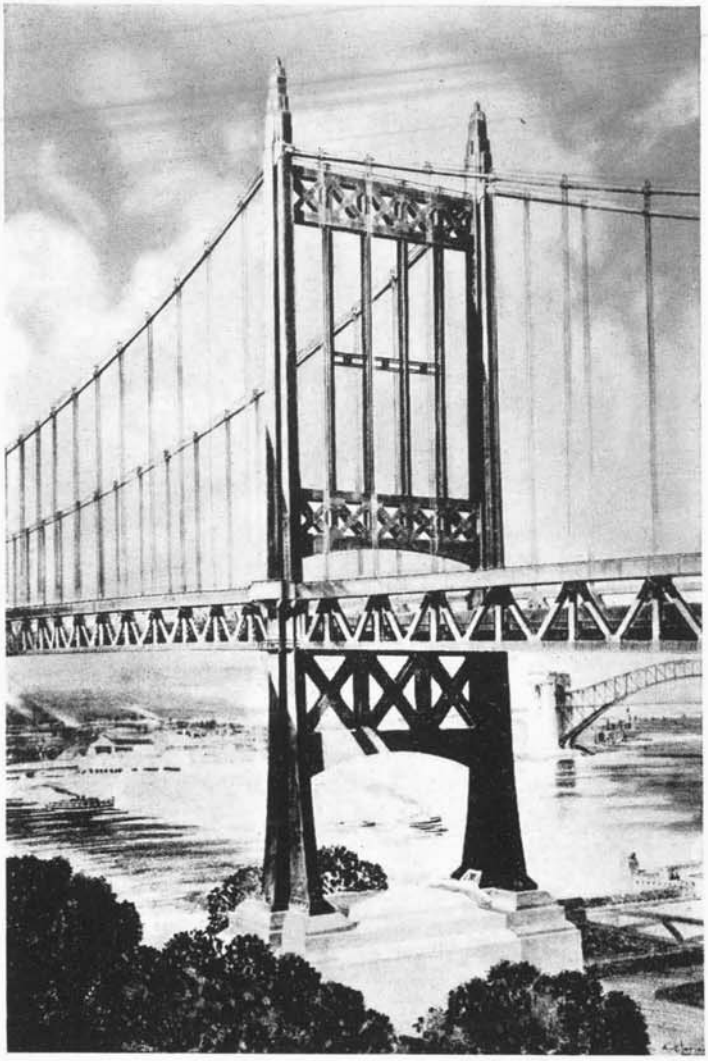
In Manhattan, the East River Drive is partly constructed and is proposed to border the entire East River and most of the Harlem River.




CROSS-SECTION, TRIBOROUGH BRIDGE.

*Courtesy of Park Department and Parkway Authorities, City of New York.*

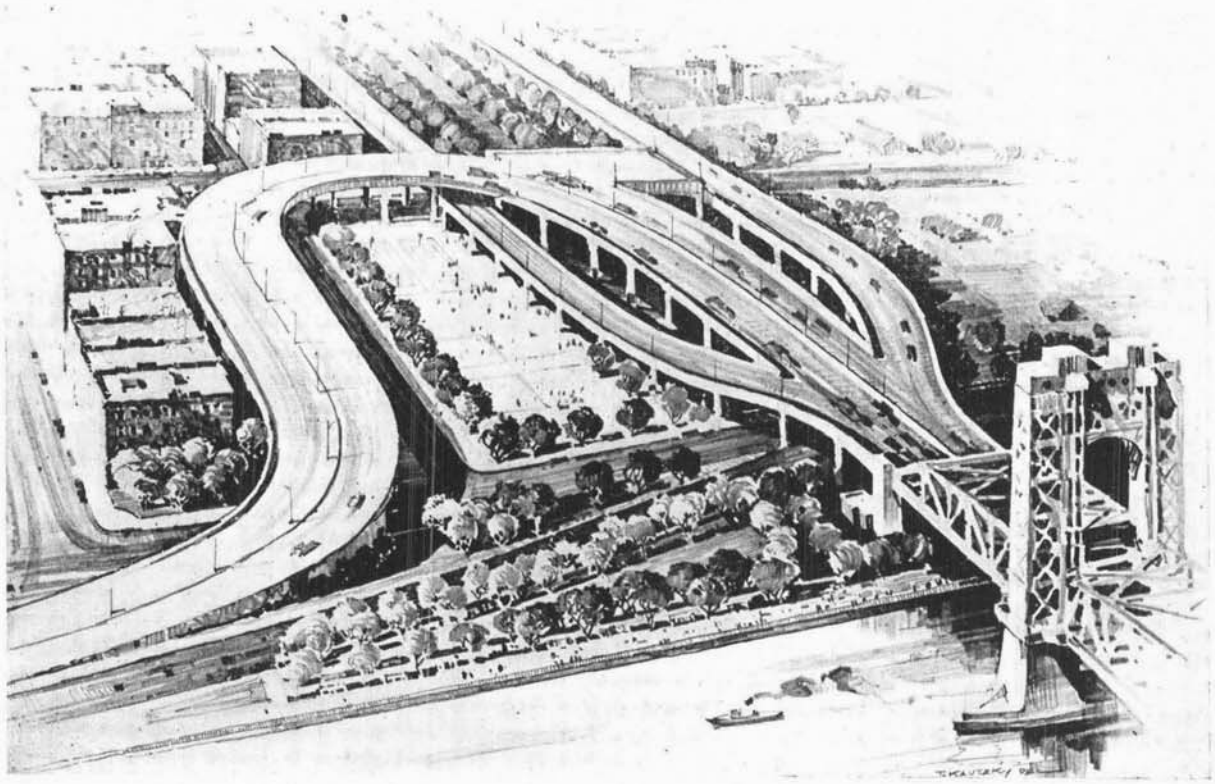
We should pause to realize what this long enumeration of parkways means. Consider that eventually a person could leave Boston



