ITEM 599.0602XX04 M - COUNTERWEIGHT SYSTEM & SPAN BALANCE

DESCRIPTION

The work shall consist of:

- Removing and disposing of the existing counterweight ropes.
- Furnishing and installing new counterweight rope assemblies, take ups, sheaves, and bearings.
- Demolishing, removing, and disposing of existing counterweights and counterweight rope anchorages.
- Furnishing and installing new counterweights and counterweight rope anchorages.
- Perform span balance calculations.
- Perform span balancing measurements using load cells.
- Furnishing and installing concrete balance blocks for balancing the rehabilitated lift span and counterweight systems.

MATERIALS

1. Wire Ropes - General

Wire ropes shall conform to the American Association of State Highway and Transportation Officials (AASHTO) “Standard Specifications for Movable Highway Bridges,” 2000 edition, Sections 3.2.1 through 3.2.15 with the following exceptions:

a. Section 3.2.3 “Construction”:

i. The Counterweight ropes shall be made of improved plow steel.

ii. The Counterweight shall be 6 x 37 XIP class rope.

b. Section 3.2.7 "Wire-Physical Properties":

i. Wires of less than 1mm may be used if consistent with the manufacturer's standard practice for manufacturing 6 x 37 XIP class rope.

c. Section 3.2.8 "Ultimate Strength":

i. One test piece shall be taken from the original coil from which each operating and Counterweight rope is fabricated. The length of each test piece shall be 50 times the nominal diameter of the rope to be tested. Each test piece shall be tested to destruction per Section 3.2.8. Rejection of ropes shall be based on Section 3.2.9.

ii. The minimum ultimate strength of the Counterweight rope shall not be less than 458.1 kN for the Ingersoll Street and Washington Street Bridges.

2. Counterweight Ropes

The counterweight ropes shall be:

a. 6 x 37 filler wire construction.

b. Independent wire rope core (IWRC).

c. Improved plow steel.

d. 28.6 mm diameter .

e One-half right regular lay and one-half left regular lay (for each bridge).

f Pre-stretched to eliminate constructional stretch.

3. Trunnion Bearings

The trunnion bearings shall be fabricated as shown on the plans. The bearing housings shall be split at the centerline with shims to allow shaft clearance adjustments. The housings shall be fabricated from ASTM A709M, Grade 250 steel. The fabrications shall be stress-relieved after welding and prior to machining. After stress relief, each weldment shall be thoroughly cleaned and checked for cracking using the dye penetrant method. Bearing caps shall be secured by four ASTM A325M grade bolts. The bearing housing shall have four mounting holes. The mounting holes shall be undersized for field installation. The bearing shall contain a bronze bushing. Each bushing shall be fabricated from ASTM B22 C91100 material. Grease grooves shall be machine cut in the bushing as shown on the plans Trunnion bearings shall have the cap half-fitted to the base half as indicated on the plans. The interface between the cap and base shall be accurately machined. Caps and bases shall be provided with double-flanged bronze bushings held in position against the frictional torque of the shaft by hex head steel cap screws, unless otherwise indicated on the plans. Bushings shall fit the inside bore and end faces of the base and cap with a class LC1 fit and shall be bored to achieve a Class RC6 fit. Bearings caps shall be provided with tapped holes for lifting eyebolts, which shall be installed.

Bushings for trunnion bearings shall be finish bored with the caps in place and with 6 mm thick bronze or brass laminated liners. At least 3 mm of the liner thickness shall be of laminated construction capable of adjustment in increments of 0.075 mm. The edges of the liners shall be cut square and flush with the bushing flange if there is no change in shaft diameter. Except for a short distance from each end, the inside edges of the liners shall be cut back to form a grease reservoir along the shaft. Holes shall be drilled through the liners with ample clearance for the cap bolts.

The bearings shall be capable of static loads of 40,275 kg and an operating speed of 8.3 rpm. Anti-friction bearings shall be selected for B-10 life of 40,000 hours.

4. Fasteners

All bolts for connecting machinery parts to each other or to supporting members shall be ASTM A449M as shown on the plans or specified otherwise and shall conform to one of the following types: Finished body, high strength bolts; Turned bolts, turned cap screws, and turned studs; High strength turned bolts.

When assembled, all joined surfaces, including those adjacent to the bolt heads, nuts or washers, shall be free of scale, except tight mill scale, and shall also be free of dirt, loose scale, burrs and other foreign material and defects that would prevent solid seating of the parts.

All elements connected by bolts shall be drilled or reamed assembled to assure accurate alignment of the hole and accurate clearance over the entire length of the bolt within the specified limit.

Bolt holes through unfinished surfaces shall be spot faced for the head and nut, square with the axis of the hole.

Unless otherwise specified on the plans or herein, all bolt holes in machinery parts, which connect these parts to support steelwork, shall be sub drilled at least 2mm smaller in diameter than the bolt diameter. The holes shall be reamed for the proper fit at assembly or at erection, only after correct assembly and alignment as completed and approved.

