VICTORY BRIDGE
(State Bridge No. 1223-150)
New Jersey Route 35, spanning the Raritan River
Perth Amboy
Middlesex County
New Jersey

HAER No. NJ-120

HAER
NJ
12-PERAM,
5-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Northeast Region
Philadelphia Support Office
U.S. Custom House
200 Chestnut Street
Philadelphia, Pennsylvania 19106

HAER
NJ
12-PERAM,
5-

# HISTORIC AMERICAN ENGINEERING RECORD

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HAER No. NJ-120

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| **Location:** | New Jersey Route 35, spanning the Raritan River<br>Perth Amboy, Middlesex County, New Jersey<br><br>UTM: 18.560060.4484220<br>Quadrangles: Perth Amboy, N.J.-N.Y. and South Amboy, N.J.-N.Y. 1:24,000 |
| **Date of Construction:** | 1924-1926 |
| **Designer:** | Clarence W. Hudson, Supervising Engineer |
| **Fabricator:** | Bethlehem Steel Company, Bethlehem, Pennsylvania |
| **Builder:** | Stillman-Delhanty-Ferris, Jersey City, New Jersey |
| **Present Owner:** | New Jersey Department of Transportation<br>1035 Parkway Avenue<br>Trenton, New Jersey 08625 |
| **Present Use:** | Vehicular bridge |
| **Significance:** | This 360 foot center-bearing swing span bridge with steel deck girder and concrete bent approach spans is significant as the largest and most recent example of a highway bridge of its type in the State of New Jersey. The bridge possesses a high degree of integrity. Much of the original equipment, including the direct-current motors, is still functional. |
| **Project Information:** | Because of poor geometry of the approaches, the narrowness of the bridge deck, and the deterioration of the bridge, the New Jersey Department of Transportation plans to replace the bridge with a high-level, fixed-span bridge on the same alignment. Preparation of Historic American Engineering Record documentation is intended to mitigate the adverse effect of demolition of the bridge. Documentation prepared 1998 by:<br><br>Richard Meyer/Senior Project Manager<br>Douglas C. McVarish/Project Architectural Historian<br><br>John Milner Associates, Inc.<br>535 North Church Street<br>West Chester, Pennsylvania 19380 |

## SUMMARY DESCRIPTION OF BRIDGE AND SETTING

The Victory Bridge (State Bridge No. 1223-150) carries New Jersey Route 35 over the Raritan River in the City of Perth Amboy and the Borough of Sayreville, Middlesex County, New Jersey. Route 35, now used primarily by local traffic, extends from Woodbridge, Middlesex County, to Seaside Park, Ocean County. A petroleum storage depot is situated west of the north bridge approach on the north bank of the Raritan River, and large industrial buildings are located east of the north bridge approach. Tidal wetlands flank the south bridge approach, which is elevated on filled land.

The bridge is located near the eastern end of the Raritan River about 2.7 km (1.7 miles) from its mouth at Raritan Bay. The Raritan River, one of the major rivers of central New Jersey, has its source in two branches. The headwaters of the North Branch are in Mendham Township, Morris County, while the headwaters of the South Branch are in Franklin Township, Hunterdon County.

### The Victory Bridge

Built in 1924-1926, the 53-span Victory Bridge consists of a camelback Warren through truss, a center-bearing, swing main span, and 16 deck girder and 36 concrete stringer spans. The 110m (360 ft.) long riveted truss swing span is constructed of steel plates, angles, and channels joined by lattice bars. The steel grid bridge deck consists of a steel grid, resting on transverse I-beams. The Victory Bridge has the longest swing span in the State of New Jersey. The swing span rotates atop a central, cylindrical, ashlar pier with concrete cap. The operator's house is located above the center pier in the truss bracing. The apex of the bridge truss is marked by an electric navigation lamp, raised on a steel conduit.

The north (Convery Boulevard) approach to the bridge is elevated above surrounding ground level on an earthen embankment. Sidewalks extend along both sides of the four-lane roadway. Steel guiderails extends along the outer edges of the sidewalk. A concrete retaining wall retards erosion of the west side of the embankment slope. The south approach is elevated above the surrounding land on concrete bents. These bents have been concealed by the filling of the adjacent land.

The swing span of the Victory Bridge rotates atop Pier 14, while the ends of the swing span are supported by rest piers 13 and 15. These piers are founded on underlying rock. The pivot pier measures 15.2m (50 ft.) in diameter and is sheathed in rock-faced granite. The two rest piers are also sheathed in rock-faced granite. A metal ladder and wood stairway extend down from the bridge deck to the base of the pivot pier. Piers one (1) through 12 (on the north or Perth Amboy approach) and 16 through 26 (on the south or Sayreville approach) are supported by pilings driven to refusal in the Raritan River.

The deck girder approach spans have steel floor beams and stringers supporting the deck and rest on concrete and ashlar piers. These battered piers extend beyond the sides of the bridge deck. The pier top is a bridge seat which supports the girder bearings. Outboard of the bearings there are vertical concrete posts, which act as cheek walls extending up to the bottom of the cantilevered sidewalks and obscuring the simple span girder ends when seen from the river. This pier top arrangement resembles a saddle when viewed from below in the direction of the roadway. The sides of these saddles form broad concrete posts that extend to the top of the railings. Originally, concrete obelisk light standards crowned these posts, but these standards were removed during bridge renovations. Some of these posts are now crowned by steel standards containing modern light fixtures. The remaining 36 spans are constructed of stringers, each continuous over three spans. These spans are used on the land approaches.

