City of New York
Department of City Planning
Transportation Division

# TASK 5A REPORT

## Feasibility Analysis & Preliminary Cost Estimates

# Verrazano-Narrows Bridge Pedestrian/Bicycle Path

Brooklyn/Staten Island, New York

*Submitted by:*

AMMANN & WHITNEY

March 1997

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# FEASIBILITY ANALYSIS & PRELIMINARY COST ESTIMATE FOR THE VERRAZANO-NARROWS BRIDGE PEDESTRIAN/BICYCLE PATH

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# I. INTRODUCTION

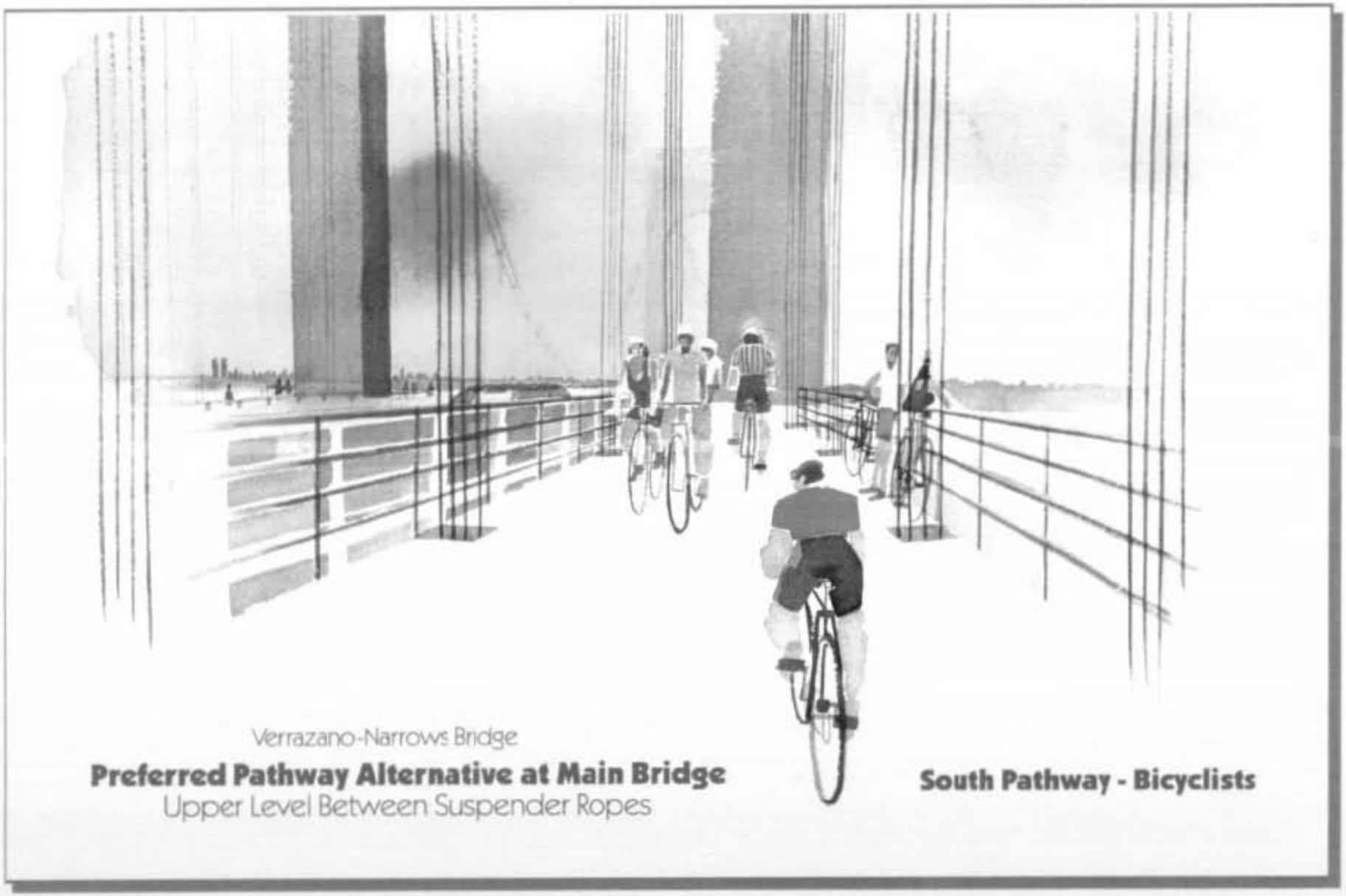
# FEASIBILITY ANALYSIS AND PRELIMINARY COST ESTIMATE FOR THE VERRAZANO-NARROWS BRIDGE PEDESTRIAN/BICYCLE PATH

## I. INTRODUCTION

This Report is part of a larger study by the New York City Department of City Planning (DCP) funded by the federal Intermodal Surface Transportation Efficiency Act (ISTEA), Congestion Mitigation Air Quality (CMAQ) program, to assess alternative linkages between Staten Island and Brooklyn for cyclists, pedestrians, in-line skaters and other non-motorized users. Ammann & Whitney has been selected as the consultant to assess the separate path routes across the Verrazano-Narrows Bridge. Bike-on-bus, ferry and on-lane bridge alternatives are also being assessed by DCP. This final report is a compilation of the technical memoranda that were prepared for each of the tasks included in the scope of work.

In Tasks 1 and 2, Ammann & Whitney examined route feasibility across the main bridge spans and approaches in Brooklyn and Staten Island. In Task 3 preliminary cost estimates were developed for each of the alternative pathway segments evaluated for the main bridge spans and approaches. In Task 4, the results of Tasks 1 through 3 were factored into evaluation matrices for selection of the preferred route alternative. Task 5 is the preparation of this final report, which contains a unified presentation of various analyses and investigations undertaken in the performance of this project. Presentation graphics have also been prepared which illustrate the preferred alternative pathway.

The Verrazano-Narrows Bridge is located between the Boroughs of Richmond (Staten Island) and Brooklyn and spans the Narrows at the lower reaches of New York Harbor. Opened to traffic in November 1964, the facility is owned and operated by MTA-Bridges and Tunnels (Triborough Bridge and Tunnel Authority).



Verrazano-Narrows Bridge

**Preferred Pathway Alternative at Main Bridge**

Upper Level Between Suspender Ropes

**South Pathway - Bicyclists**

# II. EXECUTIVE SUMMARY

## II. EXECUTIVE SUMMARY

The results of the feasibility analysis and preliminary cost estimate indicate that the preferred alternative for a pedestrian/bicycle pathway across the Verrazano-Narrows Bridge combines the path between the suspender ropes on the main bridge with the pathway at existing sidewalks on the Brooklyn Approach and the new pathway structures at the Staten Island Approach. Two separate paths are recommended, the one on the north side of the bridge for pedestrians and the one on the south side for bicyclists.

The location of the paths on the main bridge at the upper level between suspender ropes provides advantages in structural considerations, constructibility, and costs. The use of the existing sidewalks on the Brooklyn Approach also provides a pathway which minimally impacts the existing structure and significantly limits the amount of required new construction. The new pathway structures at the Staten Island Approach provide advantages in geometric considerations and user comfort criteria. Overall, this combined scheme proposes a cost effective pathway, which achieves the objective of providing a new and separate pedestrian/bicycle route across the Verrazano-Narrows Bridge.

The preferred alternative proposes two separate paths at the upper level of the main bridge which encompass the suspender ropes within the pathway railings. This would allow for a 10-foot wide path with a horizontal clearance of 7'-11" at suspender rope locations, which occur approximately every 50 feet. This scheme has the lowest whole life cost at $26.5 million which includes $6.4 million for the pathways at Brooklyn and Staten Island Approaches. A less costly scheme--$2.7 million cheaper--would provide a 7-foot continuous path between the suspender ropes.

