This document is provided for informational purposes only. The Design-Build Proposer shall not rely on this information in the preparation of a project Proposal. Please refer to the project’s Request for Proposal (RFP) for the final project requirements.

BIN 1-06560-9
Meeker Avenue Viaduct
Kings County, New York

November 2011
### TABLE OF CONTENTS

1.0 Introduction .........................................................................................................................1
2.0 Superstructure Considerations ..............................................................................................3
3.0 Innovative/Unusual Structure ...............................................................................................6
4.0 Geotechnical Considerations ...............................................................................................6
5.0 Substructure Considerations ................................................................................................7
  5.1 Piles ...................................................................................................................................7
  5.2 Spread Footings ..................................................................................................................7
6.0 Construction Considerations ................................................................................................7
  6.1 Construction Cost ...............................................................................................................7
  6.2 Life Cycle/Maintenance Requirements ..............................................................................8
  6.3 Constructability ..................................................................................................................9
  6.4 Construction Material Delivery .........................................................................................9
  6.5 Construction Duration ......................................................................................................9
7.0 Architectural Considerations ...............................................................................................9
8.0 Work Zone Traffic Control ..................................................................................................9
9.0 Utilities .................................................................................................................................10
10.0 Asbestos ............................................................................................................................10
11.0 Contaminated/Hazardous Waste .......................................................................................10
12.0 Conclusion and Recommendation .....................................................................................11
1.0 Introduction

P.I.N.: X731.26 and X729.77
TITLE: Meeker Avenue Viaduct

DATE: November 2011
SITE DATA RECEIVED: October 2016 (Eastbound)
October 2018 (Westbound)

Meeker Avenue Viaduct – Spans 76 to 78

<table>
<thead>
<tr>
<th></th>
<th>Existing</th>
<th>Proposed</th>
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<tbody>
<tr>
<td>Year Built:</td>
<td>1971</td>
<td>Anticipated 2020</td>
</tr>
<tr>
<td>No. of spans:</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Span length:</td>
<td>Span 76: 67'-9 ½”</td>
<td>Span 76: 67'-9 ½”</td>
</tr>
<tr>
<td></td>
<td>Span 77: 69'-0 3/8”</td>
<td>Span 77: 69'-0 3/8”</td>
</tr>
<tr>
<td></td>
<td>Span 78: 69'-6 7/8”</td>
<td>Span 78: 69'-6 7/8”</td>
</tr>
<tr>
<td>Width:</td>
<td>86'-0”</td>
<td>84'-0”*</td>
</tr>
<tr>
<td>Superstructure:</td>
<td>Steel multi-stringer</td>
<td>Steel multi-stringer</td>
</tr>
<tr>
<td>Substructure:</td>
<td>Steel bents on spread footings</td>
<td>Concrete piers on pile foundations</td>
</tr>
<tr>
<td>Skew:</td>
<td>Varies</td>
<td>Varies</td>
</tr>
</tbody>
</table>

*The out-to-out width of the new bridge will be 84'-0” compared to the 86'-0” width of the existing structure. However, since the proposed fascia barriers are narrower than the existing barriers, the roadway surface between the inside face of the barriers will be the same. This will allow for a smooth transition from the new bridge spans to the existing structure.
This Structure Justification Report (SJR) describes the structural alternatives that were considered for the alteration and replacement of the segment of the existing Meeker Avenue Viaduct that will be replaced as part of the Kosciuszko Bridge Project. This section of the report identifies the strengths and weaknesses of each alternative alteration and replacement scheme that was considered.

The last three (3) spans of the existing Meeker Avenue Viaduct structure will be replaced to accommodate the operational and geometric improvements of the Brooklyn-Queens Expressway (BQE) that are scheduled under four contracts of the Kosciuszko Bridge Project. For further information regarding this project see the SJR BIN 1-07569-9. This segment of the Meeker Avenue Viaduct will provide the transition from the new Brooklyn Connector, which will be part of the new Kosciuszko Bridge, to the existing Meeker Avenue Viaduct, which is beyond the project limits. The BQE is identified as an urban principal arterial interstate.

The proposed profile of the new Brooklyn Connector necessitates that spans 76 through 78 of the existing viaduct be replaced or altered, as the existing sag curve in this location is being modified to improve the existing non-standard headlight sight distance. Spans 76 through 78 consist of a series of steel bents and an abutment (Abutment D) on the east end that is shared with the existing Brooklyn Connector. The existing viaduct is approximately 86 feet wide and carries three lanes of traffic in each direction. Parking is allowed below the structure. Span lengths vary between approximately 67'-9" and 69'-7".