The south viaduct spans are raised on concrete piers, square in section, spaced six across beneath the bridge deck. The outermost of these piers are ornamented by projecting square bases and caps with beveled edges. These piers are supported by a grid of piles, driven into the ground surface. The railings of the viaduct spans consist of rectangular concrete panels, pierced with Roman-arched rectangular openings. Posts mark each group of nine concrete panels. As with the deck girder approach spans, the posts (saddles) were originally crowned with concrete obelisks, used as light standards. These obelisks have been removed, and some have been replaced by steel light standards with modern fixtures.

The ends of the bridge are marked by paired battered concrete pylons. Bronze plaques are mounted on the west pylon at the north end of the bridge and the east pylon at the south end of the bridge. The plaques, identical in text, identify the structure as the Victory Bridge and indicate that the bridge was "dedicated as a memorial and in commemoration of the services of the New Jersey citizens in the World War." The plaques further indicate an installation date of 1926 and provide the names of the members of the State Highway Commission, the names of the bridge engineers, and the name of the contracting firm responsible for bridge construction. Each pylon measures approximately 8 feet wide beneath the bridge deck and tapers to 5 feet 11 inches wide near its top. The entablature of each pylon is marked by guttae, pilasters, and an elaborate molded cornice. The pylons were originally crowned with luminaires. These lights were removed in 1972, but the brackets remain. The bridge sidewalks are bordered by concrete balustrades on the stringer approach spans and by metal railings on the deck girder and truss spans.

The swing span operating mechanism has been largely unchanged since its installation. The rack and pinion drive is activated by a series of reduction gears, located below the span. This drive is powered by the original direct-current Westinghouse motors, located in the operator's house. Power is transmitted vertically by a long line shaft from the elevated operator's house to the gear sets, located under the swing span. According to bridge personnel, the control panel for the operating machinery was replaced in the 1980s. Hydraulic piston wedges are now used in place of the original mechanical ones, and the brakes have also been replaced.

Three wood-framed structures are located on the bridge. Gate tender's houses are located north and south of the swing span. These houses are cantilevered from the sides of the bridge and rest on steel structural frameworks. Each of these houses measures approximately 6 feet 6 inches by 8 feet 3 inches in plan and is 8 feet high to the cornice. Each consists of a single room and is crowned with a pyramidal roof, sheathed in asphalt shingles. Walls are sheathed in deteriorating red cedar clapboards and are pierced by six over six, double hung windows. A single wood door, 6 feet 6 inches high and 2 feet 6 inches wide, is centered in one wall. The interiors of the houses originally contained a cast-iron stove, a chair, a built-in seat, a coat locker, and a lamp locker. The ceiling of each house is constructed of 1/2 inch tongue and groove paneling.

The larger, rectangular operator's house is nestled in the trusswork of the bridge above the central pier. A steel stairway provides access to this structure from the west sidewalk. This wood-framed house, which is sheathed in clapboards, is fenestrated with nine over nine, double hung sash windows. Its pyramidally hipped roof is sheathed in asphalt shingles. The operator's house has a single room that contains the bridge motors and related machinery, control panels, television monitors for cameras mounted on the bridge, and supplies for minor bridge maintenance.

In the original bridge design, a fourth structure, an operator's toilet, was located beneath a stairway on the fender of a rest pier of the bridge. This toilet structure, which measured 5 feet square, was sheathed in red cedar clapboards and had a roof sheathed in cypress shingles. Its side walls contained fixed, four-light windows. This toilet was removed during one of the renovations to the fenders.

Paired cast-steel safety gates, original to the bridge, are located near either end of the swing span. These gates, 19 feet long, pivot on cast-steel posts and are manually operated by bridge personnel. When not in use, these gates are held in place along the side of the bridge by steel pipe gate rests containing catches that slip over the flanges of the gates.

Bridge drawings in the files of the New Jersey Department of Transportation document repairs and alterations to the bridge. Most projects involved repairs to portions of the bridge fenders. Major repairs and alterations took place in 1985 and 1988. In 1952, new mechanical crossing gates were installed to supplement the manual safety gates. In 1959, portions of the concrete bridge deck and sidewalk were repaired. In 1970, new electric wiring was installed on the bridge, and the original incandescent light fixtures were replaced with 250 watt mercury vapor luminaires. Repairs were also made to the concrete sidewalks and railings. Work undertaken in 1985 included repaving and reconstruction of curbs for a portion of the approach roadways, improving steel guiderails, and welding steel studs to the deck of the swing span for better traction during wet weather (Anonymous 1985). In 1988, the wedge drives, mechanisms that lock the swing span in place, were converted from mechanical to hydraulic operation. Engineers for this project were Modjeski and Masters of Bordentown, New Jersey, and the contractor was Industrial Engineering Works of Trenton (Diamond 1988).

The central bridge piers are protected from maritime traffic by fenders, constructed of a latticework of wood members anchored to timber pilings by metal spikes. Originally, the wood members comprising these fenders measured 6 inches by 8 inches, 12 inches by 12 inches, 4 inches by 8 inches, 12 inches by 15 inches, and 6 inches by 12 inches in cross section. Due to the effects of salt water, these fenders have required a frequent maintenance schedule that has resulted in in-kind replacement of deteriorated members.