The majority of the Brooklyn Approach is limited by the existing available sidewalk width and required traffic lane widths. These factors restrict the width of the proposed path to seven feet. The cost effectiveness of this scheme is due to the minimal amount of construction activity required to accommodate the new pathway. Widening the pathway to 10-feet requires extensive demolition and reconstruction. Because of the relatively steep and lengthy grades (up to 4%) and anticipated high speeds that will be realized by bicyclists, the widening of the path would benefit geometric and user comfort considerations. However, the additional width would increase the cost of this scheme by $8.3 million for a total whole life cost of $34.8 million (including the 10-foot path across the bridge). Although the 7-foot pathway width is below the recommended minimum width, the American Association of Highway and Transportation Officials (AASHTO) Guide states that "because of the large number of variables involved in retrofitting bicycle facilities onto existing bridges, compromises in desirable design criteria are often inevitable. Therefore, the width to be provided is best determined by the designer, on a case-by-case basis, after thoroughly considering all the variables." It should be noted that this scheme can be constructed within the existing bridge right-of-way without the acquisition or use of adjacent property.

The 10-foot wide new pathway structures at the Staten Island approach provide for access at New York Avenue within Gateway National Recreation Area (Gateway), which is under the jurisdiction of the National Parks Service. An alternate access point for the pathway from local streets was also investigated. For an estimated whole life cost of $570,000, a 1000-foot long path-on-grade could be constructed connecting the pathway structures to Major Avenue at the intersection of Tompkins Avenue. All Staten Island pathways and structures will be constructed within the existing bridge easement areas.

To build a scheme which provides a minimum 10-foot wide pathway throughout, the most favorable combination would include the main bridge Scheme III - *Outboard Lower Level*, with Brooklyn Approach Scheme II-L-A - *Lower Level Pathway to Playground*, and Staten Island Approach Scheme II-L, *Pathways - Lower Level.* Exceedingly high construction and whole life costs are reflected in the ranking for this combination, which is far below the preferred alternative. The whole life cost of this entire pathway would be $40.4 million. Metropolitan Transportation Authority (MTA) prefers this combination, which includes Scheme III - *Outboard Lower Level,* maintaining that the wider path would be safer, easier to maintain and less of a security risk to the facility. MTA has concerns about the safety and liability inherent in any strategy that introduces pedestrian and bicycle access to the Verrazano-Narrows Bridge.

The following table summarizes this preferred alternative:

**PREFERRED PATHWAY ALTERNATIVE**

| Segment | Description | Pathway Width | Length (feet) | Whole Life Cost (millions) |
|---|---|---|---|---|
| Main Bridge | Scheme V (modified): Upper Level Between Suspender Ropes | 10' | 13,500 | $20.05 |
| Brooklyn Approach | Scheme III-U: Upper Level at Existing Sidewalks | 7' portion<br>10' portion | 3,700<br>2,150 | $2.79 |
| Staten Island Approach | Scheme II-U: Upper Level New Pathway Structures | 10' | 2,600 | $3.64 |
| **TOTAL** | | | **21,950** | **$26.5** |

The preferred alternative, retrofitting the existing structure with a 10-foot pathway which encompasses the suspender ropes (with a 7'-11" clearance every fifty feet), achieves the desired result of limiting structural and constructibility impacts, while providing safe, accessible and cost-effective bicycle and pedestrian pathways.

# V. CONCLUSIONS/RECOMMENDATIONS

# V. CONCLUSIONS / RECOMMENDATIONS

In Task 4 of Ammann & Whitney's work program, the results of Tasks 1 through 3 were factored into the evaluation matrices for selection of the preferred route alternative. Under this Task, Ammann & Whitney finalized the evaluation criteria matrices for each of the segments of the pathway (Main Bridge, Brooklyn Approach and Staten Island Approach). These completed matrices are presented as Tables V-3, V-4 and V-5. For the main bridge, Scheme V, *Between Suspender Ropes - Upper Level*, scored the highest. This was due to structural and constructibilty advantages coupled with the low costs associated with construction and maintenance. For the Brooklyn Approach, Scheme III-U, *Pathways at Existing Sidewalks*, scored the highest. This was due to the low construction costs associated with utilizing the existing available sidewalk. For the Staten Island Approach, Scheme II-L, *Pathways - Lower Level*, scored the highest. This was due mainly to above average geometric and user comfort considerations and average construction and maintenance costs.

Based on the number of schemes at each segment of the pathway, and the incompatibility of combining upper level with lower level schemes, there are thirty (30) possible combinations for an entire pathway. In order to calculate a total score for an entire pathway, the scores from each of the individual segment schemes were combined. At the onset of this Task, weighting factors were established which assigned the main bridge segment a factor of three (3), with each of the approach segments assigned a factor of one (1), when calculating the total score. This was based on consideration of the significantly longer main bridge portion of the pathway in comparison to the approach portions. Combining the various scores for the pathway segments resulted in an overall ranking for entire pathways. Table V-1 provides a summary of the top ranked pathway combinations.

## EVALUATION

The results of the evaluation indicate that the preferred alternative for a pedestrian/bicycle pathway across the Verrazano-Narrows Bridge combines the path between the suspender ropes on the main bridge with the pathway at existing sidewalks on the Brooklyn Approach and the new pathway structures at the Staten Island Approach. The total whole life cost is $23.8 million. Table V-2 provides a breakdown of the various pathway segments which comprise the preferred alternative.

It should be noted that in Task 1, Scheme V proposed a 7-foot path under the theory that a continuous path, uninterrupted by suspender ropes, was safer, despite the narrowness of the path, than the potential obstruction hazards of the suspender ropes. Scheme V was therefore evaluated as a 7-foot path. However, after further study, comments from the Technical Advisory Committee, field observations on the George Washington and Brooklyn Bridges,

consideration was given to the feasibility of widening the path to 10 feet and incorporating the suspender ropes into the path. The evaluation sheets for Scheme V reflect the 7-foot wide proposal. Findings of further consideration of a modified Scheme V, providing for a 10-foot path, are presented in the following sections of these Conclusions/Recommendations following the findings for the original Scheme V.

## Preferred Pathway Segment Descriptions

### *Main Bridge*

The main bridge segment of the pathway was designated as Scheme V in the Task 1 report. Scheme V proposes two paths to be placed between the suspender ropes above the top chords of the stiffening trusses. (See Figure V-2.) Pathway support beams (stringers) could be directly supported on the crossframes. The entire pathway structure, including railings, would be placed between the suspender ropes and the resulting width would be limited to 7 feet. This is based on the 7'-11" clearance between the ropes, a 4" allowance for railings at each side, and a 1-1/2" clearance between the ropes and railing (refer to Figure III-6). The resulting 7-foot pathway width is below the recommended width of 10 feet and the minimum width of 8 feet for a two-way bicycle path. However, the AASHTO Guide states that "because of the large number of variables involved in retrofitting bicycle facilities onto existing bridges, compromises in desirable design criteria are often inevitable. Therefore, the width to be provided is best determined by the designer, on a case-by-case basis, after thoroughly considering all the variables."

Advantages for this scheme include:

1. Lowest initial capital costs.
2. Lowest maintenance and whole life costs.
3. Negligible increase in stresses at crossframes with least effect of all schemes. Reinforcement of existing members would be localized at support point only.
4. Separation of pedestrian and bicyclists.
5. Path is visible from upper roadway which provides a measure of security.
6. Access for construction is favorable since work could be performed with relative ease from temporary lane closures on the upper roadway. However, construction access is somewhat restricted by the suspender ropes.
7. The location of the paths would offer unrestricted views.
8. Suspender ropes provide a feeling of containment without blocking vistas, thereby providing a sense of security.