TRIBOROUGH BRIDGE, HELL GATE CROSSING.

*Courtesy of Park Department and Parkway Authorities, City of New York.*

in the morning and go swimming in the Rockaways in the afternoon after a pleasant drive uninterrupted by red lights or cross traffic. A person can proceed easily from one part of the City to any other



MANHATTAN APPROACH, TRIBOROUGH BRIDGE.

*Courtesy of Park Department and Parkway Authorities, City of New York.*

part. Through traffic can proceed through the City without stopping and without crowding the City streets. The crowds from the City can escape the summer heat by pleasant and expeditious drives to the country and beaches.

Let us now review the Triborough Bridge project. The Bridge Authority was created in 1933. Before the creation of the Authority the City had spent $5,400,000 in the acquisition of land for the bridge-heads and the construction of anchorages for the proposed suspension bridge across the East River. After the Authority was created the City appropriated $10,700,000; the Authority borrowed $35,000,000 and received a P.W.A. grant of $9,200,000, making a total of $60,300,000. Of this, $23,700,000 was spent for land for the bridge and approaches, $23,400,000 for the bridge construction, and $13,200,000 for highway and parkway approaches to the bridge. When you realize that almost half of this great sum was spent to provide adequate approaches, you gather the importance now attached to this part of the problem.

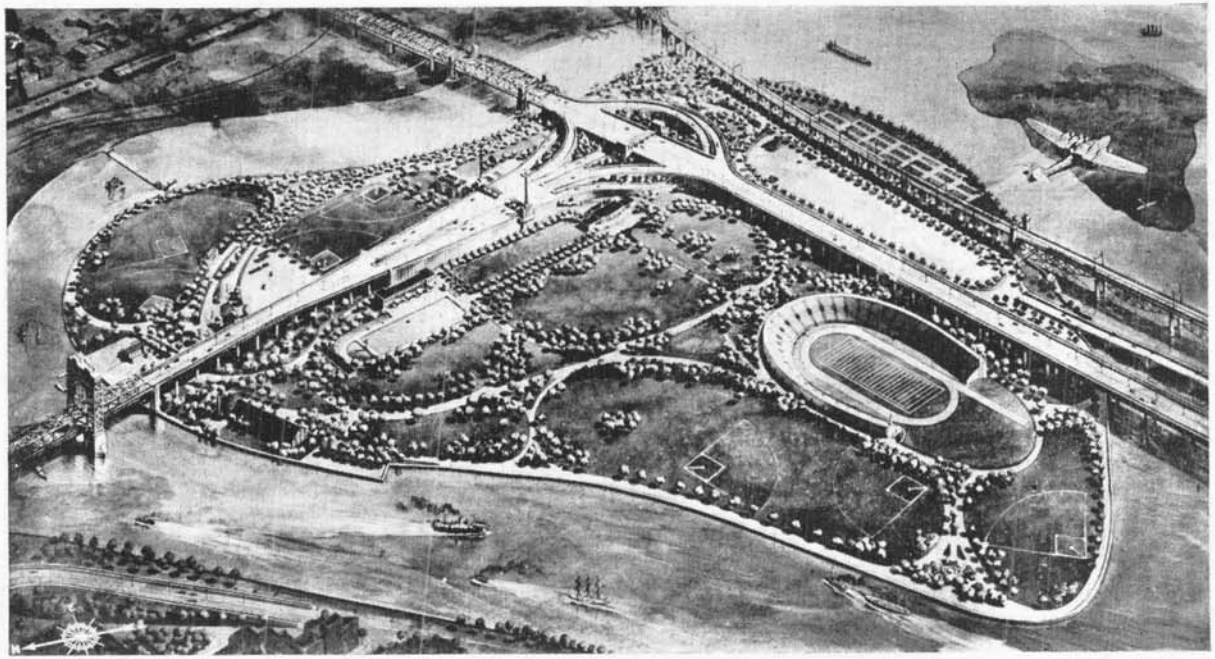
The Triborough Bridge and its approaches are 17½ miles long, with four water crossings and twelve bridges on land, besides the 3½-mile main structure. The following statistics, compiled by the Authority, give an interesting description of this immense project.