The existing viaduct was completed in 1971. It is 78 spans long and begins just south of Metropolitan Avenue and ends at the Brooklyn Connector. Each span of the existing superstructure consists of sixteen rolled steel girders that are simply supported at each end and are composite with a monolithic reinforced concrete deck. The two outside girders also contain bottom cover plates. The steel bents consist of built up steel cap beams that are integral with four steel support columns. The steel columns are supported by spread footings. See Figure 1.1.

Figure 1.1: Existing Cross Section at Meeker Avenue Viaduct

Piers 75 and 77 provide fixity on both sides of the floorbeam, with girder rotation allowed by the inclusion of deck deflection joints above the floorbeams. Pier 76 is currently configured for girder fixity on the west side, while providing expansion capabilities for the girders on the east side. A deck expansion joint is offset to the east of the cap beam top flange. Fixity is provided by utilizing bolted web connections for the supported stringers on the west side (Span 76). The
girders on the east side (Span 77) allow expansion in the longitudinal direction by the provision of slotted holes for the bolted web connections. An allowance for girder rotation is provided by the inclusion of individual half pin steel bearings that support the girders below their web connections. The half pin bearings are supported on the floorbeam by stiffened brackets. The allowance for expansion of Span 78 is provided by supporting the individual girders of that span with elastomeric bearings on Abutment D, and the provision of an expansion joint in the deck.

The proposed structure will match the alignment and span lengths of the existing structure. The proposed structure will be constructed in two stages concurrently with the adjacent Brooklyn Connector.

During reconstruction of the Meeker Avenue Viaduct and Brooklyn Connector, a temporary bridge will be utilized to carry the eastbound BQE traffic. The temporary bridge will be constructed adjacent to the eastbound side of the BQE above eastbound Meeker Avenue, between Kingsland Avenue and Vandervoort Avenue, and will carry three 11'-0" lanes of eastbound BQE traffic. The Viaduct and Connector will then be reconstructed one half at a time, with traffic maintained on a combination of the temporary bridge and the Viaduct/Brooklyn Connector. A minimum vertical clearance of 14'-0" will be maintained below the structure over Meeker Avenue during construction.

There are three 12'-0" wide travel lanes in each direction and they are separated by a median barrier. The left shoulders are 1'-0" wide and the right shoulders are 2'-6" wide with concrete barriers on each fascia. The proposed alignment will be required to match these existing widths in order to make the transition to the existing structure that will remain beyond the project limits.

The following two structure types were considered for replacement of the last three (3) spans of the existing Meeker Avenue Viaduct structure:

- Steel Girder
- Precast Concrete I-Girder

When considering replacement alternatives for the existing structure, the current parking configuration below the structure was considered and in order to preserve the parking configuration, it was necessary to preserve the existing clearances under the structure. In addition, the existing parking area is arranged so that traffic flows between the center two piers and vehicles park transversely along the length of both fascia. In order to maintain the current parking and traffic configuration it was decided that the replacement piers should be located along the same lines as the existing piers that will remain beyond the project limits.

The alternatives that were considered for the last three (3) spans of the Meeker Avenue Viaduct structure are described below.

2.0 Superstructure Considerations

In coordination with NYSDOT, the bridge types described below were developed by a team of bridge engineers and bridge architects with the overall goal of providing an attractive, economical structure that is an appropriate solution for the Meeker Avenue Viaduct.

Alternative 1: Steel Multi-Girder System (Preferred Alternative)
Alternative 1 consists of a monolithic reinforced concrete deck slab supported on steel girders, welded steel floorbeams, and cast-in-place concrete piers. See Figure 2.2. The reinforced concrete deck would use stainless steel reinforcing and the steel would be Grade 50 weathering steel (ASTM A709 Gr. 50W) with ASTM A325 Bolts. The interior girders and floorbeams would be unpainted, except at the roadway joints.

Pier 75 and 76 would remain, as would the girders of Span 76. The reinforced concrete deck of Span 76 would be replaced and haunch sizes increased to accommodate the roadway profile changes over the existing girders. The maximum increase in haunch depth would be approximately 4" and would necessitate additional haunch reinforcement.

Spans 77 and 78 would be replaced with a 2 span continuous steel girder system. Girder spacing would match the existing arrangement. Rolled sections would be utilized for the majority of girders. Steel plate girders would be utilized in lieu of the current rolled sections with cover plates. The steel girders would frame into a steel plate girder floorbeam at Pier 77 with girder continuity established by utilizing strap plates over the proposed floorbeam. The steel
floorbeam would be supported by elastomeric bearings on the concrete columns. The cap beam of Pier 76 would be modified to provide brackets supporting the west end of the girders of Span 77. The matching of the proposed girder spacing to the existing spacing would allow for the modification of the existing cap beam with minimal conflicts. The girders would be supported by elastomeric bearings that would bear on steel brackets that would be bolted to the existing cap beam. An expansion joint would be provided in the deck and offset to the east of the cap beam top flange.