Disadvantages for this scheme include:

1. Minimum width for two-way bicycle path is 8 feet, as per AASHTO Guidelines. User comfort and safety will be impacted due to anticipated high speeds.

2. Complicated framing around the towers and anchorages will be required. Movement due to thermal expansion and contraction of the existing bridge elements which will support the path must also be accommodated.
3. Path is adjacent to suspender ropes and accessibility to these supporting structural members poses a security concern.
4. Two paths required to provide for balanced loading on bridge elements.

The cost considerations, structural impact and constructibility for this scheme are most desirable. Although the substandard width may be acceptable due to retrofitting within the limiting existing structural components, the resulting geometric and user comfort aspects of this scheme are below average.

can be 12-15 see Page 87

However, if the path is widened, the findings show that the 10-foot wide path provides a significant safety improvement factor. (See Figure V-1.) Those safety improvements of the modified Scheme V include:

1. The widening of the horizontal clearance from 7 feet (continuous, between the railings) to 7'-11" (between suspender ropes, every fifty feet). This brings the retrofitted path within an inch of the AASHTO 8-foot minimum bicycle path width.
2. The creation of "safety zones" in the areas immediately east and west of the suspender ropes. Dismounted bikers would feel protected standing by the suspender ropes, while parked bicycles and bicyclists would be safely removed from passing cyclists.
3. The provision of a more generous width for passing. The additional width in the intervals between the suspender ropes also allows for slower and faster movement areas, providing safer passing conditions.

Widening the path by three (3) feet -- from 7 to 10 feet -- significantly benefits geometric and user comfort considerations. The suspender ropes at regular, predictable intervals enables cyclists to adjust their riding speed and location and avoid conflicts in passing. The additional cost of widening the 7-foot pathway to 10 feet is $2.7 million bringing the total cost to $26.5 million.

*Brooklyn Approach*

The Brooklyn Approach segment of the pathway was designated as Scheme III-U in the Task 2 report. Scheme III-U proposes two separate paths to be located at the fascia of both the westbound and east bound upper roadways. (See Figure V-3.) The path on the north side of the bridge could be reserved for pedestrians and the south side for two-way bicycling. The paths would connect with the upper level main bridge paths and be routed around the top corner of the anchorage, with supports along the exterior wall. Presently, a 7-foot wide sidewalk exists from the anchorage to Pier WB-9 (for the north side) and Pier EB-11 (for the

south side). The new paths would utilize these existing sidewalks. A barrier would be installed adjacent to the existing sidewalk curb to provide protection of the path. The roadway curb-to-curb width would be reduced by one foot, but would still provide for three 12-foot lanes.

From Pier WB-9 the north pathway would utilize the existing upper level roadway. Currently, east of Pier WB-9 on the upper level, the westbound roadway is striped to a two-lane width to eliminate merging of traffic from the Shore Parkway Ramp. The remaining lane width could be utilized for a 10-foot pathway. The pathway would extend along the upper level on-ramp from 92nd Street (Ramp C), which has sufficient width to accommodate both a 10-foot path and the existing traffic lane. A new barrier would be constructed to separate the pathway from traffic. At Pier C-3, the pathway would turn off of Ramp C and be bridged across the lower level on-ramp (Ramp A) by a new structure to the sidewalk area adjacent to the north side of Ramp A. The path would continue along the 92nd Street on-ramp to a terminus point at the intersection with 92nd Street. This would require modification of the on-ramp and adjacent sidewalk area for a length of approximately 600' to accommodate the pathway. (As an alternative, the north pathway could be bridged from the lower level on-ramp (Ramp A) by a new structure into the adjacent NYC Playground. The new structure would extend to grade along the east end of the playground and terminate at Fort Hamilton Parkway, in the vicinity of 95th Street.)

From Pier EB-11 the south path would continue along the fascia of the roadway. As the existing sidewalk narrows down, the 7-foot width would be maintained by utilizing a portion of the roadway which is widening at the off-ramp to 92nd Street (Ramp F). The path would follow the fascia of Ramp F which has sufficient width to accommodate both a 10-foot path and the exiting traffic lane. The path would terminate at the intersection of Ramp F and Dahlgren Place. A new cross-walk and Stop sign would need to be placed at this location to provide for safe crossing of bicyclists across Dahlgren Place. This location is approximately 300 feet from 92nd Street. The maximum grade of the 2700-foot long path would be 5%.

Advantages for this scheme include:

1. Lowest initial capital costs.
2. Lowest maintenance and whole life costs.
3. The horizontal layout is preferable, providing a relatively straight run along the outer edge of the approach roadways.
4. Separation of pedestrian and bicyclists.
5. The maximum grade would be 5%.
6. Access location is near 92nd Street, which provides connection with public transportation.
7. EMS access possible from upper roadway.
8. Pathway is visible from roadways providing a measure of security.
9. Modification of existing structure is minimized resulting in lower construction costs.

Disadvantages of this scheme include:

1. Pathway width is below recommended and minimum widths for a two-way bicycle path.
2. Total length of path is greatest of all schemes.
3. Separate paths require more construction effort than for a combined path.
4. Modification of sidewalk work requires closure of one traffic lane during construction.
5. Pathway is adjacent to traffic and subject to roadway noise and fumes.
6. Permanent reduction in available curb-to-curb width of the upper level roadway and the ramps to/from 92nd Street limits future traffic lane usage options for the bridge owner.

Overall this scheme is desirable due to favorable cost, constructibility and safety considerations.

*Staten Island Approach*

The Staten Island segment of the pathway was designated as Scheme II-U in the Task 2 report. Scheme II-U proposes separate 10-foot wide paths to be supported along the exterior walls and sloped roof of the anchorage. (See Figure V-4.) The path on the north side of the bridge could be reserved for pedestrians and the south side for two-way bicycling. The paths would utilize the existing sidewalks at the anchorage. These 7-foot sidewalks taper to 2'-6" at the Pier S-1. The sidewalks would be widened to accommodate a 10-foot wide path while still maintaining a 2'-6" wide safety curb. Appropriate barriers would also be built to separate the roadway and pathway. (See Section A-A of Figure V-4.) The existing fascia stringers have enough capacity to support the widened sidewalk. The length of modified sidewalk would be 300 feet. From Pier S-1 to Pier S-2 the path would be carried by new stringers supported by the existing end floorbeams and pier columns. The paths would then turn and bridge over the existing TBTA maintenance road, carried by new footings, columns and stringers. (See Section B-B of Figure V-4.)

The south path would continue westward and reach grade approximately 600 feet west of New York Avenue. The path would then turn and proceed on grade back to New York Avenue. The 10-foot wide path would be built at 5% maximum grade. Pathway alignment and all construction will be located within the TBTA's bridge easement area and will not impact upon Gateway. When Fort Wadsworth becomes open to the public, it is proposed that the path terminate at New York Avenue in Gateway during park hours. For an alternate access location, (see Figures V-4 and III-20), the path could continue westward a length of 1000 feet, running adjacent to the existing TBTA maintenance road (and within the bridge right-of-way) to the intersection of Major Avenue and Tompkins Avenue.

The north path would connect with a two-level ramp structure built adjacent to Marshall Avenue. The ramp structure would meet ADA requirements. The access point would be at New York Avenue within Gateway during park hours. For an alternate access location, the path could turn south beneath the bridge approach (within the TBTA right-of-way) and connect with the path on the south side of the bridge, and continue to Major Avenue.

Advantages for this scheme include:

1. Separation of pedestrian and bicyclists.
2. The horizontal layout of the south path would be preferable, providing a relatively straight run with the least amount of 90-degree turns.
3. The south path (reserved for bicyclists) would have a maximum grade of 5%.
4. Access point would be within Gateway and be close to proposed North Shore Greenway. Alternate access point is close to public transportation and to the existing South Shore Greenway.