Work on the bridge was begun on October 25, 1929, by the City of New York acting through the Department of Plant and Structures. Discontinued in the spring of 1932 because of lack of funds, it was resumed in November, 1933, by the Triborough Bridge Authority and completed in July, 1936.

On the bridge proper, exclusive of highways, 83,500 tons of steel and 400,000 cubic yards of concrete were used. The concrete would have paved a four-lane highway from New York to Philadelphia.

The suspension bridge over the East River at Hell Gate has a main span 1,380 feet long between towers and two side spans each 705 feet in length. The pair of 20¾-inch suspension cables pass over two 315-foot towers and are embedded in 59,000 cubic yards of concrete at the Ward's Island anchorage and 74,500 cubic yards on the Queens side. The deck of the bridge is 135 feet above the river and 98 feet wide. It contains two four-lane roadways, separated by a central curb, and sidewalks.

The Harlem River Crossing includes three truss spans with a total length of 772 feet and a vertical lift span 310 feet long. The lift span weighs 2,050 tons and its 29,000 square feet of deck space is greater than that of any other lift bridge. It carries two three-lane

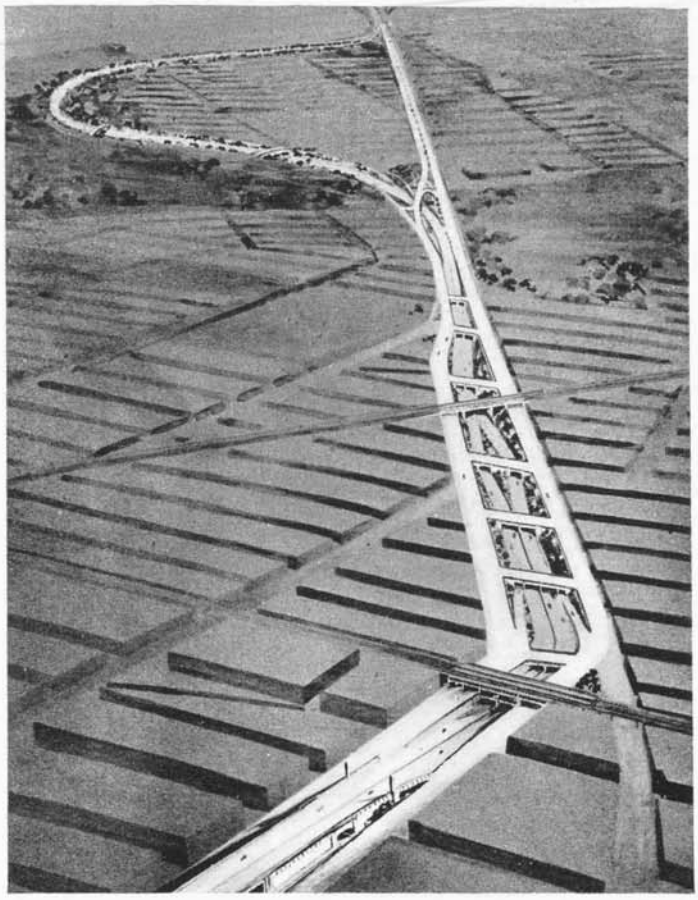


RANDALL'S ISLAND JUNCTION, TRIBOROUGH BRIDGE.