A new solid pier would be constructed in the location of Abutment D. This new pier would support the girders of Span 78 as well as retain the proposed Expanded Polystyrene (EPS) fill of the Brooklyn Connector, and would be called Pier 0 of the Brooklyn Connector. All girders at the pier would be seated on elastomeric bearings and a deck expansion joint would separate the Meeker Avenue Viaduct from the Brooklyn Connector.

The rehabilitation and reuse of Abutment D was investigated but the existing abutment is in poor condition and replacement is recommended. The existing abutment, which has undergone significant repairs, has been flagged for significant transverse cracking. The foundations of the new concrete columns of Pier 77 and Pier 0 would be supported on mini (bored-in) piles. The pros and cons of the foundation alternatives are discussed in Section 5.0 of this SJR.

The proposed Pier 77 would be arranged to match the existing 4 pier column alignment because, as indicated above, the area below the structure functions as a parking lot. Maintaining the same pier alignment would have minimal impact on the current parking and driving arrangement. The one drawback of matching the current pier alignment would be the need for temporary shoring of the floorbeam as it is constructed in two stages.

A multi-girder system is a redundant framing system. The floorbeam at Pier 77 could be constructed to follow the roadway cross slope and the longitudinal girders could frame into the floorbeams with adequate top of steel elevation to provide uniform haunches at the girders. In addition, the span lengths and girder spacing would allow for the efficient use of rolled sections and steel plate girders.

Matching the steel structure type of the existing viaduct to remain beyond the project limits would provide an aesthetically seamless transition to the Kosciuszko Bridge.

Alternative 2: Concrete Girders.

These spans would have the same configuration and girder spacing as the steel girder alternative but utilize Type II and Type III AASHTO I-Beams. A cast-in-place concrete floorbeam could be utilized instead of the steel floorbeam at Pier 77. As with the steel girder solution, there would be a composite reinforced concrete deck utilizing stainless steel reinforcing steel.

Prestressed concrete girders would have advantages over other superstructure types as life cycle costs for concrete superstructures are typically less than steel superstructures as steel components are more susceptible to weather induced corrosion requiring steel repairs and repainting multiple times throughout the life cycle. However, the use of unpainted weathering steel for the interior girders and floorbeams, except at the expansion joints for the steel alternative, would minimize the life cycle cost advantage provided by a concrete superstructure.
In addition, the spans of the existing Meeker Avenue Viaduct that will remain are steel bents. The inclusion of two concrete spans with a series of steel spans would not be preferred as an economy of scale would not be realized. Furthermore, a concrete superstructure is inherently heavier than a steel superstructure, and would result in larger capacity foundations and increased foundation cost. In addition, there would be detailing and construction complications at the interface of the prestressed girders and the existing Pier 76, as well as the need to temporarily shore the concrete floorbeam forms during construction.

For these reasons a concrete girder alternative was eliminated from consideration for the Meeker Avenue Viaduct.

3.0 Innovative/Unusual Structure

As per Section 20.2.2 of the NYSDOT Bridge Manual, the Meeker Avenue Viaduct is not considered an unusual structure. However, the Kosciuszko Bridge Project as a whole is considered a complex project due to the geometric constraints on the replacement structure being located within the tight transportation corridor and the intricate construction staging and contract required to maintain traffic on this critical interstate highway.

4.0 Geotechnical Considerations

A geotechnical subsurface investigation was performed between September and November 2009. The full results of this investigation can be found in the Preliminary Geotechnical Report included in Appendix B. The investigation included sixteen (16) 4-inch diameter boreholes.

Based on the results of the subsurface investigation the soil/rock stratigraphy above bedrock at the project site can be generally described in the following 5 sections:

- Stratum 1: Fill;
- Stratum 2: Organic Deposits
- Stratum 3: Silty Sand
- Stratum 4: Silty Clay
- Stratum 5: Decomposed Rock.

Strata 1 and 2 are not considered as suitable foundation bearing strata. Strata 3, 4 and 5 are considered adequate foundation bearing strata.

Stratum 3 exists at a depth of approximately 10 to 15 feet from the ground surface. As a result, deep spread foundations are anticipated to achieve adequate soil bearing capacity.