## HISTORICAL BACKGROUND

### The Raritan River Crossing

The Raritan River is the single largest geographic feature spanned by bridges in Middlesex County, New Jersey. It divides the county in two and has provided engineers and bridge builders with significant challenges in designing bridges to span it.

The earliest means of crossing the Raritan River in the vicinity of Perth Amboy was by ferry. In 1684, the Redfords ferry began operation between Perth Amboy and South Amboy. This conveyance eliminated the necessity of fording the river or traveling west to New Brunswick to cross. This ferry was later supplemented by others operating out of Perth Amboy to Staten Island and to the Navesink.

The first bridge to cross the main channel of the Raritan River was built near present Bound Brook in 1762. This structure lasted only eight years before it was destroyed by an ice floe. The Landing Bridge, the first span across the Raritan River at New Brunswick, was built in 1773. Twenty-two years later, New Brunswick's Albany Street bridge was erected (Anonymous 1959a).

The first bridge to cross the Raritan River at Perth Amboy was constructed for the New York & Long Branch Railroad. This single track, wooden trestle with 480 foot draw span, was opened for rail traffic in 1875. It was replaced in 1908 with the present double track, steel girder bridge (Anonymous 1940b). The 1908 bridge still accommodates regular rail traffic.

The first vehicular bridge across the Raritan River at Perth Amboy was the County Bridge, opened to traffic on June 18, 1906. This bridge consisted of a steel draw span, a steel cantilever span, and a steel fixed span, each resting on concrete abutments. It extended across the river from the foot of Sheridan Street. The draw span, a Parker truss, measured 288 feet 4 inches long. The bridge approaches were laid on 168 timber bents (State Highway Engineer 1928:72).

The opening of the County Bridge was celebrated by a ceremony in which dignitaries boasted that its completion marked the union of North and South Jersey. The blowing of factory whistles and the rush of hundreds of pedestrians and vehicles highlighted its opening day. The bridge's dedication was marred by a slight mishap chronicled in the *Perth Amboy Evening News*:

> It had been planned to have the mayors of the two Amboys meet in the center of the draw and greet each other, but as the crowd choked the structure, the locks were seen to be working improperly and the throngs were ordered from the draw...where they waited within ten minutes of an hour, while those in charge endeavored to mend matters. The sudden heavy weight when the draw first swung to, probably had much to do with throwing the draw off center, it was stated.
>
> As the draw was finally swung for the second time after the crowds had waited almost an hour to recross, a thick plank on the bottom of the railing on the southerly side where the draw touches, was caught and split its entire length of almost twelve feet. This made those who had crowded out beyond the safety gates run and clamber for safety.
>
> As they heard the rending of the woodwork those who could not see the source were filled with fears that some of the structure was giving way.... (Anonymous 1906).

Almost from the time of its opening, the County Bridge was derided as a "white elephant." In a County Board of Freeholders meeting on April 6, 1916, Freeholder Alfred T. Kerr of South Amboy urged the construction of a new bridge using the existing draw span but with approaches rebuilt in steel. He predicted that the existing bridge would be unfit for traffic within five years. Another freeholder, William

S. Dey, also of South Amboy, agreed that the bridge was in need of replacement but suggested that the new bridge be of concrete construction.

In 1919, as a precursor to funding of a new bridge, Senator Thomas Brown of Perth Amboy introduced legislation in the Senate to authorize the state to take over the existing bridge. At a December 1920 meeting of the State Highway Commission it was announced that a definite location for the proposed new bridge had been determined.

This announcement raised opposition from some Perth Amboy residents. Hearings were held concerning the proposed bridge location, the placing of city water mains on the bridge, and provisions for trolley tracks. As a result of these hearings, bridge planners decided that the north bridge approach would extend south from the intersection of Convery Place and Smith Street. Planners also agreed to include trolley tracks on the bridge. The latter decision became moot when the Jersey Central Traction Company, operators of the trolley system in the city, ceased operation (Anonymous 1953).

The construction of a new span across the Raritan River to connect the Amboys was among the State Highway Department's first bridge projects in Middlesex County. The Raritan River crossing formed a major bottleneck on old New Jersey Route 4 and was particularly prone to traffic jams during peak summer months when travelers headed to the beaches from the New York metropolitan area. The new bridge was also planned as a feeder for the Smith Street approach to the Perth Amboy-Tottenville Ferry, a vital transportation link to New York City.

In 1920, the *Perth Amboy Evenings News* urged the dedication of the bridge to New Jersey men and women who had been killed in the First World War. This idea was subsequently adopted, and the bridge was formally named the Victory Bridge (Anonymous 1959b).

The Perth Amboy end of the bridge was constructed on land owned by the National Fireproofing Company and the Donnell Lumber Company, while the Sayreville end of the bridge traversed filled salt marsh meadows owned by the New Jersey Shipbuilding and Dredging Company. Construction of the north approach roadway necessitated the demolition of a portion of the C. Pardee tile works on the east side of the road, and the National Fireproofing Company kilns on the west side of the road (General Plan-North Viaduct Approach, NJDOT bridge drawing files).