*Courtesy of Park Department and Parkway Authorities, City of New York.*

roadways and sidewalks and, when closed, is 55 feet above the river. The electric motors in the two 210-foot towers can lift it 80 feet higher to permit the passage of large vessels.

The Bronx Kills Crossing consists of three truss spans with a total length of 600 feet. The 350-foot center span can be converted into



QUEENS APPROACH, TRIBOROUGH BRIDGE.

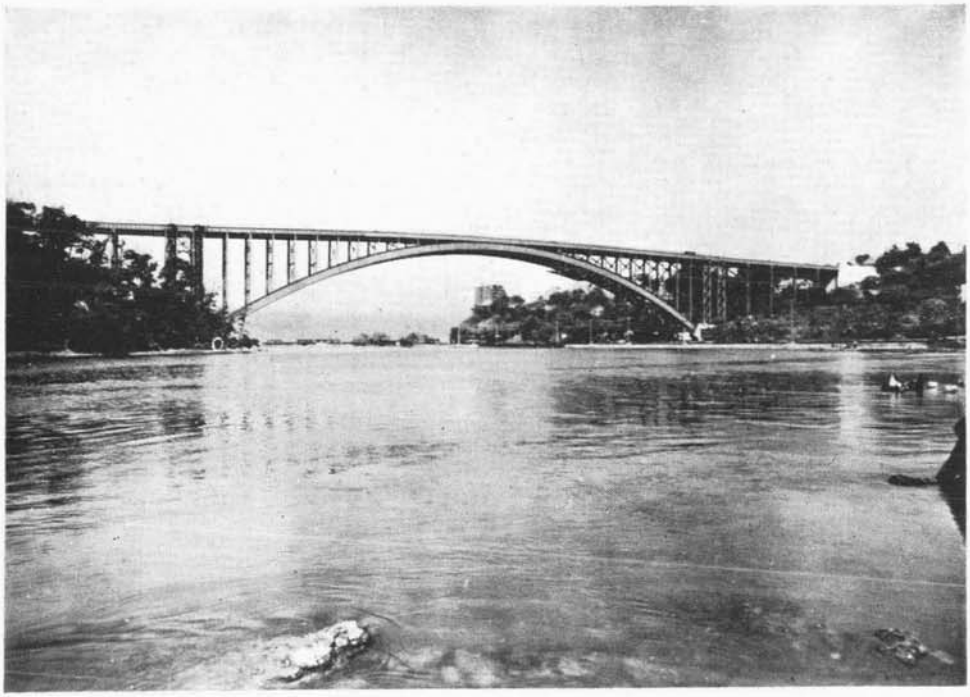
*Courtesy of Park Department and Parkway Authorities, City of New York.*

a vertical lift bridge if the Kills are ever made navigable. Weighing 2,900 tons, it would be the largest lift span ever built. It carries two four-lane roadways and sidewalks.

The East River Drive, Manhattan approach to the bridge, is 1½ miles long, extending from York Avenue and 92nd Street to 122nd

Street. The two roadways are three lanes wide. Between them is a 15-foot safety aisle, and along the water-front a 40-foot landscaped mall.

The Queens approach is 6¼ miles long and includes Grand Central Parkway Extension and a widened Astoria Boulevard. The parkway is six lanes wide and the boulevard eight. At St. Michael's Cemetery the two converge and enter an eight-lane depressed highway which leads directly to the bridge a mile away.



HENRY HUDSON PARKWAY BRIDGE.

*Courtesy of Park Department and Parkway Authorities, City of New York.*

The Bronx approach also is 6¼ miles long. Its width varies from six to eight lanes. It represents a widening and repaving of Southern Boulevard, Whitlock Avenue and Eastern Boulevard to Pelham Bay Parkway.

The Henry Hudson Bridge was contemplated as far back as the beginning of the century. An appropriation for plans was made as far back as 1904. The land at Spuyten Duyvil, where the Henry Hudson Monument now stands, was acquired over 30 years ago.