The use of pile foundations can also be considered. Due to the limited vertical clearance that exists during construction, the foundations can be supported on bored in mini-piles. The use of mini-piles in this location would provide the advantage of allowing pile installation for the piers while the existing foundations are still in place.
Results based on the preliminary mini-pile analysis (for vertical load only) using the obtained boring data are as follows:

- Allowable Pile Capacity:
  9 5/8” OD:  120 tons

- Pile Length Required:
  75 feet

5.0 Substructure Considerations

5.1 Piles (Preferred Option)

Due to the limited vertical clearance at the Meeker Avenue Viaduct that exists during construction, the foundations would be supported on mini-piles (bored-in-piles) as they can be installed with low headroom equipment. This is subject to approval by NYSDOT GEB. An advantage of mini-piles is that they can be drilled through the existing concrete spread footings.

The use of piles would also minimize excavation depth, thereby minimizing excavation support requirements.

5.2 Spread Footings

A suitable bearing layer exists at a depth at approximately 10 to 15 feet from the ground surface.

Therefore, spread footings can be considered in these areas. However, the new spread footings would require a deeper excavation than pile supported footings in order to reach the suitable bearing layer. In addition, the use of spread footings would require that existing foundations be removed, and possibly portions of the existing floorbeams be temporarily supported as part of the staged construction, which would add to the project cost.

Reuse of the existing spread footings to support the new superstructure may be feasible by removing the existing steel columns and floorbeam and modifying the existing footings to support the new structure. However, the condition of the existing spread footings requires investigation prior to modification design.

The soil in the project area has also been found to be contaminated, as described in Section 11.0 of this report. The deeper excavation of the spread footing option would lead to further exposure to the contaminated materials as well as a higher quantity of contaminated disposal. For these reasons it is recommended that the new foundations be pile supported.

6.0 Construction Considerations

6.1 Construction Cost

For each of the bridge types, detailed cost evaluations were completed for significant bridge items including foundations, structural concrete, reinforcement, and structural steel. These
detailed estimates were prepared by a professional estimator, who had been employed by contractors for many years, using the same methodologies as are employed in the construction industry in preparing competitive bids. As a result the estimates are based on a detailed breakdown of the costs of materials, fabrication, delivery of materials to the site, and the labor and equipment required to install the items, subcontractor mark-ups, insurance and office overhead. For other typical bridge items, such as concrete barriers and bearings, the unit prices were estimated by a professional estimator using best judgments based on previous experience.

These preliminary estimates are comparative estimates and do not represent the full construction costs estimate as they do not include demolition, drainage, lighting, sign structures, etc.

The preliminary overall project costs in 2010 dollars, including a contingency of 25%, are summarized below in Table 6.1

Table 6.1 – Total Estimated Construction Cost

<table>
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<tr>
<th>Structure Type</th>
<th>Total Estimated Project Cost (2010 Dollars)</th>
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<tbody>
<tr>
<td>Steel Girders</td>
<td>$10.3 M</td>
</tr>
<tr>
<td>Concrete Girders</td>
<td>$7.0 M</td>
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</tbody>
</table>

Although the estimate for the steel girder option is higher than the concrete girder option, this estimate does not account for the constructability complications of the concrete girder option which could lead to increased costs. The concrete option would require detailing and construction complications at the interface of the prestressed girders and the existing pier to remain as well as the need to temporarily shore the concrete floorbeam forms during construction.

6.2 Life Cycle/Maintenance Requirements

The NYSDOT will continue to be responsible for the maintenance of the Meeker Avenue Viaduct. All bridge types will require periodic inspection and maintenance, including cleaning and washing, pavement re-striping, joint repair/replacement and wearing surface replacement.

Bearing replacement would be required at 20 to 30 year intervals. It is expected that the joint areas and outside face of the steel fascia girders will require painting every 12 to 15 years.

Since there will be non-standard shoulders along the Meeker Avenue Viaduct limited lane closures will be required for inspection and maintenance. However, this cannot be avoided since the shoulder widths are limited due to Right-of-Way and alignment constraints.
6.3 Constructability

The reconstruction of the existing Viaduct will result in closure of the affected parking area below for the duration of construction.

From Kingsland Avenue to Vandervoort Avenue, the construction of the temporary eastbound bridge as well as the proposed viaduct will result in temporary night closures for Meeker Avenue, Morgan Avenue and Vandervoort Avenue.

Eastbound Meeker Avenue will be closed to pedestrian access during the construction of the temporary eastbound bridge and proposed new eastbound structure. Local businesses along eastbound Meeker Avenue will still be accessible via existing alternate entrances along the adjacent streets.