Preparation of bridge plans was begun on March 11, 1921. The bridge was designed by Clarence Walter Hudson (1867-1943). Hudson, a Manasquan, New Jersey native, graduated from Lehigh University in 1889 with a degree in civil engineering. From 1892 to 1906 he worked as a designing engineer for the Phoenix Bridge Company of Phoenixville, Pennsylvania, one of the leading bridge designers of the day. After leaving the Phoenix Bridge Company, he became a partner of Dr. Mansfield Merriman, and the two opened a consulting engineering office in New York. Dr. Merriman retired within the year, and Hudson carried on the business until 1933.

In addition to his engineering practice, Hudson served as Professor of Civil Engineering and chairman of the department at the Polytechnic Institute of Brooklyn from 1907 to 1927. He was the author of at least three civil engineering texts, *Notes on Plate-Girder Design* (New York: John Wiley & Sons, 1911), *Deflections and Statically Indeterminate Stresses* (New York: John Wiley & Sons, 1911), and *Elements of Graphic Statics* (New York: McGraw Hill Book Company, 1923). His obituary described him as a "designer of many large bridges in the United States." Among his designs were the Washington Bridge at Providence, Rhode Island and a bridge over the Lehigh River that united three smaller municipalities into the city of Bethlehem, Pennsylvania (Anonymous 1943).

Hudson's plans called for a bridge having a total length of approximately 2,591m (8,500 ft.) and a paved roadway of 11.6m (38 ft.) between curbs. Of the total length of the bridge, 1,688m (5,536 ft.) were planned as earth fill approaches; 328m (1,077 ft.) as reinforced concrete viaduct; 468m (1,536 ft.) as deck plate girder span, and 110 m (360 ft.) as swing draw span. The bridge was to be carried on piles, except for the piers carrying the draw span. These piers were to be founded on rock at depths varying from 24.7 to 34m (81 to 112 ft.) below mean water level (State Highway Commission 1924).

Construction was delayed due to problems regarding right-of-way acquisition. Bids for construction were requested and received on September 11, 1923. The lowest bid received was $3,934,000, an amount deemed to be excessive. Bids were readvertised and received in November 1923. The contract was awarded to Stillman-Delehanty-Ferris Company of Jersey City in the amount of $3,702,921.97. The specified time for completion of the contract was thirty months.

The contract for construction of the bridge was signed on January 2, 1924, and work began two days later. The first task was the removal of several houses on Smith Street to make way for the north bridge approach. At its peak, 350 workers were employed in the bridge construction, and three workers were killed in construction accidents (Anonymous 1946). By May 1924, *The New York Times* reported that an "immense caisson" was launched and towed to the middle of the river where it was to be sunk. The framework of the caisson was filled with concrete, and a working chamber left at the bottom, enabling workmen to ascend and descend while excavating to solid rock 115 feet below the water surface:

> While the workmen excavate the material in the river's bed, allowing the caisson to settle gradually downward, other workmen at the surface will build up the timber framework and concrete filling (Anonymous 1924).

Material used in bridge construction included 50,800 cubic yards of concrete, 7.5 million pounds of structural steel, 165,000 pounds of ornamental steel, 2,300 cubic yards of granite, 5,000 piles, and 162,000 cubic yards of earth fill. The bridge is constructed on 55 piers, 16 of which are built in the river, varying in depth from 26 to 40 feet below mean water level. The three draw span piers are carried down to rock (Anonymous 1946).

In February 1926, Senator Morgan Larson of Middlesex County introduced legislation to authorize the State Highway Commission to spend not more than $50,000 to provide suitable decorations for the bridge in keeping with its role as a memorial bridge (Anonymous 1926a). This bill was passed. An April 1926 article indicated that the State Highway Commission had voted to plant Japanese barberry shrubs as a decorative feature on the earthen slopes of the south bridge approach (Anonymous 1926b).

The bridge was opened to the public on May 28, 1926. Completion of the bridge was celebrated by formal dedication ceremonies on June 24. These ceremonies were witnessed by an estimated 200,000 spectators (Anonymous 1926d). Perth Amboy Mayor William C. Wilson was general chairman of the celebration. Lieutenant Commander Lewis Compton was in charge of a dedication parade that featured nearly 10,000 marchers. Among the marchers were General Charles P. Summerall, leading a company of troops and a band from Governors Island, New York; Colonel A.F. Casad, leading officers of the Raritan Arsenal; a company of marines from the Brooklyn Navy Yard; and 250 men from the National Guard of New Jersey (Anonymous 1926c). Grand Marshal was General Hugh L. Scott, former Chief of Staff of the Army and chairman of the State Highway Commission. As New Jersey Governor A. Harry Moore stepped upon the swing span, a giant American flag was unfurled from the highest point of the span. The celebration also included a band concert on the bridge, airplane maneuvers, a parachute jump, a gun salute fired from Eagle Boat No. 48, a naval drill by U.S. destroyers and visiting yachts, fireworks, and a dance.

The Victory Bridge planners failed to anticipate the increased traffic that would result from its completion. A retrospective article in the *Perth Amboy Evening News* indicated that shortly after its completion the bridge produced the "worst traffic jams in the history of the city." Thousands of automobiles that had traveled from south of the Raritan River were lined up at the Staten Island ferry landing. Because the ferry landing was located at the foot of Smith Street, a major commercial and residential street in the city, loud protests were soon heard (Anonymous 1953).