Nothing constructive progressed until the act creating the Henry Hudson Parkway Authority in 1934. From that point on things moved quickly. Surveys and plans for the bridge and parkway were made and a bond issue of $3,100,000 was negotiated. Work progressed quickly until the opening of the bridge on December 12, 1936. A 4¼-mile section from the north end of Riverside Drive to the Sawmill River Parkway at the City line was completed, partly by the Authority and partly by the State Department of Public Works.

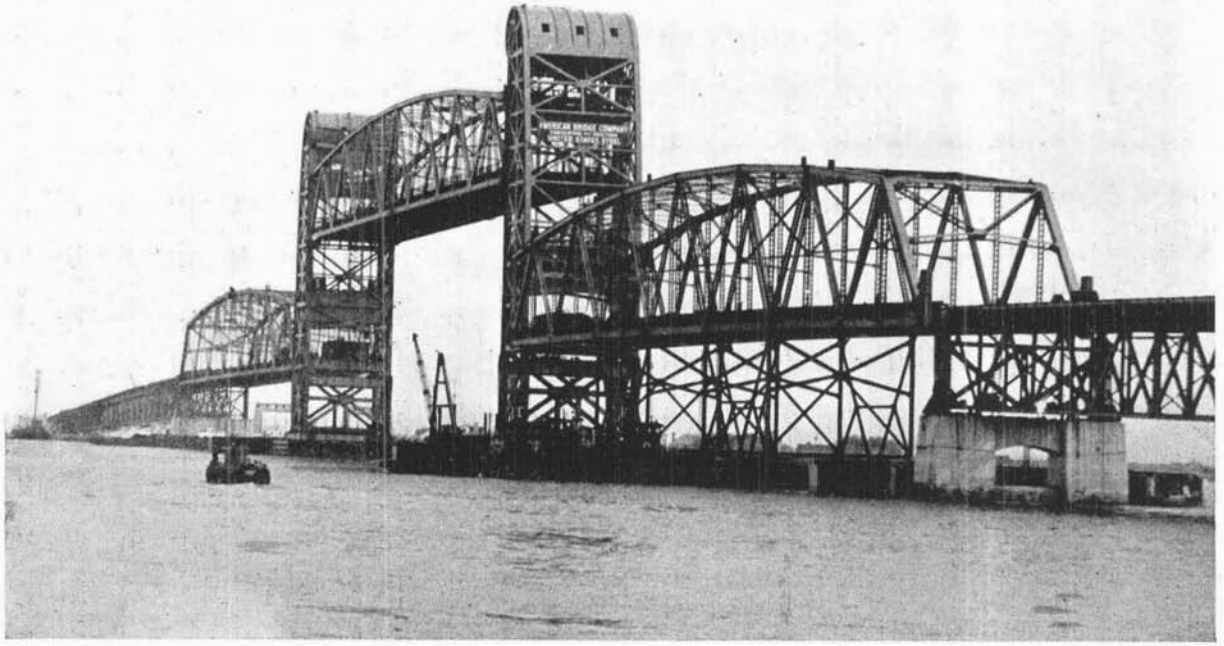
The Henry Hudson Bridge is a rigid arch of 840 feet between piers with a clearance of 142.5 feet above mean high water at the center of the arch. Its total length is approximately 2,000 feet. It is the largest bridge of its type in the world and its design lends itself to the high land at either end of the bridge.

At the same time, the West Side Improvement was being constructed by the Department of Parks, including the Henry Hudson Parkway between 72nd Street and the north end of Riverside Drive. The section between 72nd Street and the George Washington Bridge was opened on Columbus Day of last year. The remaining section between the George Washington Bridge and Dyckman Street was opened on January 15 of this year.

The Henry Hudson Parkway Authority, anticipating a great increase in traffic on the completion of the West Side Improvement, negotiated an additional bond issue of $2,000,000 in July of last year and proceeded with the plan and construction of an upper deck on the Henry Hudson Bridge, additional parkway roadway to Inwood Hill Park and the widening of Henry Hudson Parkway to Kappock and 239th Streets in The Bronx. It is expected to open these added facilities about May of this year.

This Parkway, together with the West Side Highway, is perhaps destined to be the most important link of all in the metropolitan arterial highway and parkway system, and may readily become the most heavily traveled artery in the world. Besides an ever-increasing uptown and downtown Manhattan traffic, it is a fast direct route for traffic between New England, Upper New York State and The Bronx with Brooklyn, New Jersey and the eastern states and, to a large extent, the tourists from the entire United States. It is a true parkway and one of the most beautiful, overlooking the Hudson River.