Holes in shims and fill plates for machinery parts shall be reamed or drilled to the same tolerances as the connected parts at final assembly.

Whenever possible, high strength bolts connecting machinery parts to structural parts, or other machinery parts, shall be inserted through the thinner element into the thicker element.

Turned bolts are bolts having a machined shank 2 millimeter larger in diameter than the threaded portion and shall be used to fasten all machinery parts to each other and to their supports. The fit between turned bolts and their holes shall be Class LC6. The holes shall be drilled and reamed at final assembly after proper alignment of all components has been satisfactorily achieved by the use of temporary bolts or clamps.

5. Counterweight Sheaves

The counterweight sheave hubs and rims shall be fabricated from ASTM A668M, counterweight webs and stiffeners shall be fabricated from Class D and ASTM A709M, Grade 250 steel. The fabricated sheaves shall be stress relieved prior to final machining. All dimension shown on the plans are final dimensions, and do not make allowance for distortion due to welding. Upon completion of stress relief, the weldments shall be cleaned and inspected for any cracking (Dye Penetrant method). Any cracks shall be brought to the attention of the Engineer prior to any repairs. Unauthorized repairs shall be grounds for outright rejection of the weldment.

The counterweight sheaves will be set on new shafts. The new shafts will be ASTM A668M, Class D forged steel.

Counterweight rope grooves shall be machined to provide the same nominal root diameters for each set. A tolerance of +0, -0.1 mm shall be maintained for each groove root diameter relative to all other operating sheaves root diameters within an individual sheave. The nominal diameter between the two sheaves comprising a set shall not exceed 0.01 mm variation. The root diameters shall be measured and recorded. The dimensions of each sheave within each set shall be provided to the Engineer.

6. Sockets

The Counterweight ropes shall be fitted with galvanized open spelter sockets rated not less than 100 percent of the ultimate strength of the rope itself. The sockets shall be attached to the ropes by using zinc conforming to the current material specifications for slab zinc (spelter) of the

AASHTO Designation M120, high grade. Wire rope test sections shall be prepared with sockets provided for the project for each size rope to be installed. The sockets shall be attached such that the rope, when stressed to 80 percent of its ultimate strength, will not slip more than 1/6 the nominal diameter of the rope. If a socket should break at a test load below the ultimate strength of the rope, another piece of rope shall be tested with two additional sockets. If a socket fails again at a test load below the ultimate strength of the rope, all sockets provided for that particular rope size shall be rejected, and new sockets of stronger material or heavier design shall be furnished and the test procedure shall be repeated.

7. Pins

All pins shall be accurately finished, round, smooth, and straight and, when turned to different diameters, shall have rounded fillets at the shoulders. All pins used to connect the counterweight ropes shall be ASTM A668M, Class D forged steel.

8. Take ups

The take ups for attaching the counterweight ropes to the lift spans and counterweights shall be ASTM A668M, Class M alloy steel. Nuts for take ups shall meet the requirements of Section 715-14 of the Standard Specifications.

9. Counterweights

The counterweights shall be Class A concrete manufactured in accordance with the requirements of Section 501-2 of the Standard Specifications.

Reinforcing steel shall meet the requirements of Section 556-2 of the Standard Specifications, Structural steel shall be ASTM A709M, Grade 250 and shall meet the requirements of Section 715-01 of the Standard Specifications. The contractor may substitute ASTM A709M, Grade 345 at no additional cost to the State.

High-strength nuts, bolts and washers shall meet the requirements of Section 715-14 of the Standard Specifications.

10. Counterweight Balance Blocks

The counterweight balance blocks shall be Class A concrete manufactured in accordance with the requirements of Section 501-2 of the Standard Specification. Balance blocks shall have a recessed handle, weights painted on each block and shall be fabricated in accordance with Section 2.1.3 of AASHTO "Standard Specifications for Moveable Highway Bridges", 2000 edition.

CONSTRUCTION DETAILS

1. Removal of the Counterweight Ropes and the Counterweight

For each bridge, the lift span shall be securely supported in its lifted position and the counterweights then jacked and securely supported to relieve any loads before disconnecting any counterweight or operating ropes. Design and detailing of the supporting structure shall be completed by a New York State Licensed Professional Engineer and submitted to the Engineer for review prior to erection. The existing counterweight ropes shall be disposed of by the

Contractor. The counterweights shall be removed from their pits and disposed of by the Contractor.

2. Counterweight Ropes

Each counterweight shall have three right regular lay ropes attached to one side and three left regular lay ropes attached to the other side to prevent rotation of the counterweight.