Disadvantages of this scheme include:

1. TBTA maintenance road at the north side of the approach roadways would need to be relocated/modified for a length of 300 feet to accommodate the ramp structure required at the terminus of the north pathway.
2. Extensive and costly reconstruction of existing sidewalk and roadway parapet.
3. Relocation of electrical conduits and lightpoles currently installed at roadway parapet.
4. Separate paths require increased construction effort.
5. Modification of sidewalk work requires closure of one traffic lane during construction.
6. Fencing would be required to maintain security of TBTA areas.

Overall this scheme is above average due to favorable geometric and user comfort considerations.

## Conclusions

The modified Scheme V path on the main bridge at the upper level between suspender ropes is the preferred alternative. This route would allow for a 10-foot wide path with a horizontal clearance of 7'-11" at suspender rope locations which occur approximately every 50 feet. This alternative has advantages in structural considerations, constructibility, and costs. The use of the existing sidewalk on the Brooklyn Approach also provides a pathway which minimally impacts the existing structure and significantly limits the amount of required new construction. The proposed pathway structures at the Staten Island Approach provide advantages in geometric considerations and user comfort criteria. Overall, this combined scheme proposes a cost effective pathway, which achieves the objective of providing a new and separate pedestrian/bicycle route across the Verrazano-Narrows Bridge. The total whole

life cost is $26.5 million.

The majority of the Brooklyn Approach is limited by the existing available sidewalk width and required traffic lane widths. These factors restrict the width of the proposed path to seven feet. The cost effectiveness of this scheme is due to the minimal amount of construction activity required to accommodate the new pathway. Widening the pathway to 10-feet requires extensive demolition and reconstruction. Because of the relatively steep and lengthy grades (up to 4%) and anticipated high speeds that will be realized by bicyclists, the widening of the path would benefit geometric and user comfort considerations. However, the additional width would increase the cost of this scheme by $8.3 million for a total whole life cost of $34.8 million (including the 10-foot path across the bridge). Although the pathway width is below the recommended minimum width, the AASHTO Guide states that "because of the large number of variables involved in retrofitting bicycle facilities onto existing bridges, compromises in desirable design criteria are often inevitable. Therefore, the width to be provided is best determined by the designer, on a case-by-case basis, after thoroughly considering all the variables."

To build a scheme which provides a minimum 10-foot wide pathway throughout, the most favorable combination would include the main bridge Scheme III - *Outboard Lower Level*, with Brooklyn Approach Scheme II-L-A - *Lower Level Pathway to Playground*, and Staten Island Approach Scheme II-L, *Pathways - Lower Level.* The whole life cost of this entire pathway would be $40.4 million. Metropolitan Transportation Authority (MTA) prefers this combination, which includes Scheme III - *Outboard Lower Level,* maintaining that the wider path would be safer, easier to maintain and less of a security risk to the facility. MTA has concerns about the safety and liability inherent in any strategy that introduces pedestrian and bicycle access to the Verrazano-Narrows Bridge.

# TABLE V-1: Summary of Top Ranked Pathways

| Ranking | Segment | Scheme | Description | Number of Paths | Pathway Width | Cost $ Million | Factored Score |
|---|---|---|---|---|---|---|---|
| **1** | Main Bridge | V - 7ft | Between Suspender Ropes - Upper Level | 2 | 7' | 17.35 | 1080 |
| | Brooklyn | III-U | Pathways at Existing Sidewalk - Upper Level | 2 | 7'/10' | 2.79 | 350 |
| | Staten Island | II-U | Pathways - Upper Level | 2 | 10' | 3.64 | 355 |
| | | | | | ***Total*** | ***23.78*** | ***1785*** |
| **2** | Main Bridge | IV - 8ft | Outside of Truss - Upper Level | 2 | 8' | 29.96 | 1035 |
| | Brooklyn | III-U | Pathways at Existing Sidewalk - Upper Level | 2 | 7' | 2.79 | 350 |
| | Staten Island | II-U | Pathways - Upper Level | 2 | 10' | 3.64 | 355 |
| | | | | | ***Total*** | ***36.39*** | ***1740*** |
| **3** | Main Bridge | V - 7ft | Between Suspender Ropes - Upper Level | 2 | 7' | 17.35 | 1080 |
| | Brooklyn | II-U | Pathways at Widened Sidewalk - Upper Level | 2 | 10' | 11.04 | 300 |
| | Staten Island | II-U | Pathways - Upper Level | 2 | 10' | 3.64 | 355 |
| | | | | | ***Total*** | ***32.03*** | ***1735*** |
| **4** | Main Bridge | III - 8ft | Outside of Truss - Lower Level | 2 | 8' | 29.5 | 1020 |
| | Brooklyn | II-L-A | Pathway to Playground - Lower Level | 2/1 | 10'/14' | 5.59 | 330 |
| | Staten Island | II-L | Pathways - Lower Level | 2 | 10' | 2.51 | 380 |
| | | | | | ***Total*** | ***37.6*** | ***1730*** |
| **16** | Main Bridge | III - 10ft | Lower Level - 10' width | 2 | 10' | 32.3 | 315 |
| | Brooklyn | II-L-A | Pathway to Playground | 2/1 | 10'/14' | 5.59 | 330 |
| | Staten Island | II-L | Pathways | 2 | 10' | 2.51 | 380 |
| | | | | | ***Total*** | ***40.4*** | ***1655*** |

Note: The combined pathway scheme ranked 16th is shown here for reference, as it is the highest ranking scheme which provides a minimum 10' path at each segment of the pathway.

# TABLE V-2
## PREFERRED PATHWAY SUMMARY TABLE

| PATHWAY SEGMENT | LENGTH (feet) | WIDTH | GRADE (max.) | COMMENTS |
|---|---|---|---|---|
| MAIN BRIDGE | | | | |
| *North Pathway* | 6,750 | | | Anchorage to anchorage |
| 7' path between ropes | 6,750 | 7'-0" | 4% | |
| 10' alternate | 6,750 | 10'-0" | 4% | 7'-11" @ suspender ropes (every 50') |
| *South Pathway* | 6,750 | | | Anchorage to anchorage |
| 7' path between ropes | 6,750 | 7'-0" | 4% | |
| 10' alternate | 6,750 | 10'-0" | 4% | 7'-11" @ suspender ropes (every 50') |
| BROOKLYN APPROACH | | | | |
| *North Pathway* | 3,150 | | | Access at 92nd Street |
| Around anchorage | 100 | 10'-0" | 4% | |
| Anchorage to Pier WB-9 | 1,500 | 7'-0" | 4% | Utilizing existing sidewalk |
| Pier WB-9 to Ramp 'C' | 300 | Varies | 4% | |
| Ramp 'C' | 300 | 10'-0" | 4% | |
| New Structure over Ramp 'A' | 350 | 10'-0" | 8.33% | |
| Modified sidewalk | 600 | 10'-0" | - | |
| *South Pathway* | 2,700 | | | Access at Dahlgren Place |
| Around anchorage | 100 | 10'-0" | 4% | |
| Anchorage to Pier EB-11 | 1,700 | 7'-0" | 4% | Utilizing existing sidewalk |
| Pier EB-11 to Ramp 'F' | 200 | Varies | 4% | |
| Ramp 'F' | 700 | 10'-0" | 5% | |
| STATEN ISLAND APPROACH | | | | |
| *North Pathway* | 1,075 | | | Access at west side of New York Ave |
| Around anchorage | 100 | 10'-0" | 4% | |
| Anchorage to Pier S-2 | 300 | 10'-0" | 4% | |
| New Multi-level Ramp Structure | 675 | 10'-0" | 8.33% | |
| *South Pathway* | 1,525 | | | Access at west side of New York Ave |
| Around anchorage | 100 | 10'-0" | 4% | |
| Anchorage to Pier S-2 | 300 | 10'-0" | 4% | |
| New Pathway Structure | 525 | 10'-0" | 5% | |
| Path on grade | 600 | 10'-0" | - | |
| Alternate Access Path - Major Avenue | 1,000 | 14'-0" | - | Combined pathway |

Notes:
1. The 10' alternate at the Main Bridge encompasses the suspender ropes within the pathway railing.