Under an Act of the State Legislature in 1934, the Marine Parkway Authority was created. Late in 1935 a bond issue of $6,000,000 was negotiated which carried on the construction of Marine Parkway Bridge from the end of Flatbush Avenue to Jacob Riis Park and, in



MARINE PARKWAY BRIDGE (SHOWING A FLANKING SPAN BEING FLOATED INTO PLACE).

*Courtesy of Park Department and Parkway Authorities, City of New York.*

conjunction with W.P.A. work progressed under the Department of Parks, reconstructed the entire park and made traffic connections with Rockaway Beach Boulevard and the Beach Channel Drive which is now being constructed by the Borough President of Queens.

The Marine Parkway Bridge has a total length of 4,022 feet and 6 inches, with a 44-foot roadway and a 6-foot sidewalk. The three main spans each give a 500-foot clear channel. The two flanking spans give a clearance of 50 feet above mean high water, while the center span has a clearance of 55 feet when lowered and 150 feet

MARINE PARKWAY BRIDGE, SHOWING OPEN TYPE OF FLOORING.

*Courtesy of Park Department and Parkway Authorities, City of New York.*

when raised. The total length of the vertical lift span is 540 feet,—the longest highway lift span in the world. The total weight of steel is 12,000 tons and the total volume of concrete is 47,000 cubic yards. The three long spans have an open steel grating as a floor or roadway, to lighten the dead load.

The Marine Parkway is the only direct connection between Brooklyn and the Rockaways, leading from the end of Flatbush Avenue across Rockaway Inlet to Jamaica Bay. It is planned to connect with the City arterial system through the Circumferential or Shore Parkway. At its south end is Jacob Riis Park, the best developed

ocean-front park in the City, with its fine beach, boardwalk, bathhouse, game areas, malls, golf course, and 72-acre concrete parking field, which I believe to be the largest hard-surfaced parking field in the world. It will accommodate 15,000 cars, and is so large it has its own telephone system to facilitate the operation.

Last year the Triborough Bridge Authority, which has been empowered to construct the Whitestone Bridge, increased its bond issue by $18,000,000 and began the construction of this important bridge, which is scheduled to be completed in time for the World's Fair.

The Whitestone Bridge is a suspension bridge, with main span approximately 2,200 feet in length. These long spans are now possible because of the development of higher strength steels and due to the fact that highway bridges have a relatively higher dead load and a smaller live load than bridges carrying rapid transit. They particularly lend themselves to the suspension type bridge when the weight can be kept down.

This bridge will connect with the arterial system through the Whitestone and Cross Island parkways on the Queens end and the Hutchinson River Parkway extension on The Bronx end. It will be particularly valuable for traffic from New England and The Bronx to Queens, Brooklyn and Eastern Long Island, and *vice versa*.

It might be well here to review the last few bridges. The main span of the Triborough Bridge was, of course, a suspension bridge of 1,380 feet. The Whitestone Bridge is to be a suspension bridge with a 2,200-foot main span, which, I understand, will be the fourth longest in the world. The Henry Hudson Bridge, due to the high land on either side and the length of the span, 840 feet, more properly lends itself to a rigid arch. This is the longest through-plate girder rigid arch in the world.

The Marine Parkway Bridge, with a length of slightly under 4,000 feet, might properly have been a suspension bridge except for the narrowness of Jacob Riis Park and the long length of approach necessary to get the grade of a suspension bridge down to earth in a low terrain, coupled with the fact that Floyd Bennett Air Field made it a necessity to keep the highest part of the structure as low as possible in order not to endanger fliers using that field; therefore, a vertical lift span of 540 feet in length was introduced in the center and was flanked by two other spans of equal length which are stationary.