To alleviate these traffic jams, Convery Boulevard, which provides the north bridge approach, was widened and extended to provide a direct highway link from the bridge north through Woodbridge to New York. This proved to be only a short term solution. The intensive industrial, commercial, and residential development that occurred in the surrounding area during the second quarter of the twentieth century made the bridge inadequate in handling the demands of traffic traveling between the southern and central portions of New Jersey and New York City. Within ten years of its completion, the Victory Bridge was outmoded. Its low river clearance necessitated frequent openings that regularly snarled traffic.

To accommodate the substantial increase in vehicular traffic through the area, the high-level Thomas Alva Edison Memorial Bridge was constructed west of the Victory Bridge. This span was officially opened for traffic on October 10, 1940. At the time of its completion, the Edison Bridge, at 4,400 feet in length, was the longest plate girder bridge in the United States (Anonymous 1940a). Unlike the Victory Bridge, the Edison Bridge is a high-level fixed span. The perceived role of the Edison Bridge was conveyed in an advertisement placed in the *Perth Amboy Evening News* by the Retail Merchants Association of Perth Amboy:

> It is indeed a day of joy that we witness at long last the opening for traffic of the Edison Bridge.
>
> For years, you, our friends and customers from South Amboy, Morgan, Laurence Harbor, Keyport, Matawan, Old Bridge, Sayreville and South River have been inconvenienced by the heavy flow of traffic on the Victory Bridge, especially Friday and Saturday. Thank goodness those days are over.

> Now, you may come to Perth Amboy any day of your choosing, shore traffic or no shore traffic,...and you can rest assured that there will be no more traffic jams. That is now all a memory, for THE EDISON BRIDGE IS OPEN (Retail Merchants 1940).

The Edison Bridge was, in turn, superseded by the Garden State Parkway Bridge over the Raritan River to its west. This bridge, built in the early 1950s, presently accommodates much of the Jersey Shore traffic that passes through the Perth Amboy area. Other long distance traffic north-south traffic is concentrated on the New Jersey Turnpike west of Perth Amboy.

**Swing Bridge Technology**

The earliest extant swing span bridge in New Jersey is the 1896 Union Avenue bridge over the Passaic River in Bergen County. The Victory Bridge is a late example of the swing span bridge, a type which reached its peak of popularity between 1880 and 1910 (Lichtenstein 1994:59).

Otis Ellis Hovey, in his book *Movable Bridges*, indicated that the earliest swing bridges were center-bearing wooden structures. The center pivots of these bridges were usually constructed of cast iron and, in some instances, were fitted with steel discs. The entire dead and live load at the center pier was carried by the center pivot. A ring with a few balance wheels was employed to maintain stability when the span was open or moving.

In the early nineteenth century, English engineers built several rim-bearing bridges, primarily double-swing spans that met in the middle of the channel. In the United States, the earliest recorded examples of swing span bridges were of the rim-bearing type. Among the earliest known American examples is the original Rush Street Bridge in Chicago, constructed across the Chicago River in 1856. In the following decade, several similar bridges were built, most across streams of the Mississippi River valley (Hovey 1926:36). In rim-bearing bridges, the span rides on a large number of tapered rollers positioned around the center of the span, rather than on the thrust bearing of the center-bearing design.

During the latter part of the nineteenth century, the use of center-bearing bridges gradually increased. This design largely superseded the rim-bearing bridge. Hovey attributes much of the increased popularity of center bearing bridges to the designs of C.C. Schneider, engineer of the Pencoyd Iron Works. Schneider was vocal in his advocacy of the center-bearing design (Hovey 1926:37).

F.C. Kunz, author of *Design of Steel Bridges*, cited some of the advantages of the center-bearing type of lift bridge over the rim-bearing type:

> It requires less power to turn, has a smaller number of moving parts, is less expensive to construct and maintain, requires less accurate construction than the rim-bearing type, and does not easily get out of order. The structural and the machinery parts are entirely separate, and when the bridge is closed it forms either two independent fixed spans, or a fixed span continuous over two openings resting on firm, substantial supports (Kunz 1915:277).

Otis Ellis Hovey wrote of the advantages of a swing bridge over other types of movable bridges, such as the bascule:

> When the conditions at the site are favorable and there are no restricting circumstances, a swing bridge is the simplest, best, and most economical type in first cost and maintenance.

Among the advantages cited are the lack of mechanical joints and trunnions in the superstructure to cause friction and wear, the lack of stress on the operating machinery when the bridge is closed, the lack of need for counterweights, the low amount of power required to operate the bridge, the ability of the bridge to provide two navigable channels, and the ability to view all parts of the bridge from the operator's house (Hovey 1926:20).

A swing span bridge rotates on a central pivot to a position parallel to the river channel to allow passage of marine traffic. The Victory Bridge, as most New Jersey examples, is a center-bearing type of swing span. All swing span bridges in New Jersey are operated by rack and pinion drives and reduction gear sets (Lichtenstein 1994:59).

In a center-bearing bridge, a large bronze thrust bearing at the center of the span supports the span's weight when the bridge is open. The span is balanced so that its center of gravity is over the bearing. This bearing receives the span weight through a heavy cross-girder. The bearing is flanked by balance wheels that stabilize the span as it opens and closes. The center bearing, which rests on a pivot base, also keeps the span centered.

When the swing span is closed, the brakes are engaged and the bridge machinery is at rest. When the bridge is to be opened, the brakes are released and the motor is started. The drive machinery opens and closes the swing span. The primary arrangement for turning swing bridges consists of a rack attached to the lower circular track or roller path and a vertical shaft with a pinion geared into the rack. By turning the shaft and pinion, the bridge is swung around its center (Kunz 1915:279-280).