The tension in each Counterweight rope shall be equalized in the following manner:

For each bridge, the counterweights shall be supported such that they are at or above their normal position for the fully raised position of the rehabilitated bridge and their centerlines are level. Design and detailing of the supporting structure shall be completed by a New York State Licensed Professional Engineer and submitted to the Engineer for review prior to erection. The rehabilitated bridge shall be elevated with all four corners 610mm above the bridge position corresponding to the supported counterweight position. The new counterweight ropes shall then be connected to the counterweights and bridge. The bridge shall then be lowered 610 mm and a torque of 73.8N-M shall then be applied to each tensioning nut located on the span side counterweight anchors. The bridge shall then be lowered to its live load shoes which will raise the counterweights to their normal position. The tension in each Counterweight rope shall then be determined using a tension measuring device approved by the engineer. The American Bridge method of rope tensioning by measuring vibration is acceptable. The tensioning nuts shall be adjusted to provide equal tension in each rope such that all six (6) ropes per side are within 5 percent (maximum to minimum tension value). The second nut on each anchor shall then be tightened while the first nut is held in place to prevent loosening of the tensioning nuts.

3. Counterweights

The concrete counterweights shall be constructed in accordance with the requirements of Section 555 of the Standard Specifications as shown on the plans and in accordance with this specification.

Reinforcing steel for the counterweights shall be in accordance with Section 556 of the Standard Specifications.

Structural steel work shall be in accordance with the New York State Steel Construction Manual.

The contractor shall perform detail balance calculations in order to determine the weight of the counterweights and balance blocks required to balance the span in accordance with the requirements of this specification. The balance calculations shall include the shipping weight of all structural, mechanical, electrical and architectural components of the lift span. The weight of the two concrete counterweights shall be equal to the calculated lift span weight minus three and one-half (3.5) percent minus the specified span heavy balance condition.

A total of eight (8) percent of the lift span weight shall be supplied in concrete counterweight blocks.

Balance calculations shall be signed and sealed by a Professional Engineer licensed in the State of New York and submitted to the Engineer for review and approval prior to construction of the counterweights.

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Counterweight details, weights and the number of balance blocks indicated on the plans documents are based upon preliminary balance calculations. Actual counterweight weight and balance block quantities may vary and shall be based on the final balance calculations and measurements performed by the contractor.

The required size of the counterweights shall be subject to the dimensional limitations shown on the plans. The determination of counterweight size shall account for: the weight of the counterweight rope take ups, the weight of the take up anchorage, the weight of the reinforcing steel, and the weight of any reductions (e.g., chamfers, recesses, etc.) or additions to the counterweight volume.

4. Span Balance

The counterweights shall be weighed before installation of the Counterweight ropes. A load cell shall be placed under each set of four Counterweight rope attachments. Based on the actual weight measurement taken after the rehabilitation is complete, the weight of the counterweights shall be adjusted to achieve a span heavy balance condition of:

(a) 5800kg +/- 227kg for Washington
(b) 4419kg +/- 227kg for Ingersoll.

Adjustments shall be made by removing or installing concrete balance blocks to the counterweights. No weighting of the span will be permitted. All equipment and material not to become part of the permanent installation shall be removed from the span and counterweights. The entire lift span-counterweight system shall be weighed at all four live load shoes simultaneously after completion of the work. After final adjustments are made by the removal or installation of balance blocks, and the proper balance condition verified at the four corners.

Unused counterweight blocks shall be stored in the counterweight pits as directed by the Engineer.

5. Shop Drawings

Shop drawings for all components supplied under this item are required and shall be submitted to the Engineer for approval.

6. Lubrication

The wire ropes shall be lubricated in accordance with the rope manufacturers recommendation. The rope dressing shall be applied at intervals in accordance with the manufacturer's recommendations given the application and the time of year. A final application of dressing shall be performed within 2 weeks prior to final hand over of the structure to NYSDOT.

Lubrication of all counterweight shaft bearings shall be subject to the requirements of the construction details for lubrication in Special Specification 559.0601 Bridge Operating Machinery.

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7. Protection for Shipment

All wire ropes shall be shipped on reels with a drum diameter of not less than 25 times the rope diameter.

All parts shall be completely protected from weather, dirt and foreign materials during manufacture and shipment, and shall be stored indoors in a clean, dry place while awaiting erection.

Tags recording part number, in accordance with the approved shop drawings, shall be wired to each part prior to shipment. Mounting hardware and other small parts shall be bagged and crated for shipment.

METHOD OF MEASUREMENT

The work of this item will be measured as a lump sum unit of work per bridge.

BASIS OF PAYMENT

The lump sum price bid per bridge for these items shall include the cost of all labor, equipment and material required to install and complete the work.

Progress Payments will be authorized as a percentage of the lump sum price based upon the following schedule:

Fifteen percent (15 %) of the lump sum price per bridge will be paid upon completion of removal of existing wire ropes, take-ups, bearings, shafts and counterweights.

Thirty percent (30 %) of the lump sum price per bridge will be paid upon completion of construction and installation of counterweights.

Forty Five percent (45%) of the lump sum price per bridge will be paid upon completion of furnishing and installation of new counterweight sheaves, bearings, shafts, take-ups, and wire ropes.

The remainder (10%) of the lump sum price per bridge will be paid upon completion of span balancing work, and approved testing and operation of related components.

Payment will be made under:

Item 599.06020104 M Counterweight System & Span Balance – Ingersoll Street
Item 599.06020204 M Counterweight System & Span Balance – Washington Street