6.4 Construction Material Delivery

The construction materials for the Meeker Avenue Viaduct may be delivered to the site utilizing Newtown Creek for waterway delivery, or the Interstate Highway system and primary arterials in the vicinity for delivery by truck. The size of each structure member will be considered during final design to ensure that deliverability problems will be mitigated. Field splices of the girders may be utilized to control delivery problems. There are numerous low clearance bridges in the area but the preliminary evaluation indicates that truck delivery is feasible to the Meeker Avenue Viaduct.

6.5 Construction Duration

Stage reconstruction of the Meeker Avenue Viaduct must be coordinated with the adjacent Kosciuszko Bridge replacement construction. Based on additional studies conducted as part of the initial stage of Final Design, the overall construction duration is expected to be performed under four separate construction contracts with an overall duration of approximately six (6) years to complete. The overall construction duration would be the same for any of the structure types considered for the Meeker Avenue Viaduct.

7.0 Architectural Considerations

The Meeker Avenue Viaduct, although not as bold as the signature main span and approaches, should still be a noteworthy addition to the Kosciuszko Bridge Project, as well as an efficient and functional mode of connection to the bridge. The use of steel as the preferred material presents options for color, and can provide a clean, yet sturdy appearance that will integrate the structures with the existing environment.

The Meeker Avenue Viaduct will remain open below. The existing parking area will remain and current parking configuration kept, maintaining continuity with the existing parking area not affected by this project.

8.0 Work Zone Traffic Control

The work zone traffic control arrangement for the Meeker Avenue Viaduct reconstruction will have the same staged construction sequence as the adjacent Brooklyn Connector
reconstruction.

Six lanes of traffic, three eastbound and three westbound, will be maintained throughout construction on a combination of the new and existing structure, and a temporary bridge over eastbound Meeker Avenue.

A three lane eastbound temporary bridge will be required and will extend from Kingsland Avenue to Vandervoort Avenue above Meeker Avenue. The temporary bridge will be operational before the existing eastbound structure can be demolished. Three eastbound lanes of traffic will be maintained on the temporary bridge until the proposed westbound structure is completed and fully operational.

Intermittent single lane closures will be utilized occasionally during off-peak hours to switch traffic patterns between construction stages. All temporary lanes will be 11'-0".

9.0 Utilities

During the construction of the temporary bridge over eastbound Meeker Avenue, several pile bents will be constructed over an existing NYCDEP 12” CIP water main and a NYCDEP combined sewer main. These utilities may need to be relocated to facilitate the proposed bent construction. Con Edison has several electrical utilities within the eastbound Meeker Avenue that will require coordination with Con Edison to ensure these utilities are protected and maintained during construction. A new storm sewer system will be constructed on the mainline BQE roadway, which will connect to newly installed manholes and storm lines constructed in eastbound Meeker Avenue. Water and Sewer designs will be coordinated and approved by NYCDEP.

The proposed design for westbound Meeker Avenue does not include impacts to the existing 12” water main, gas main or the sanitary sewer line within the roadway. Therefore, no utility impacts are anticipated along westbound Meeker Avenue.

10.0 Asbestos

The inspection of the existing bridge structure identified several locations of suspect asbestos containing materials. The suspect materials include bond breaker, arc shields, debris, waterproofing membrane, and pipe wrap and insulation on utilities that are to be relocated.

See the Asbestos Assessment and Design Report for further information. The report provides the results from the field investigation including asbestos materials identified, location, type and quantity found. Appropriate handling and disposal procedures will be specified in the construction documents.

11.0 Contaminated/Hazardous Waste

Several environmental investigations completed for the project identified soil and groundwater across much of the project site with volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, and polychlorinated biphenyls (PCBs), likely as a result of the historic industrial nature of the area. Construction of the Meeker Avenue Viaduct foundations, which will be pile supported, will require excavation and dewatering in areas of known contamination as well as special handling of any subsurface materials removed during the
installation of the mini-piles. See BIN 1-07569-9 for further information regarding contaminated materials within the project area.

12.0 Conclusion and Recommendation

Based on the parameters discussed relating to the technical criteria, construction methodology, and aesthetics of each option, the preferred alternative is the steel multi girder system. Although the steel girder option may be slightly more expensive than the concrete girder option, constructability of the steel girders would be more straightforward. The constructability complications of the concrete option could result in increased costs.

The steel multi girder system utilizing steel floorbeams and reinforced concrete piers provides the appropriate aesthetic appearance and constructability advantages described in this report. Although complicated due to construction staging, the conventional construction method opens up bidding to numerous contractors. Because of these reasons the steel multi girder system is the preferred alternative.

Signature/Title  _____________________________________

Date:   _____________________________________