Some bridges, including the Victory Bridge, use a circular rack. This arrangement provides flexibility to open the span in either direction of rotation. If something obstructs the span in one direction, it can be opened in the opposite direction. If a rack tooth fails, preventing rotation in one direction, the span can be rotated in the opposite direction (USDOT 1977:1-4).

Typically, the driving motor of the bridge is connected through a flexible coupling consisting of shafts and gears to bevel pinions. The pinions are engaged with bevel gears mounted on vertical shafts. These shafts are supported by pillow blocks. Spur pinions are mounted on the lower ends of vertical shafts. The spur pinions are engaged with the curved rack on the center pier.

The span must also be stabilized when it opens and properly aligned and rigidly supported when it is closed. When a span is closed, it must be firmly supported at several points in order to bear live loads. These tasks are accomplished by live-load supports or wedges. Historically, the primary stabilizing components of most swing spans, including the Victory Bridge, were motor-driven wedges. In the case of the Victory Bridge, these original motor-driven wedges have been replaced by hydraulic wedges.

Wedges are driven into position between the piers and the span bottom. When positioned, the wedges transmit live loads from the spans to the piers. Prior to the opening of the span, the wedges are withdrawn. The movement of the wedges is powered by the operating machinery. A motor drives a primary reducer which is coupled by longitudinal shafts to secondary worm-gear reducers at the ends of the shaft. The worm-gear reducers drive spur gear sets on the four corners of the span. The gears rotate cranks, which drive wedges by means of adjustable connecting rods. The wedges slide in T-slot guides attached to the bottom of the span. The wedge seats are located on the rest piers of the bridge (USDOT 1977:1-4, 1-6).

The bridge is locked in place with centering latches. When the span is to be opened, the latches are raised. The span can then rotate. Specifications for the end machinery of the Victory Bridge indicated:

> The latch lever and pall shall be adjusted so that the latch will be released from its raised position when the span begins to swing. The latch counterweight shall be adjusted so that the latch will fall into the latch catch when the span reaches the closed position at a speed low enough to permit sudden stopping without injurious shock or jar; but will pass over the catch if the span is moving at a higher speed (State Highway Commission 1924).

The turning and wedge motors and associated control machinery are located in the operator's house. Each motor is connected by a short shaft to a motor pinion and an outboard bearing. The two motors are interconnected by a series of bevel and mitre gears and shafts. Clutch levers are situated between the two motors and are connected by perpendicular shafts to the clutch collars. A 4 3/4 inch line shaft is located above the turning motor and connects to paired mitre gears located north and south of the turning motor. These mitre gears, in turn, connect to line shafts that extend to the east wall of the operator's house. Within the wall framing are located two additional sets of mitre gears that connect to long line shafts extending from the operator's house to the rack and pinion mechanism beneath the swing span. The shafts are connected to the mechanism by means of spur gears, spur pinions, bevel gears, mitre gears, and short line shafts.

The swing span of the Victory Bridge pivots atop a cast steel pivot base, 10 feet in diameter. The center of the pivot consists of a series of concentric rings. A cast steel oil ring fits into the outermost ring, and the cast steel pivot casting fits above the oil ring. Threaded onto the top of the pivot casting are two disks. The lower disk is forged from hardened steel, while the upper disk is fabricated from bronze. The center of the swing span is stabilized by paired steel wheels mounted to the bottom of heavy cross girders, approximately 23 feet from the center of the swing span.

Another line shaft extends to the west side of the operator's house. This line shaft is powered by the wedge motor. Within the west wall of the operator's house, paired mitre gears connect this line shaft with a vertical line shaft that extends along the west side of the bridge truss. This shaft connects beneath the swing span roadway to a horizontal shaft that extends the width of the roadway. This shaft is, in turn, geared to vertical shafts that originally operated the bridge wedges. As noted, these original mechanical wedges have been replaced by hydraulic wedges.

## SOURCES OF INFORMATION/BIBLIOGRAPHY

### Interview

Telephone interview with Barbara Booz. July 1998.

### Engineering Drawings

Collection of approximately 100 microfilmed engineering drawings prepared by the New Jersey State Highway Commission, Division of Bridges, 1923, and the Bethlehem Steel Company, 1924, at the New Jersey Department of Transportation, Trenton. Original drawings have been misplaced.

### Historic Views

Postcard of the Victory Bridge, no date, in the New Jersey postcard collection, Special Collections Department, Alexander Library, Rutgers University, New Brunswick, New Jersey