Before closing, I would like to touch on the design of the approaches in general terms. The approaches are mainly parkways

restricted to pleasure traffic in the center roadways and flanked by border roads for mixed traffic. The center or express roadways are divided in the newest designs to provide one-way traffic in each direction. Landscaped areas are provided in the center dividing strips and on the sides to make them true parkways pleasant to ride on, as well as efficient and fast traffic carriers. All crossings at grade are eliminated by bridges and the entrances and exits are so designed that turns across traffic are not necessary or allowed. Grades are held as flat as possible and all curves are long radius and carefully superelevated where necessary. Concrete paving is used to provide the best non-skid, permanently smooth riding surfaces with a minimum of maintenance. Utilities and manholes are kept from under the pavements to the fullest extent possible to avoid tearing up the pavements for repairs and to avoid the necessity of riding over manhole covers. Landscaping is designed to intercept the glare of opposing headlights from adjacent roads. No bicycles, horse-drawn vehicles or pedestrian crossing, except at bridges, are allowed. Everything is done to provide for a smooth, swift, uninterrupted flow of traffic through pleasant surroundings.

The traffic schemes, or layout of roadways, are a matter of special study, varying from simple straight exits into a parallel border road to clover-leaf intersections and still more complicated layouts at the junction of parkways and important thoroughfares, as, for instance, the "pretzel" at the junction of the Grand Central and Interborough parkways in Queens. There are distinct principles followed in the development of these layouts, however, which make them easy to follow through no matter how complicated they may seem on a plan. Besides eliminating all cross traffic and left-hand turns, they are designed to carry the main lines of traffic straight through. They must avoid forcing on the driver a choice of taking one out of more than two roads. In other words, do not have more than two diverging roadways at any one point. Signs must be most carefully planned to clearly mark a choice of routes, and the driver must be warned as he approaches so that he may be on the proper side of the road when he arrives at the choice of routes. Neon signs in different colors may be necessary at the more important route splits. Streamlined traffic is still in its infancy, but its importance is being realized more strongly every day. New ideas are being developed and put into practice constantly. They must be adopted cautiously but never be thrown aside lightly.

## Abstracts from the Discussion

GEORGE E. SPARGO,* M.M.E.N.Y.—There is one point that I do not think Mr. Taylor emphasized sufficiently. Perhaps he thought that you were all acquainted with the problem. The reason we did not construct the upper level on the Henry Hudson Bridge in the first instance was because the bankers were hesitant about granting the full $5,000,000 needed to build the complete bridge. This was their first experience with one of Commissioner Moses' projects and they preferred to wait until they saw the money coming in but agreed that if traffic came up to the estimates that the engineers made, the money would be made available.

EMIL H. PRAEGER.†—I can add very little to what has already been said. Mr. Taylor indicated that a large percentage of the cost of these projects has been spent for the approaches. This is particularly true in the case of the Henry Hudson Bridge, where the bridge itself took less than half of the total appropriation.

In the case of the Henry Hudson Bridge there was a reason for building two levels rather than one, in addition to the reason given by Mr. Spargo. The topography, especially on the south side, is such that it lends itself better to a two-level bridge than it would to a one-wide-surface bridge as a wide approach pavement would mar the landscape.

I think that the day of plaza to plaza bridges is at an end. In practically all of our projects extreme thoroughness was exercised in the study of connecting conditions, and if the same amount of study had been given to the old East River bridges they could carry a great deal more traffic than they do now.

MR. PRAEGER (answering a question on the measures taken to protect the grating on the Marine Parkway Bridge).—One shop and three field coats of paint were used. I think in future jobs it would be well to galvanize the metal, although we did not galvanize it in this case. Of course, there will be a certain amount of maintenance but not much more than the maintenance on the remainder of the bridge.

MR. TAYLOR (answering a question on the maximum grades used on the bridges).—On the parkway and main roadways, we tried to

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keep to a grade of not more than 3½ per cent., but this was not followed in all cases because of economical considerations. The steepest grades we have on the Henry Hudson Bridge are slightly over 6 per cent. These grades are not inconvenient since these parkways are limited to pleasure cars. Grand Central Parkway in Queens has not a single grade over 3½ per cent. or a single curve of less than 2,000-foot radius. We try to hold these as minima, but these are not the controlling factors, where the cost of trying to apply these standards outweighs the benefits.

JOSEPH C. O'DEA,* M.M.E.N.Y.—Have you reached any decision as to the proper width of the malls for the separation of traffic? Is there any special treatment or batter to the curbs?

MR. TAYLOR.—We usually use a battered curb, but we batter them only slightly because cars will mount them easily. In some cases we used a 3-inch curb on parkways but this is practically no protection and does not keep a car from mounting the curb. We prefer a mall from 10 to 20 feet wide. A minimum of 2 feet for separating roadways on bridges may be used.

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