# TABLE V-3
## EVALUATION MATRIX - MAIN BRIDGE

| CRITERIA | WEIGHTING FACTOR | Scheme III - 10ft | Scheme III - 8ft | Scheme IV - 10ft | Scheme IV - 8ft | Scheme V |
|---|---|---|---|---|---|---|
| STRUCTURAL CONSIDERATIONS<br>Additional Weight<br>Stresses on existing structure<br>Interference with existing structure (towers, struts, etc.)<br>Strengthening of existing members (reinforcement) | 25 | 3 | 4 | 3 | 4 | 5 |
| | | 75 | 100 | 75 | 100 | 125 |
| GEOMETRIC CONSIDERATIONS<br>Pathway width<br>Profile/maximum grades<br>Horizontal layout (curves, turns, ramps)<br>Separation of pedestrians & bicyclists | 10 | 4 | 3 | 4 | 3 | 1 |
| | | 40 | 30 | 40 | 30 | 10 |
| CONSTRUCTIBILITY<br>Structural Type (Prefabrication,cast-in-place, etc.)<br>Access for erection<br>MPT/impact on traffic during construction | 10 | 3 | 3 | 2 | 2 | 4 |
| | | 30 | 30 | 20 | 20 | 40 |
| SAFETY CONSIDERATIONS<br>Lighting<br>Protection of public<br>Call boxes/surveillance<br>Security (accessibility to existing structural elements)<br>Railings/fencing<br>EMS access | 15 | 4 | 4 | 4 | 4 | 3 |
| | | 60 | 60 | 60 | 60 | 45 |
| USER COMFORT<br>Separation of pedestrians & bicyclists<br>Pathway width<br>Total climb<br>Wearing Surface<br>Aesthetics/Views<br>Lighting<br>Horizontal layout (curves, turns, ramps)<br>Security<br>Signage | 15 | 4 | 3 | 5 | 4 | 1 |
| | | 60 | 45 | 75 | 60 | 15 |
| CONSTRUCTION COSTS & OPERATION<br>Initial construction cost<br>Maintenance costs<br>Security force | 25 | 2 | 3 | 2 | 3 | 5 |
| | | 50 | 75 | 50 | 75 | 125 |
| **SUMMARY** | **100%** | **315** | **340** | **320** | **345** | **360** |

Numerical Rating Scale

1 - Undesirable
2 - Below Average
3 - Average
4 - Above Average
5 - Most Desirable

# TABLE V-4
## EVALUATION MATRIX - BROOKLYN APPROACH

| | | Lower | | | Upper | | |
|---|---|---|---|---|---|---|---|
| | | *Ramp to JPJ Park* | *Pathway Playgnd* | *Pathway 92nd St* | *Ramp to JPJ Park* | *Pathways 10' wide* | *Pathways 7' wide* |
| CRITERIA | WEIGHTING FACTOR | Scheme I - L | Scheme II - L -A | Scheme II - L -B | Scheme I - U | Scheme II - U | Scheme III - U |
| GEOMETRIC CONSIDERATIONS<br>Pathway width<br>Profile/maximum grades<br>Horizontal layout (curves, turns, ramps)<br>Separation of pedestrians & bicyclists | 15 | 2 | 4 | 4 | 2 | 5 | 3 |
| | | 30 | 60 | 60 | 30 | 75 | 45 |
| APPROACH CONNECTIONS<br>Location of access point<br>Proximity of Public Transportation<br>Connection with existing/proposed bikeways | 20 | 4 | 3 | 3 | 4 | 3 | 3 |
| | | 80 | 60 | 60 | 80 | 60 | 60 |
| CONSTRUCTIBILITY<br>Effect on existing structure / surrounding areas<br>Structural Type (Prefabrication,cast-in-place, etc.)<br>Access for erection<br>MPT/impact on traffic during construction | 10 | 3 | 3 | 3 | 2 | 2 | 4 |
| | | 30 | 30 | 30 | 20 | 20 | 40 |
| SAFETY CONSIDERATIONS<br>Lighting<br>Protection of travelling public<br>Call boxes/surveliance<br>Security (accessibility to existing structural elements)<br>Railings/fencing<br>EMS access | 15 | 3 | 4 | 3 | 3 | 4 | 4 |
| | | 45 | 60 | 45 | 45 | 60 | 60 |
| USER COMFORT<br>Separation of pedestrians & bicyclists<br>Pathway width<br>Total climb / grade<br>Aesthetics<br>Lighting<br>Horizontal layout (curves, turns, ramps)<br>Security<br>Signage | 15 | 2 | 3 | 3 | 2 | 4 | 3 |
| | | 30 | 45 | 45 | 30 | 60 | 45 |
| CONSTRUCTION COSTS & OPERATION<br>Initial construction cost<br>Maintenance costs<br>Security force | 25 | 3 | 3 | 3 | 3 | 1 | 4 |
| | | 75 | 75 | 75 | 75 | 25 | 100 |
| **SUMMARY** | **100%** | **290** | **330** | **315** | **280** | **300** | **350** |

Numerical Rating Scale

1 - Undesirable
2 - Below Average
3 - Average
4 - Above Average
5 - Most Desirable