### Secondary and Published Sources

Anonymous

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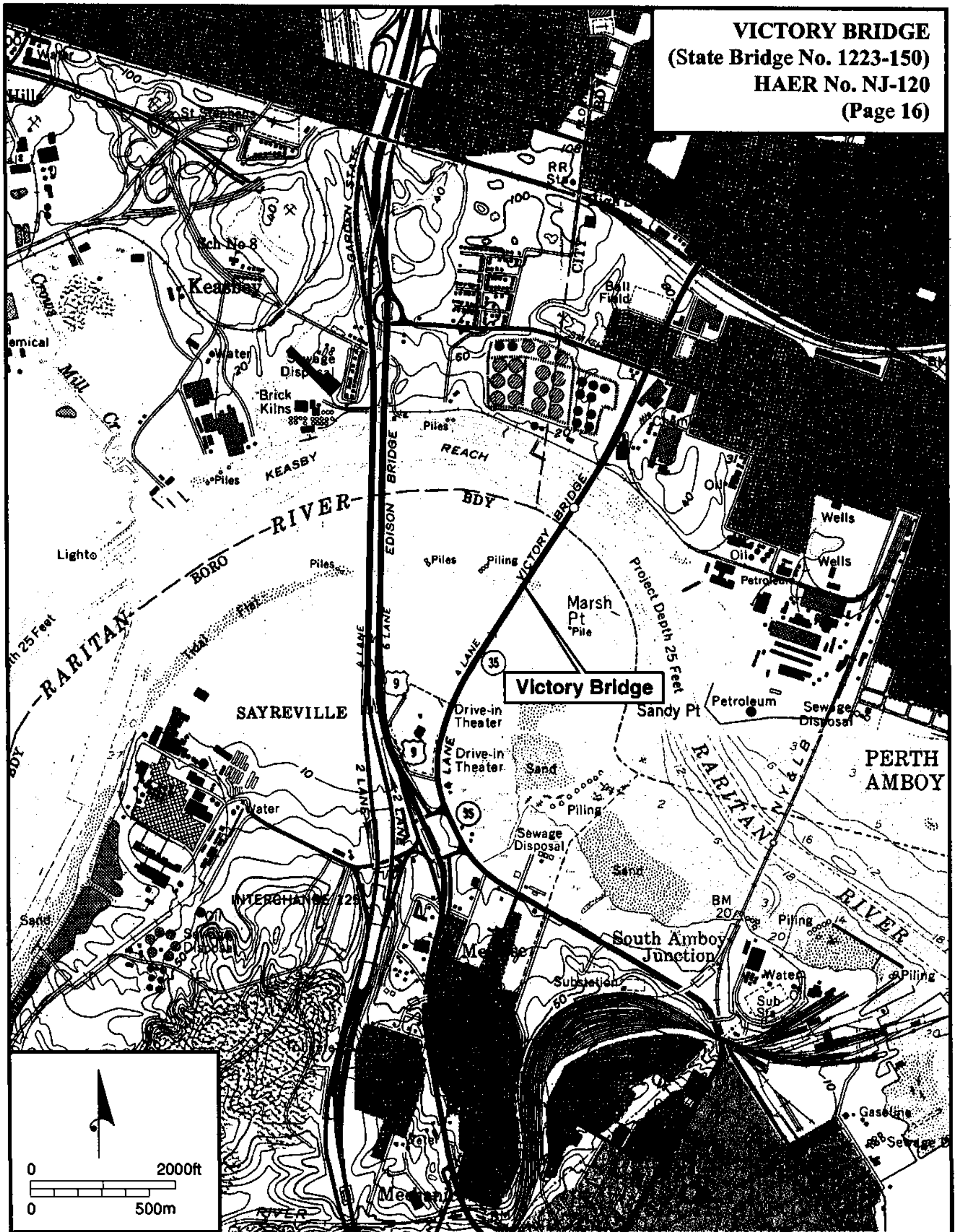
**VICTORY BRIDGE**
**(State Bridge No. 1223-150)**
**HAER No. NJ-120**
**(Page 16)**




Detail, *Perth Amboy, N.J.-N.Y.* 7.5-minute quadrangle (USGS 1956) and *South Amboy, N.J.-N.Y.* 7.5-minute quadrangle (USGS 1954), showing the Victory Bridge.