# TABLE V-5
## EVALUATION MATRIX - STATEN ISLAND APPROACH

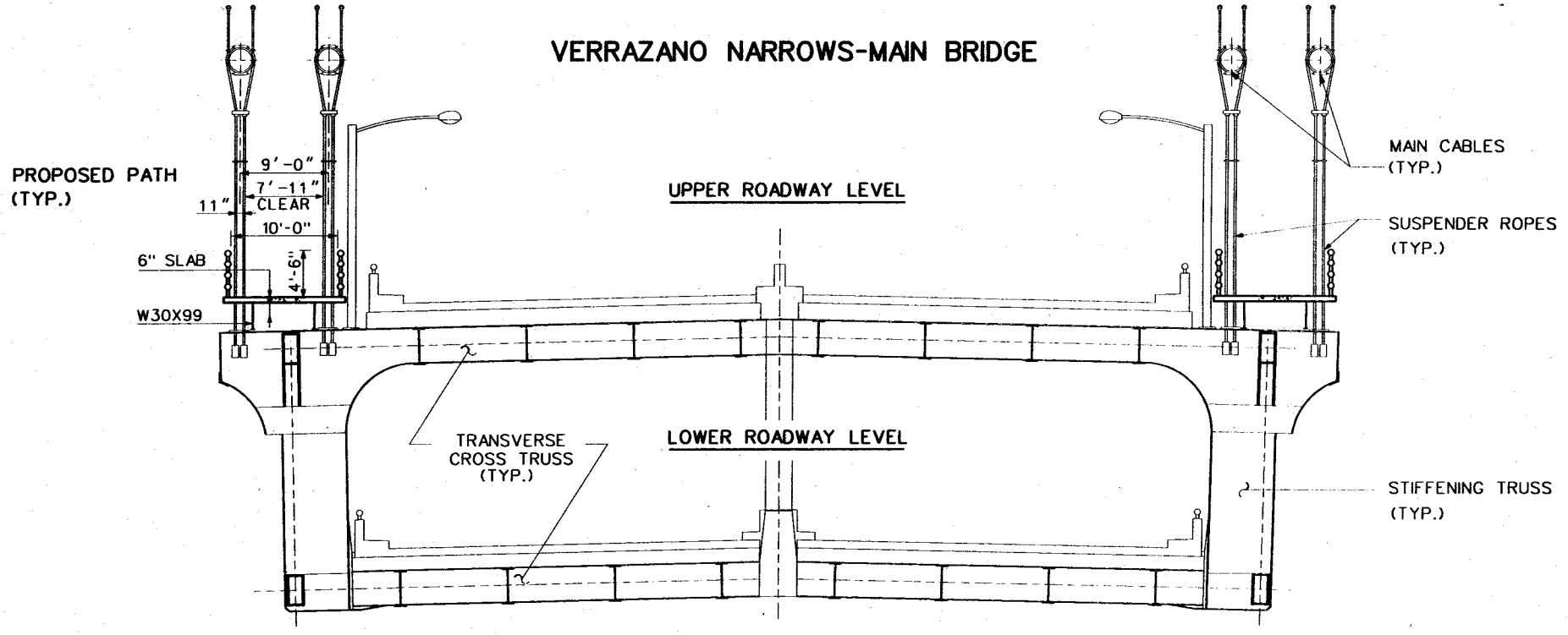
| | | Lower | | Upper | |
|---|---|---|---|---|---|
| | | *Ramp to NY Ave* | *Pathways* | *Ramp to NY Ave* | *Pathways* |
| **CRITERIA** | **WEIGHTING FACTOR** | **Scheme I - L** | **Scheme II - L** | **Scheme I - U** | **Scheme II - U** |
| GEOMETRIC CONSIDERATIONS<br>Pathway width<br>Profile/maximum grades<br>Horizontal layout (curves, turns, ramps)<br>Separation of pedestrians & bicyclists | **15** | 3 | 5 | 2 | 5 |
| | | 45 | 75 | 30 | 75 |
| APPROACH CONNECTIONS<br>Location of access point<br>Proximity of Public Transportation<br>Connection with existing/proposed bikeways | **20** | 4 | 4 | 4 | 4 |
| | | 80 | 80 | 80 | 80 |
| CONSTRUCTIBILITY<br>Effect on existing structure / surrounding areas<br>Structural Type (Prefabrication,cast-in-place, etc.)<br>Access for erection<br>MPT/impact on traffic during construction | **10** | 3 | 3 | 3 | 2 |
| | | 30 | 30 | 30 | 20 |
| SAFETY CONSIDERATIONS<br>Lighting<br>Protection of travelling public<br>Call boxes/surveliance<br>Security (accessibility to existing structural elements)<br>Railings/fencing<br>EMS access | **15** | 3 | 4 | 3 | 3 |
| | | 45 | 60 | 45 | 45 |
| USER COMFORT<br>Separation of pedestrians & bicyclists<br>Pathway width<br>Total climb / grade<br>Aesthetics<br>Lighting<br>Horizontal layout (curves, turns, ramps)<br>Security<br>Signage | **15** | 3 | 4 | 3 | 4 |
| | | 45 | 60 | 45 | 60 |
| CONSTRUCTION COSTS & OPERATION<br>Initial construction cost<br>Maintenance costs<br>Security force | **25** | 4 | 3 | 2 | 3 |
| | | 100 | 75 | 50 | 75 |
| **SUMMARY** | **100%** | **345** | **380** | **280** | **355** |

*Note: A separate upper level scheme (III-U) utilizing the existing 7' sidewalk at the S.I. Anchorage without widening, was not evaluated due to the limited available length of 190'.*

Numerical Rating Scale

1 - Undesirable
2 - Below Average
3 - Average
4 - Above Average
5 - Most Desirable

# Figures For Preferred Alternative Pathway Scheme




# MODIFIED SCHEME V

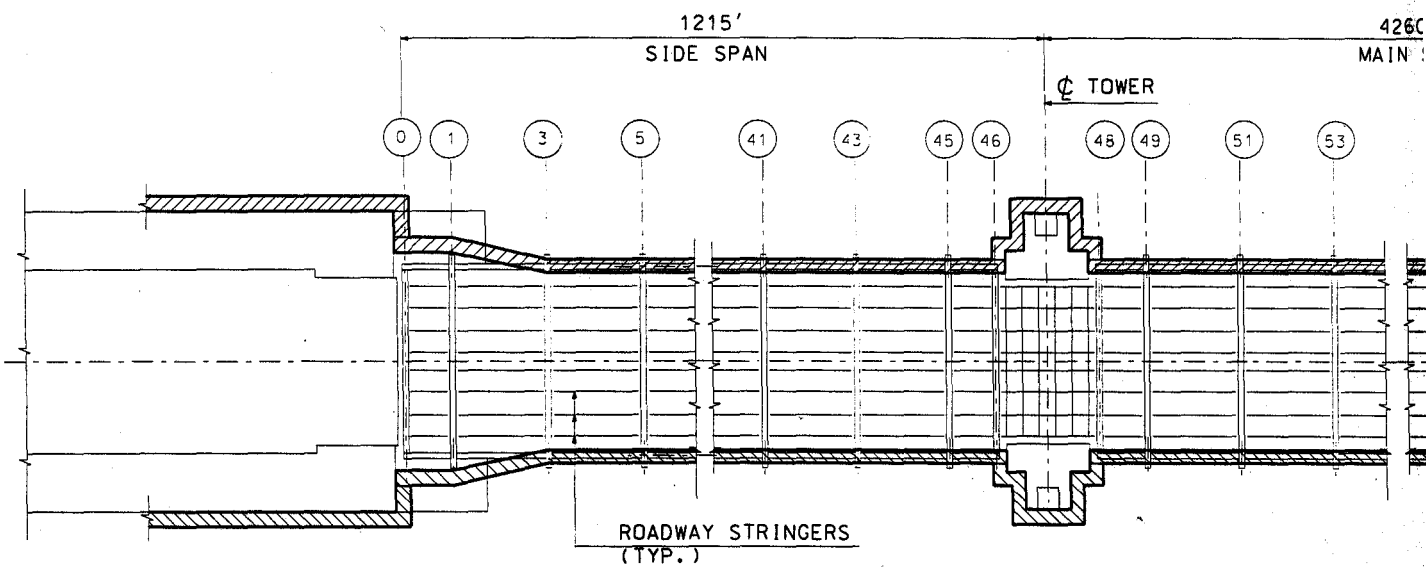
## PROPOSED PATH
## LOCATED BETWEEN SUSPENDER ROPES

FIGURE V-1

AMMANN & WHITNEY
CONSULTING ENGINEERS

c: \u\veraz\scheme5.dgn Mar. 18, 1997 13: 49: 56

88
V-2

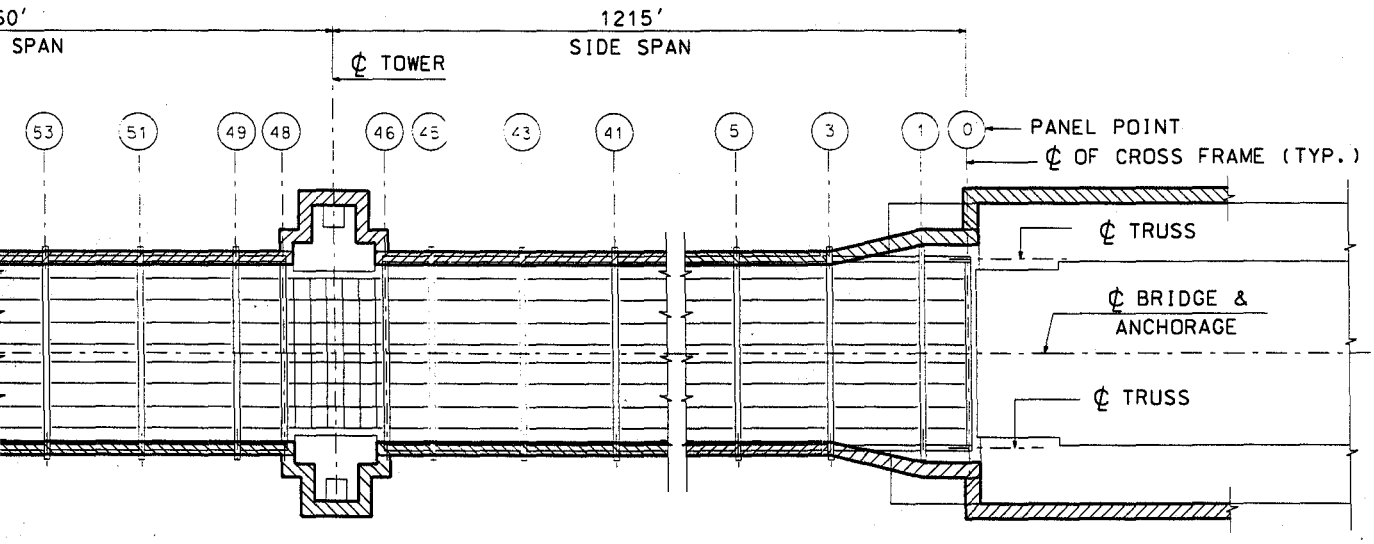



STATEN ISLAND ANCHORAGE

STATEN ISLAND TOWER

## SCHEME V – PLAN OF PATHWA

c:\u\veraz\fps5.dgn Mar. 17, 1997 15:54:40



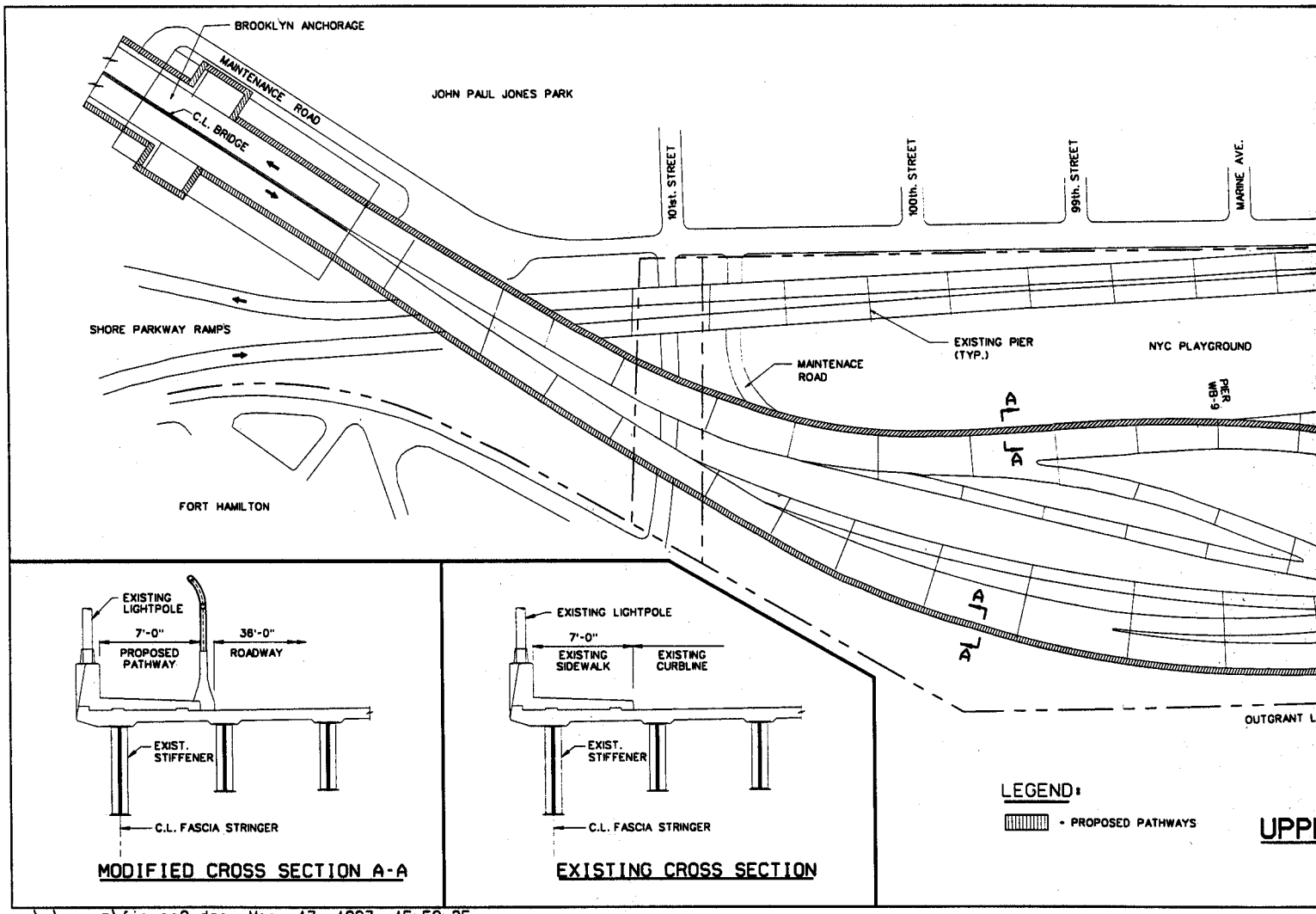

BROOKLYN TOWER

BROOKLYN ANCHORAGE

AYS BETWEEN SUSPENDER ROPES

FIGURE V-2

AMMANN & WHITNEY
CONSULTING ENGINEERS