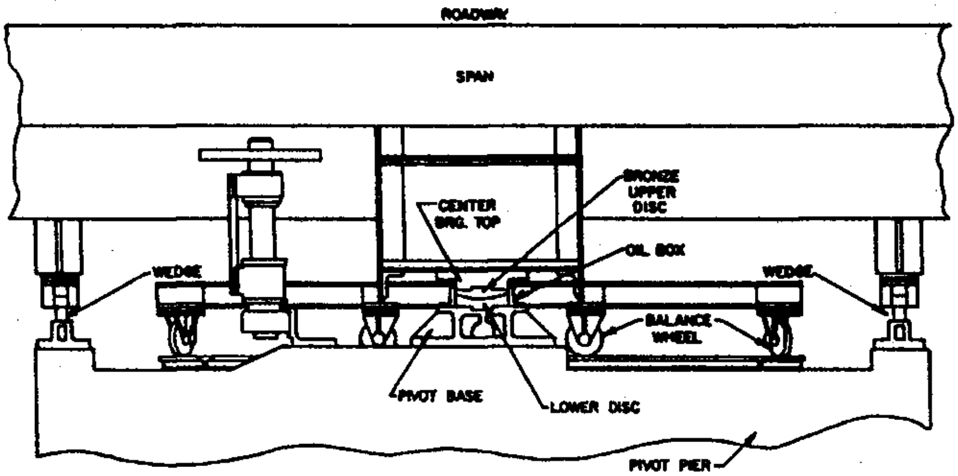
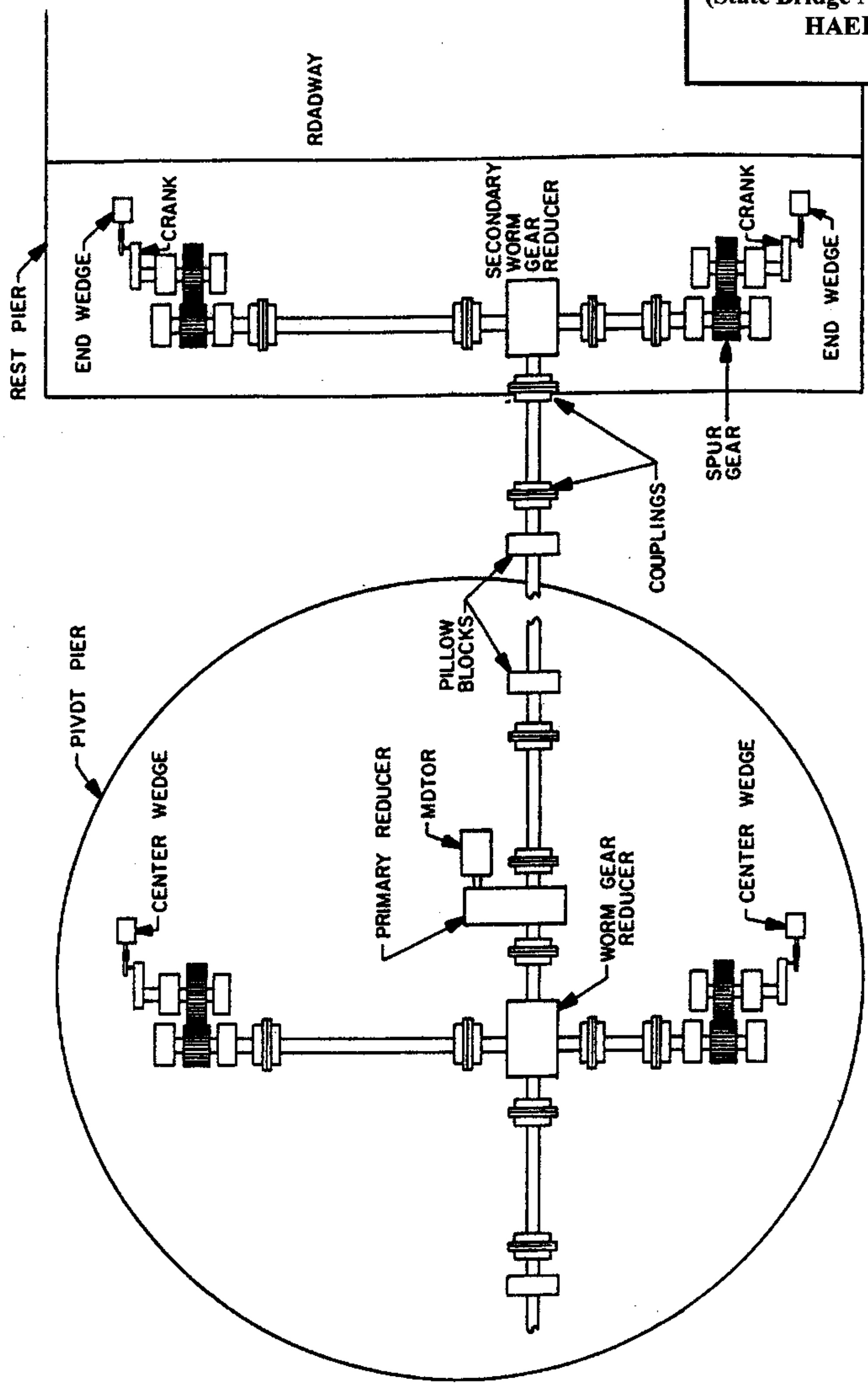
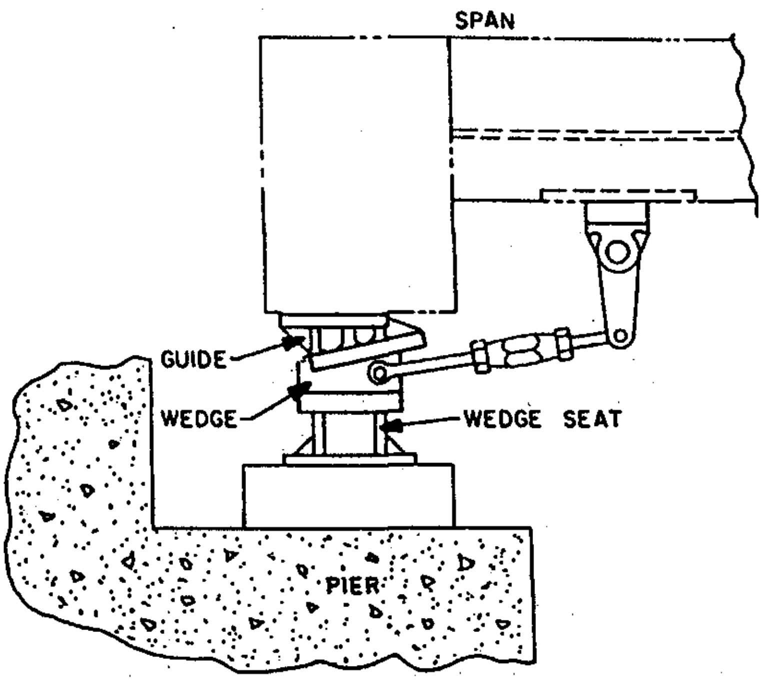



Diagram of center bearing swing span bridge (USDOT 1977).




Wedge drive machinery (USDOT 1977).




Wedge components (USDOT 1977).