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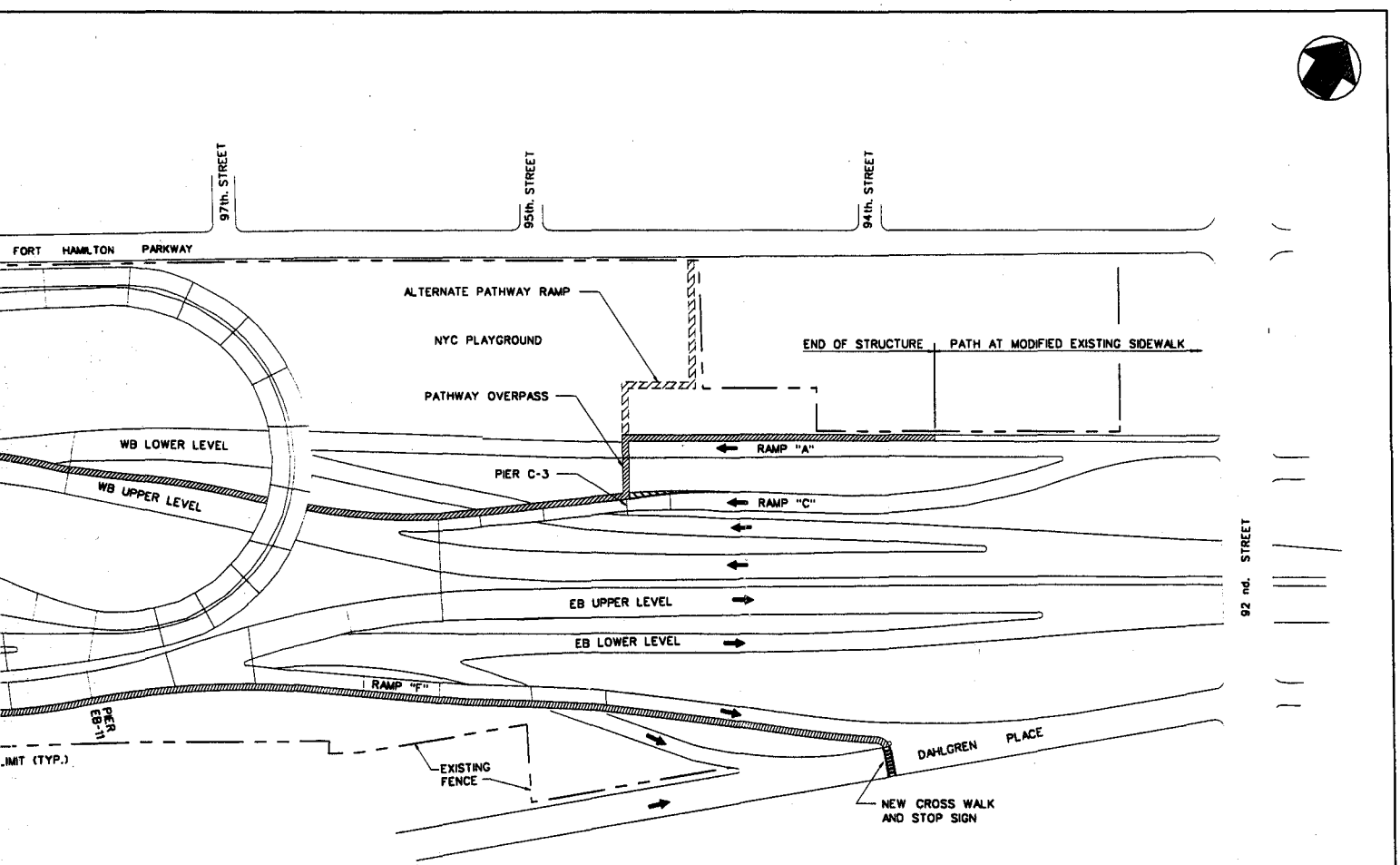
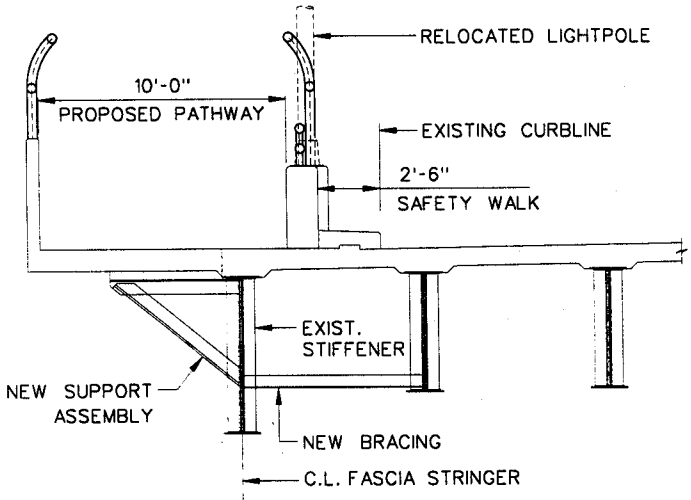


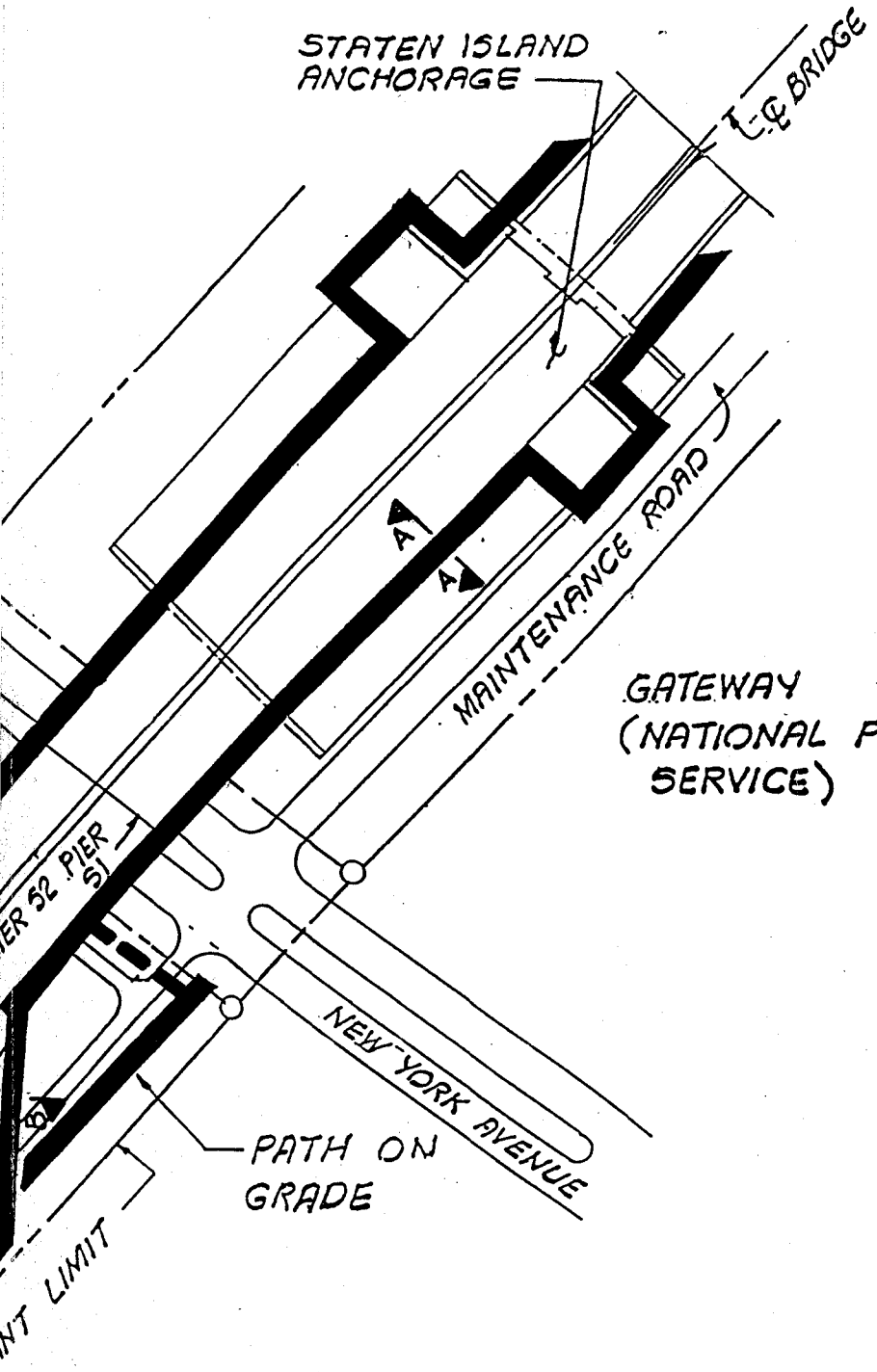

ER LEVEL SCHEME III-U

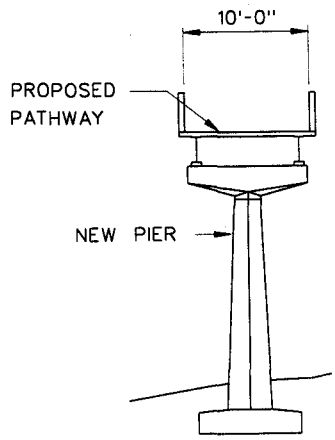
0 50 100 200'

| AMMANN & WHITNEY CONSULTING ENGINEERS | BROOKLYN APPROACH VNB BICYCLE PATH STUDY | FIG. V-3 |
|---|---|---|




MODIFIED CROSS SECTION A-A




SECTION B-B

LEGEND:

PROPOSED PATHWAYS

ALTERNATE PATH TO MAJOR AVENUE

WAY

| | | |
|---|---|---|
| AMMANN & WHITNEY CONSULTING ENGINEERS | STATEN ISLAND APPROACH (SCHEME II-U) PATHWAY CONNECTION TO UPPER LEVEL | FIGURE V-4 |